



Quality Management Program—Laboratory Services

2003 Review



Quality
Collaboration
Integrity



Quality Management Program—Laboratory Services
Ontario Medical Association

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QUALITY MANAGEMENT PROGRAM— LABORATORY SERVICES

VISION

To be a world-class provider of accreditation, quality assessment and supports to laboratories and related services for diagnosis and treatment of disease, and the promotion of health.

THE PURPOSE/MISSION

To promote quality improvement of laboratories and other related services for the public good and the benefit of health professionals.

VALUES

- *Quality*
- *Collaboration*
- *Integrity*

QUALITY POLICY

QMP-LS commits to provide high quality laboratory accreditation, assessment and education services, that:

- Meet all customers' requirements; applicable regulatory, statutory and contractual requirements; and relevant national/international standards;
- Evaluate and continually improve the effectiveness of the service;
- Ensure this policy is communicated to and understood by all employees;
- Provide a process for establishment, review and modification of quality objectives;
- Review and modify this policy annually for continued suitability.

ACKNOWLEDGEMENTS

Quality Management Program—Laboratory Services is a department of the Ontario Medical Association (OMA) and deemed an agent of the Ontario Ministry of Health and Long-Term Care (MOHLTC). This unique partnership between the OMA and the MOHLTC serves the health professionals and the public by promoting quality improvement of laboratories in the Province of Ontario. In addition to the small number of permanent staff, committee members and numerous volunteers provide support to QMP-LS.

We are indebted to our committee members (Appendix A) who provide their expertise and guidance and devote considerable time to QMP-LS. We specially acknowledge the contributions of the following members who have retired from QMP-LS' committees in 2003. Two very long-term members of the committees who will be greatly missed are:

Dr. George Massarella—Hematology and Cytology Committees

Dr. Murray E. Treloar—Management Committee, Professional Advisory Committee (PAC), Bacteriology and Anatomic Pathology Committees

Other long-term members are:

Dr. Yao-Shan Fan—Genetics Committee

Dr. Tim Feltis—Hematology Committee

Dr. Kevin Kain—Parasitology Advisory Committee

Dr. Donald Low—Management Committee, PAC and Microbiology Committee

Ms. Maureen MacDonald—Chemistry-General and Enzymes Committee

Dr. Catherine M. (Meg) McLachlin—Management, PAC and Cytology Committee

Dr. Jennifer Raymond—Maternal Serum Screening Committee

Ms. Brenda Roberge—Immunology Committee

Ms. Marguerite Zeale—Immunology Committee

Dr. John R. Srigley—Anatomic Pathology Committee

Dr. Philip Wyatt—Management, PAC and Genetics Committee

Other retiring members are:

Dr. Victor Prabhakaran—Immunology Committee

Dr. Sherry Taylor—Genetics Committee

We recognize their contributions.

Our client laboratories and professional associations allow their staff to serve as advisors, consultants or volunteers and we acknowledge their support. Many members of the laboratory community (listed in Appendix B) continue to provide technical and consultative services. We recognize their support.

The current staff members are listed in Appendix C. In 2003, the development and implementation of a quality management system has increased their workload considerably. We thank the staff for their hard work and ongoing commitment. Ms. Cheryl D'Souza, Office Administrator, and Ms. Denise McIntyre left QMP-LS in 2003. We wish them well.

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The reader is cautioned not to take any single item, or part thereof, of the 2003 Review out of context.

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THE YEAR IN REVIEW

PATIENT SAFETY AND THE LABORATORY

Changes in health care and health technologies have had major beneficial impact on health outcomes but are not without risk. There is general acceptance, as well as legal precedence, that risk shall be explained to the patient as the basis of informed consent. Rarely is informed consent sought for a laboratory test while the risk is indisputable. The recent Quality Institute Conference organized in Atlanta by the Centers for Disease Control and Prevention (CDC) emphasized that the laboratory is part of the patient safety and risk environment.

Most Canadian health care professionals are aware of the publications by the U.S. Institute of Medicine that indicated 98 000 deaths and one million injuries per year due to medical errors, including errors in diagnostic processes. Comparable Canadian statistics are difficult to find and the errors in medical laboratories are rarely identified or discussed. Since laboratory testing provides up to 80% of the information used by physicians to make important medical decisions it is important to determine the frequency of laboratory mistakes, whether they result in harm to the patients, where in the path of workload such mistakes or errors are likely, and the most effective way of curtailing their frequency and impact.

In an ambulatory care setting the frequency of laboratory mistakes is about 34/100 000 patient visits with the data suggesting that only one-third of laboratory errors adversely affect the patient. Errors are thought to occur predominantly in the pre- and post-analytical phases of the path of workflow. Technology such as bar-code identification of the patient and the sample, direct entry of information to an electronic health record, and linkage of the laboratory information system to the health information system will largely eliminate the opportunity for such errors. We cannot forget the 10% or so of errors that occur at the analytical stage. QMP-LS data indicate that continued attention must be paid to quality control procedures and findings, the calibration of instruments, and conformity to standard operating procedures to eliminate these major contributors to analytical error. Proficiency testing programs that concentrate on the analytical values are helpful in underscoring this need but fail to address pre- and post-analytical problems. Some years ago, QMP-LS introduced patterns-of-practice surveys as an adjunct to wet-sample challenges. These surveys have been critical in understanding the root cause of pre- and post-analytical errors as well as supporting best practice guidelines for all phases of the path of workflow.

To ensure that laboratories provide the best possible service to patients and health care professionals we need to adopt a culture of quality management. We need a process to determine how often laboratory mistakes occur, how to systematically eliminate sources of error, and focus on the near misses that cause no observable harm as well as those that result in adverse events. Success will depend on a non-punitive approach of dialogue and education that is fair and equitable, universally available, and seeks to bring about improvements of benefit to all.

Canada has started on a pathway that is known to relatively few people. The Royal College of Physicians and Surgeons of Canada held a stakeholder meeting during its annual meeting in 2001 to address a national integrated strategy to improve patient safety. Five working groups developed Principles for Action and made 19 recommendations in five major categories. The agreed Principles were:

- Collaboration across all health care sectors
- Nurture a culture of safety
- Understand the underlying systemic factors
- Initiate professional development programs—evidence-based using a team approach and periodic audit
- Comprehensive identification of hazards to patients
- No blame environment
- Encourage partnerships between consumers and providers

- Develop cost-effective evidence-based initiatives critical to improvement
- Open disclosure of information relative to health issues.

The key recommendations were:

- Establish a Canadian Patient Safety Institute
- Improve legal and regulatory processes
- Improve measurement and evaluation processes
- Establish educational and professional development programs
- Improve information and communication processes.

The Principles are reflected in the operating principles of QMP-LS External Quality Assessment (EQA) and the Ontario Laboratory Accreditation (OLA) program as published during 2001 and again in the 2002 Review. Information on QMP-LS policies, processes, and procedures, as presented elsewhere in this Review, illustrates how we have worked to improve our measurement and evaluation processes, to continue to enhance the educational interaction and programs, and how we are using electronic communications to improve service to the participating laboratories.

QUALITY SYSTEM

In 2003, QMP-LS continued to work towards compliance with relevant national and international standards and to meet the requirements of ISO (International Organization for Standardization), *Guide 43-1*, ILAC (International Laboratory Accreditation Cooperation) *G13*, and ISO *Guide 58*.

The design and documentation of QMP-LS' quality system policies, processes and procedures is in progress. We purchased a document management software application in 2003, which will house all controlled documents and records. Administrative training for this application was provided to some staff members. To provide effective file transfer capability between this and other QMP-LS database and file storage applications, we decided to review and standardize all file structures and naming conventions. At the same time, the decision was made to house all participant information on the QMP-LS Document Server, accessible through the QMP-LS Web site. This application is also controlled through defined levels of access and password protection.

Bi-weekly staff education sessions have been conducted on principles of Quality Management, writing documents and the use of the controlled document management system. All QMP-LS' divisional activities have been aligned with the quality system activities and divisional policies, processes and procedures are being documented.

DEVELOPING GLOBAL RELATIONSHIPS

Sharing Experience Nationally and Internationally

Three scientific presentations were made at national and international meetings following the submission and acceptance of abstracts (Appendix D). Four papers were published in peer-reviewed journals and an eight-module 'How-To' guide on *Managing Laboratories to Assure Quality* was published in association with the Caribbean Epidemiology Center (CAREC) in Trinidad. Fifteen presentations were made at local and Canadian national meetings, two in the United States and two in Trinidad (Appendix E).

A major symposium in September in Toronto on OLA attracted a large audience to hear 13 speakers and participate in three concurrent breakout discussion sessions (Appendix F). As detailed in the OLA report, there were five assessor training sessions during the year and 16 OLA seminars throughout the province on *Am I Ready for Accreditation?*

Visitors to QMP-LS during the year included Mr. M. Dinardo concerning the IL Symposium, Dr. M. Escobar of the University of Toronto, Ms. M. Cournoyer of Priority Programs, MOHLTC, Ms. W. Kitson-Piggott and Dr. W. Labastide of CAREC, Dr. S. Tilak and Dr. J. Arsenault of Hospitals In-Common Laboratory Inc., Prof. Dr. M. Bujko and

Dr. G. Mijovic of the Institute of Public Health, Montenegro, Ms. Donna and Mr. Steve Thompson of Thompson Consulting, Ms. N. Bestic of the Canadian Standards Association, Mr. G. MacKenzie of BD Diagnostic Systems, Dr. Muir Gray of the United Kingdom National Screening program, Dr. V. Walley of Peterborough, and Dr. Gilbert Hill of the Hospital for Sick Children, Toronto.

The Managing Director attended the Quality Institute on The Laboratory and Patient Safety organized by CDC in Atlanta.

Collaboration with Partners in Health Care

Dr. Richardson was invited to be an author for the National Association of Clinical Biochemists publication on *Laboratory Medicine Practice Guideline on Evidence-Based Practice for Point-of-Care Testing*.

QMP-LS has presented to the Provincial Advisory Committee on Laboratory Services and participated in the Standards and Targets Sub-group activities.

Continued collaboration with Cancer Care Ontario (CCO) to prepare an update to the cytology quality assurance guideline and to reflect the recent changes to the Bethesda System is ongoing. Emphasis is on the clinical guideline.

We continue to participate in the Ontario Consultative Group for Maternal Serum Screening. Plans to add additional analytes to the biochemical screen are in place. Discussions continue with the College of Physicians and Surgeons of Ontario (CPSO) regarding integrated first trimester screening particularly in regard to quality assurance of ultrasound examinations.

QMP-LS was awarded two short-term contracts by Health Canada for the ongoing development of a national Web site for genetic services. Funding for continued development of the genetic services Web site OnGene has been provided by the Ministry of Health and Long-Term Care (MOHLTC) and a grant from the Women's Health Council to address first trimester and integrated MSS has been awarded. The Change Foundation granted support to North York General Hospital in partnership with multiple stakeholders, including QMP-LS and the CPSO, for the project *Personalizing Genetic Information in Pregnancy-conflicts and Solutions*.

The Interprovincial Quality Assurance (IPQA) group held its annual meeting in Quebec City in June. A more formal structure for IPQA including incorporation and bylaws was elaborated. The continued development by a Steering Committee is led by Saskatchewan. A definitive proposal was considered. The proposed name for the new organization is Canadian Coalition for Quality in Laboratory Medicine (CCQLM). QMP-LS holds the Chair of the Accreditation Working Group and the Laboratory Information Systems Working Group. We participate actively in the Transfusion Medicine, Microbiology, Chemistry and Anatomic Pathology Working Groups. We host the Web page for CCQLM and its working groups.

QMP-LS provides a cytology EQA program to the Alberta Laboratory Proficiency Testing Program (now named Alberta Laboratory Quality Enhancement Program) under contract. Out-of-province participants are included in Ontario surveys, on a cost-recovery basis in various disciplines as discussed in the EQA report. Transfusion medicine EQA materials are provided to Thistle QA in South Africa.

We continue as an active member of NCCLS. We have the opportunity to review and comment on proposed guidelines at the draft stage, to vote on tentative standards and to suggest members of sub-committees. Dr. Phil Wyatt has been appointed Chair of the subcommittee on Maternal Serum Screening. Dr. Nancy Carson was appointed as an observer on the Sub-committee on Quality Assessment Programs for Molecular Methods.

Some years ago the Pan American Health Organization established a cervical cytology quality assurance program for Central and South America called the Red-Pac Network. QMP-LS acts as an external referee for the panel of slides to be distributed by the program. The network is operated from a base in Chile.

The partnership between QMP-LS and the Canadian Public Health Association (CPHA) provides support to CAREC and to Laboratory Services in Kosovo. The primary support to Kosovo has been to the microbiology laboratories of the National Institute of Public Health. Ms. Donna and Mr. Steve Thompson have spent extended periods in Prishtina enhancing bench knowledge and skills of the medical microbiologists and technicians. Dr. Richardson, Ms. Christine Fleming, Ms. Donna and Mr. Steve Thompson conducted a workshop on Antimicrobial Susceptibility Testing of fastidious bacteria in October. Dr. Richardson and Ms. Fleming also carried out a technical assessment of the laboratory of the Institute of Public Health in Montenegro following the workshop.

The Canadian International Development Agency (CIDA) funded HIV/AIDS project in the Caribbean continues under new funding. QMP-LS/CPHA was successful in a bid to provide support to the new project. Additionally, by a separate cost-recovery arrangement, QMP-LS provides CAREC with an EQA program in bacteriology and immunology. Two surveys are conducted each year with challenges requested by CAREC. Material is shipped in bulk to CAREC for forwarding to laboratories throughout the Caribbean. Worksheets are analyzed by QMP-LS for review and comment.

Dr. Richardson was appointed to the Standards, Legislation and Accreditation Expert Advisory Committee of the Strengthening of Medical Laboratory Services in the Caribbean project of CAREC. He assisted in the technical assessment of medical laboratories in Haiti and the Dominican Republic as part of this project.

Joanne Miyazaki represented QMP-LS on the Provincial Advisory Committee on Predictive Genetic Services and the Laboratory Sub-committee. She also participated in the federal government meeting on health technology assessment in genetics.

The Canadian Standards Association (CSA) Technical Committee Z252 and the Canadian Advisory Committee to ISO (International Organization for Standardization) Technical Committee 212 are now known as the National Committee for Medical Laboratory Quality Systems. Dr. Richardson is Vice-chair of this committee, which seeks national consensus on standards for medical laboratory practice in Canada.

ISO TC212 continues its work on developing international standards for medical laboratories. Dr. Richardson is one of four delegates of Standards Council of Canada (SCC) to this technical committee. Three working groups continue to address quality laboratory systems, reference methods and materials, and *in vitro* diagnostic system standards. The long awaited ISO 15189 on *Medical Laboratories: Requirements for Quality and Competence* was approved in November 2002 and was published in February 2003. Dr. Richardson and Dr. Mike Noble of the University of British Columbia are writing an interpretive guide to be called *Plus 15189* and will be published by Canadian Standards Association. ISO 15190 on the *Requirements for Safety in the Medical Laboratory* will be published shortly. ISO 22870 on the *Requirements for Quality and Competence of Point-of-Care Testing* will be released shortly as a Draft International Standard.

Dr. Richardson was appointed by the Chief Scientist of Health Canada to the Expert Committee on Quality and Laboratory Accreditation.

QMP-LS provided support to the Michener Institute in its certificate course for Clinical Laboratory Quality Managers. The first course was completed and the second began in January 2004.

QMP-LS continues in discussion with the SCC concerning the accreditation of QMP-LS itself and participates in the PALCAN (Program for Accreditation of Laboratories Canada) Partners Advisory Committee of the Council.

EDUCATION

QMP-LS' philosophy in the delivery of education is to focus on problem areas identified through our EQA or OLA activities. In addition to sharing our experience nationally and internationally as noted earlier, specific educational activities are detailed in the EQA and OLA Reports.

QMP-LS News highlights developments in laboratory medicine, details operational changes at QMP-LS and provides information on upcoming activities and events. Effective November 2003, QMP-LS News is posted on our Web site and printed copies are not distributed. An electronic notification is sent to recipients, together with a link to the newsletter. In October 2003, we revamped our Web site to provide improved electronic services to our clients. We replaced the complex navigational tree with simple pull down menus across the top of the page to facilitate navigation of the Web site. Additional EQA and OLA information is provided to participants via secure, password-protected access.

QMP-LS continued to provide education and professional development to its staff.

Symposia, Workshops and Courses

QMP-LS and The Michener Institute for Applied Health Sciences jointly produced two Cytology workshops in 2003—*Effusion Cytology: Challenges, Pitfalls and Ancillary Studies* and *Gynecological Cytology Update*.

In 2003, QMP-LS continued its collaboration with the College of Medical Laboratory Technologists of Ontario (CMLTO) and the Ontario Society of Medical Technologists (OSMT) to deliver workshops across Ontario. A histology workshop entitled *Setting Technical Quality Standards for Histological Staining* was developed with the presenter Mr. Bryan Hewlett. The series of regional workshops will be initiated in the spring 2004.

In 2003, two Internet-based educational courses—*Introduction to Hematology: The Erythrocyte* (introduced in 1997), and *Erythrocyte Disorders: Detection and Diagnosis* (introduced in 2000) were offered. These courses will be discontinued in 2004.

To raise awareness of QMP-LS' evolving role, a display booth providing information about QMP-LS was available at various events and regional meetings and staff were present to address queries.

INFORMATION SERVICES

Improving Quality and Service and Reducing Costs

Information Services designed and developed a number of software tools in 2003 to improve our measurement and evaluation processes and the quality of our service within our organization and, most importantly, to our participating laboratories.

- We developed and implemented software to manage and maintain the QMP-LS Quality System (Figure 1).
- We produced Q-Accredit!®—an application that is used by our OLA division to collect and maintain visit-related laboratory data, to prepare OLA visit checklists and to capture site visit response data (Figure 2).
- To avoid additional costs, we re-engineered our in-house registration software for the inaugural OLA symposium to accommodate Web-based registration by facility/organization (Figure 3).



Figure 1. Screenshot of software developed to maintain QMP-LS quality system

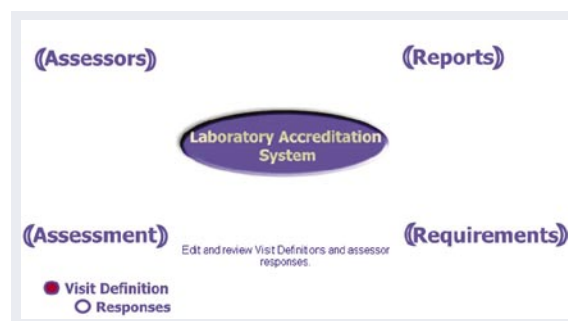


Figure 2. Screenshot of Q-Accredit! software

This facility-based registration system has been designed to administer future QMP-LS events at no additional cost.

- Commencing January 2003 we began scanning and electronically archiving the Analysis Worksheets for all EQA surveys. The resultant elimination of paper-based records will ultimately realize substantial storage cost savings in addition to improving access to our laboratory records.
- We developed an enhanced Survey Report for Blood Gas surveys that provides comprehensive information, at a glance, for multiple instruments for each test, including the survey's statistics, the laboratory's results and the histogram of peer performance (Figure 4).

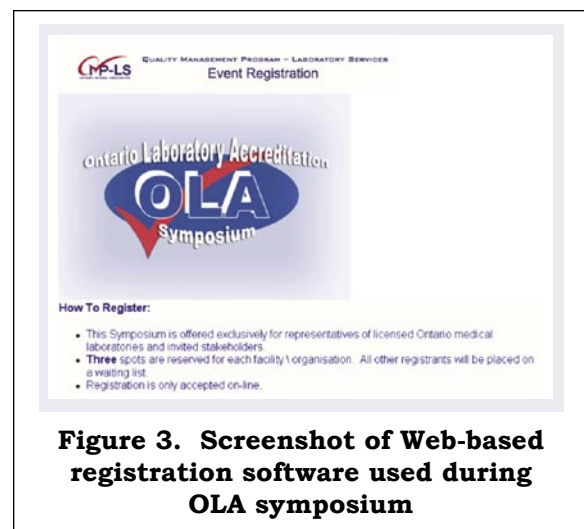


Figure 3. Screenshot of Web-based registration software used during OLA symposium

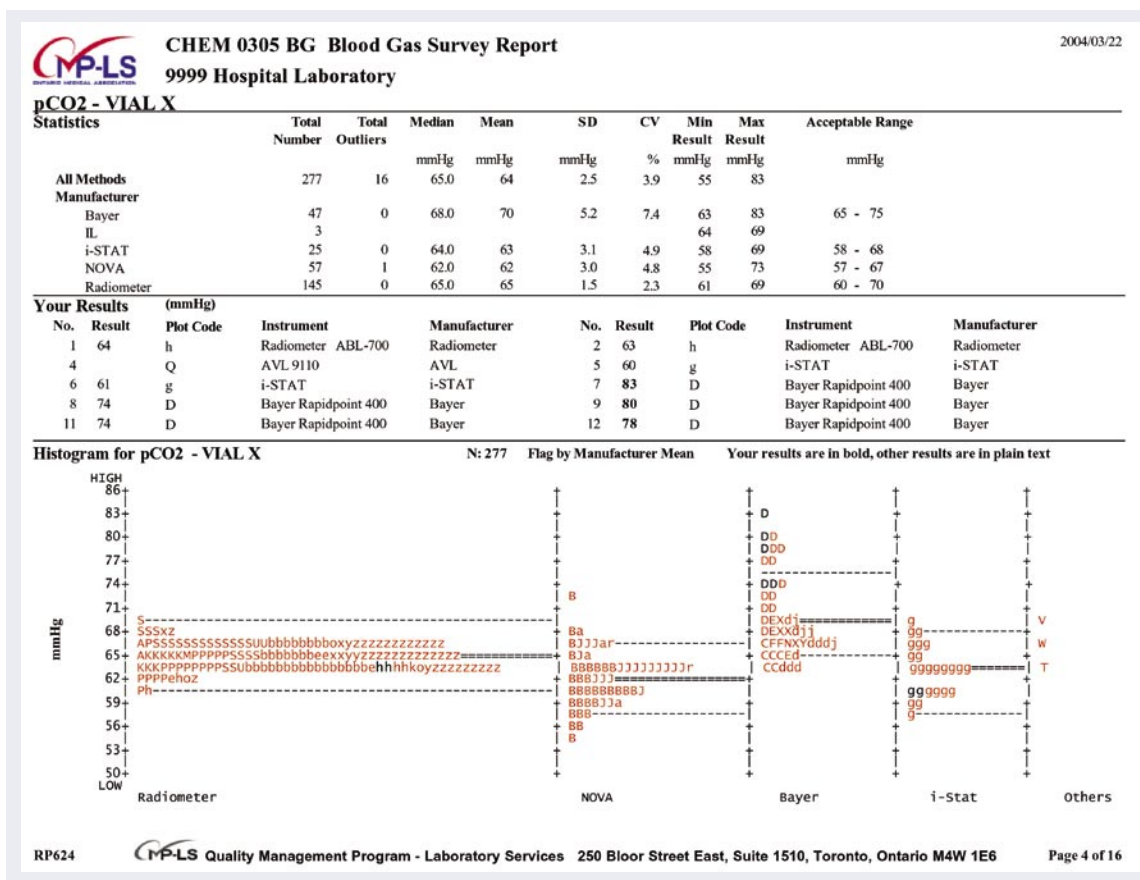


Figure 4. Screenshot of enhanced blood gas Survey Report

We anticipate in 2004 this Web-accessible report format will be the model for other statistically based participant reports.

- The Lab Performance History application (Figure 5) was developed to enhance the post-survey evaluation phase of the EQA survey administration process. New OLA requirements and integrated survey flagging and error classification are among the improvements.

- QMP-LS realized significant cost savings by moving the paper-based QMP-LS Newsletter to an Internet-accessible format. To facilitate this medium change, we developed an electronic subscription and notification service (Figure 6), which not only decreases printing and distribution costs but increases readership at no additional cost!

Continuing Collaborative Activities

- Nationally we provide an Internet-based electronic workspace accessible by all members of the Interprovincial Quality Assurance (IPQA) group (now known as the Canadian Coalition for Quality in Laboratory Medicine).

In 2003 QMP-LS also chaired the IPQA's Information Technology Working Group.

- QMP-LS continued to operate the OnGene Ontario Genetic Services Web site that was developed in partnership with the North York General and Mount Sinai Hospitals and funded by a grant from The Change Foundation, after additional funding was provided by Ontario's Ministry of Health and Long-Term Care.

We also continued to develop and operate the Canadian Genetics Quality Network Web site on behalf of Health Canada. The site, www.cgqn.ca serves as the national resource center for education, consultation and referral for the genetic tests (cytogenetic and molecular) available in Canada.

MANAGEMENT COMMITTEE

The Management Committee consists of members appointed according to the Ministry of Health and Long-Term Care (MOHLTC)/Ontario Medical Association (OMA) Agreement. The membership includes representation from MOHLTC, the OMA, the College of Physicians and Surgeons of Ontario, the College of Medical Laboratory Technologists of Ontario, the Chair of Professional Advisory Committee and the Managing Director, QMP-LS (Appendix A). The Advisory Council, with representation from the stakeholder organizations (Appendix A), provides input to the Management Committee on the development of policies, processes and procedures. Members of the Advisory Council are invited to attend Management Committee meetings.

In 2003, the Management Committee met three times in the year and convened a conference call meeting.

Regular agenda items included:

- QMP-LS work plan, budget and operational matters
- Policy issues
- Progress reports on problem laboratories

The screenshot displays a web application titled "LABORATORY PERFORMANCE HISTORY" with a sub-header "DRUG MONITORING - Drugs of Abuse". It includes a "SURVEY LAB STATUS" section with a "NON PROFICIENT INFO" link and a "CONTINUE TO MONITOR" button. Below this is a "Flagging and Errors" section with a "Other Flags" link. The main table, "DRUG MONITORING", has columns for "Analyte", "VIAL Result", "MethodRef", "Flag", "# Labs", "Error No", "Error Desc", and "Notes". A row for "Barbiturates" shows a "Positive" result, "798 0" method reference, an "Inappropriate R" flag, and a "Significant Error" with error number "5". A "Correspondence Information" section at the bottom states: "A Memo of Clarification will be sent for the INADEQUATE result for vial Y." and "We shall clarify this result soon."

Figure 5. Screenshot of laboratory performance history application



Figure 6. Electronic subscription and notification service on QMP-LS Web site

- Working towards the resolution of issues brought forward by QMP–LS committees and operational divisions, including impact analysis, LLIS inspections during OLA roll out, assessment of interpretive surveys and recommendations for Ham's and Sucrose Lysis tests.
- Updates from the EQA, OLA and Information Services divisions on operational objectives.
- Report on educational activities.

Special issues for 2003 included:

- QMP–LS Quality Policy, the draft Quality Manual and high-level guiding policies.
- Review and recommendations relating to on-site consultations.
- Investigation of discordant findings.
- Report of EQA Internal review and revision of EQA processes to comply with ISO Guide 43-1/ILAC Guide 13:2000.
- Update on OLA Impact Analysis and pilot accreditation assessments.

CONJOINT COMMITTEE

The Conjoint Committee (Appendix A) met on three occasions during the year, co-chaired between Ms. Ogram and Dr. Richardson. Ms. Marnie Cooper joined the committee in February to serve as co-chair. Laboratories being monitored for poor survey performance by the scientific committees and brought forward on the recommendation of the QMP–LS' Management Committee were reviewed and appropriate actions determined. Issues concerning specific laboratories were also addressed when requested by Management Committee. Two on-site-consultation reports were reviewed for performance issues in flow cytometry and parasitology respectively, and one laboratory was declared non-proficient in parasitology.

Other topics addressed were:

- Assessing performance of individuals versus laboratories.
- Process for consideration of non-proficient laboratories.
- Development of a dispute resolution process.
- Development of an Enhanced Maternal Serum Screening Program.
- Issues from the EQA division.
- Issues from the OLA division.
- Updates on the development of the Quality Management System.
- Activities of the Test Review Committee.

EXTERNAL QUALITY ASSESSMENT

Objectives for the External Quality Assessment (EQA) division for 2003 included the following:

- Review and revise EQA survey models against international standards.
- Develop access for participants to electronic document server.
- Conduct survey of QMP-LS committee members for strategic planning process.
- Monitor participant response to use of form for discordant findings.

Progress with these objectives is as follows:

REVIEW OF EQA SURVEY MODELS

All EQA survey models were reviewed against international standards as well as EQA schemes offered by peer organizations in other jurisdictions. As a result of this review, and where resources allowed, modifications have been made to the surveys offered in 2004. These vary according to discipline and survey but include the following:

- *Frequency of EQA Challenge*
Minimal criteria were established to allow appropriate monitoring of performance:
 - Minimum of two surveys per year
 - Minimum of two samples per survey
 - Minimum of ten samples per year
- *Criteria to Constitute Assigned Target Value*
This is the value used for assessing participants' performance. For quantitative tests, it is the participant consensus (mean/median) or validated reference value. For qualitative tests it may also include reference or expert laboratory consensus.
- *Criteria for Evaluation of Performance*
Acceptance criteria are based on:
 - Effect of analytical performance on clinical decision (biological variation)
 - State-of-the-art performance
 - Published professional recommendations
 - Performance goals set by peer organizations
- *Testing Material Specifications*
 - Specifications for testing material include criteria for homogeneity and stability testing.
- *Review of Interpretive Surveys*
 - Jurisdictional issues concerning diagnostic components of interpretive surveys are currently under consideration by QMP-LS senior committees.

This review of the EQA survey models will continue into the first two quarters of 2004. Once complete, a *Guide to the EQA Program* will be made available to laboratory participants. This will also include information that is currently available in the paper-based EQA Discipline Binders.

ACCESS TO ELECTRONIC DOCUMENT SERVER

- *EQA Survey Reports*
EQA Survey Reports for 2003 were the last to be distributed in hard copy format for laboratories with Internet capability. Provisional and Survey Reports for 2004 surveys are now published in electronic format and posted on the QMP-LS Document Server, accessible to participants through the QMP-LS Web site. Access to specific laboratory discipline reports is secured through password protection.

- *Testing Schedule*

The 2003 Testing Schedule was also the last to be distributed in hard copy format. The 2004 Testing Schedule now indicates the week of distribution. It is posted on the QMP-LS Web site and is also accessible on the Document Server under general discipline information.

SURVEY OF QMP-LS COMMITTEES

A survey of QMP-LS scientific committees was conducted during the first part of 2003 to enable QMP-LS staff to understand the laboratory environment in Ontario from the participant perspective. This information was used in part for a strategic planning exercise and in part for quality improvement opportunities. A synopsis of information addressing trends in laboratory medicine for consideration in development or provision of EQA services is included in Table 1.

Table 1. Trends in Laboratory Medicine Environment with Potential Impact on Development and Provision of EQA Surveys

Question	Summary of Responses (n=31)
Future trends in healthcare	● Aging healthcare providers ● Amalgamation of hospitals and laboratories ● Professional certification, competence, accountability, liability ● Changing population demographics and metrics ● Patient safety and requirement for occurrence management/incident documentation ● Limited funding
Future trends in laboratory medicine	● Growth in point-of-care tests and physician office testing ● Regionalization of laboratories ■ Impact of management and staffing of multiple sites ■ Referral pathways and complexity of performance ■ Rapid growth of molecular biology and genetics tests ● Continued growth of automated testing ● Capability for timely introduction of EQA in response to new tests ● Stricter/higher standards of testing required by accreditation (OLA)
Trends in technology	● Automation in disciplines where testing has traditionally been manual, e.g., transfusion medicine, cytology ● Use of computer algorithms for auto-verification of results, QC, auto-release of results, auto crossmatch ● Advances in molecular testing within or across disciplines ● Increasing number of instruments/testing principles which may require method-specific testing material, analysis ● Use of telecommunications for diagnostic testing, education, data sharing consultation, reporting
New test modalities	● Rapid molecular diagnostic kits/methods ● Interdisciplinary/syndromic testing e.g., MSS and ultrasound in pre-natal screening for genetic abnormalities ● Use of microarrays ● Point-of-care tests ● Commercial diagnostic kits
Trends in laboratory organization/structure	● Laboratory regionalization/consolidation of tests/use of reference laboratories ■ impact on tiered levels of testing ■ sharing of staff ■ distribution of testing material ■ identification of appropriate laboratory contacts ■ increased specimen transportation times ■ use of appropriate reference intervals ● Greater use of non-MLTs in laboratories ● Interdisciplinary testing e.g., MSS and ultrasound ● Increased complexity/privatization/partnerships of laboratory organizations
Additional services for consideration	● Educational challenges ● Multiple report formats ● Web-enabled reporting ● Web-based digital images

INVESTIGATION OF DISCORDANT FINDINGS

EQA provides a unique point-sampling of laboratory process output. This, coupled with the inter-laboratory comparison perspective of EQA, frequently identifies problems with analytical performance not detectable by internal quality assurance activities. While it has been reported that most laboratory-associated errors occur in the pre- and post-analytical phases of workflow, this may be a perception rather than reality, if analytical errors as detected by EQA are indeed unrecognized. For many years, QMP-LS committees have corresponded with laboratories regarding unexpected or discordant findings associated with EQA surveys. However, 2003 was the first year that a form to document the investigation of discordant findings was issued to laboratories with committee correspondence. The form was designed to capture and categorize causes of error associated with EQA surveys and to provide guidance to participants in cause analysis and identification of corrective action. Reasons for categorizing causes of error are to:

- Identify common cause of error among participants.
- Contribute to continuous improvement of laboratory services.
- Contribute to improvement of instrument or method design.
- Assist laboratories in meeting accreditation requirements.
- Improve provision of EQA program.

The laboratory responses were reviewed and categorized by discipline in a similar manner to that described in the NCCLS Guide GP27-A *Using Proficiency Testing (PT) to Improve the Clinical Laboratory*. This guide is intended for use by laboratories as part of an internal quality assurance program.

The amount of information provided by participants in these forms varied. Overall, approximately 40% of these forms were returned completed. Many participants opted to continue the practice of responding by way of letter or memorandum. Feedback from participants and committee members suggests that discipline-specific forms may be preferable to the multi-discipline form. These are currently under development. QMP-LS staff is also exploring the use of electronic forms that may be completed on-line and returned by e-mail.

PROVISION OF EQA SERVICES

Provision of EQA challenges in 2003 consisted of 123 routine challenge surveys, 4 patterns-of-practice surveys and 4 questionnaires. Parameters monitored by discipline are listed in Appendix G. The number and type of Ontario laboratories required to participate in the program are shown in Tables 2 and 3.

Provision of services outside of Ontario is conducted on a cost-recovery basis. See Table 3 for an indication of utilization of QMP-LS EQA surveys in other jurisdictions.

Table 2. Comparison of Types of Ontario Laboratories Participating in EQA

Laboratory Facility Type	Number of Laboratories			
	2000	2001	2002	2003
Private	62	53	54	47
Hospital	183	181	182	180
Public Health	11	11	12	12
Psychiatric	1	0	0	0
Canadian Blood Services	6	6	6	6
Federal Government	2	2	1	1
Other	2	1	2	2
Total	267	254	257	248

Table 3. Number of Participating Ontario Laboratories in 2003 vs. Out of Province

Discipline	Ontario	Out of Province
Anatomic Pathology	79	0
Chemistry-General	206	5
Drug Monitoring	169	18
Endocrinology	123	1
Enzymes, Cardiac Markers	198	1
Lipids	135	1
Immunology	71	3
Maternal Serum Screening	7	2
Hematology-General	217	2
Flow Cytometry	18	16
Red Cell Disorders	87	1
Coagulation	200	0
Hematology-Morphology	206	0
Transfusion Medicine	176	0
Bacteriology	115	0
Mycology	23	2
Parasitology	25	0
Virology	74	3
Genetics	10	13
Cytology	88	3
Point-of-Care Testing	186	0

MONITORING PARTICIPANT PERFORMANCE

The scientific committee evaluation of survey results includes assessment of error based on the clinical significance of discordant findings. Lesser errors are assessed for results that exceed the established acceptable limits, and significant errors for results that have the potential to cause mistreatment or misdiagnosis. Committees correspond with the participating laboratories regarding the discordant findings (see below), requesting input on the cause of the result and implementation of corrective action. Unacceptable or incomplete participant responses may prompt further communication, continuing to monitor survey performance and/or an offer of an on-site consultation. Tables 4 and 5 provide information on on-site consultations and non-proficient laboratories, respectively. The number of on-site consultations conducted in 2003 was six. One laboratory was declared non-proficient during 2003. Summary of committee action is shown in Appendix H.

The feedback provided as part of the EQA survey includes Survey Reports of individual performance as well as summary information of all participant results. The scientific committees provide educational feedback in the form of Committee Comments, guidelines and Broadsheets.

Table 4. QMP-LS On-site Consultations that Occurred During Each Year, 1994–2003

Discipline	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Bacteriology	4	0	5	3	2	0	4	0	0	0
Parasitology	2	0	1	0	3	1	0	0	1	1
Virology	3	2	1	0	0	1	0	0	0	0
Microbiology Total	9	2	7	3	5	2	4	0	1	1
Chemistry	11	14	5	2	1	1	0	2	1 *	1 *
Endocrinology	1	1	0	0	0	0	0	0	0	0
Enzymes & Lipids	0	0	0	0	0	1	2	0	0	0
Immunology	1	0	0	0	0	0	0	0	0	0
MSS	0	0	0	0	0	1	0	0	1	0
Chemistry Total	13	15	5	2	1	3	2	2	2	1
Hematology	0	0	1	0	0	0	2	0	1	0
Flow Cytometry	...	...	...	...	...	...	...	...	0	1
Morphology	0	0	0	0	1	1	0	4	0	0
Coagulation	0	0	0	0	0	0	0	0	0	0
Bone Marrow	0	0	0	0	0	0	0	1	0	0
Transfusion Medicine	1	1	5	1	3	1	3	6	2	3
Hematology Total	1	1	6	1	4	2	5	11	3	4
Genetics	0	1	1	0	0	0	0	0	0	0
Genetics Total	0	1	1	0	0	0	0	0	0	0
Cytology	3	0	0	1	1	0	2	1	1	0
Cytology Total	3	0	0	1	1	0	2	1	1	0
Grand Total	26	19	19	7	11	7	13	14	7	6

* Included Enzymes

Table 5. Number of Newly Named Non-proficient Laboratories by Discipline, 1994–2003

Discipline	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Chemistry	0	0	0	0	0	0	0	0	0	0
Hematology	0	1	0	1	0	0	0	0	0	0
Microbiology	0	0	0	1	0	0	0	0	0	1 *
Other	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	2	0	0	0	0	0	1

* Parasitology

During 2003 the following were provided to laboratories:

- 99 Committee Comments
- 87 Survey Reports
- 1 Broadsheet

Discordant Findings

Specific discipline reports detail information regarding discordant findings. The types of errors encountered are associated with the particular objective of the survey challenge and are anticipated to vary in frequency. An overview of all disciplines reveals the following information:

Clerical Errors

Most errors are associated with transcription errors in completion of Analysis Worksheets. In some disciplines this occurs when results from a laboratory report are transcribed to the Analysis Worksheet, e.g., hematology. In other disciplines, transcription errors were largely due to the incorrect selection of method codes, e.g., antibiotic codes in bacteriology.

Material Errors

There were relatively few material errors. Those that were reported involved problems with storage or location of material after it was received in the laboratory.

Method Errors

Method errors vary according to discipline. Most errors associated with the automated chemistry disciplines are instrument-related and include method validation, maintenance and calibration and/or variation associated with reagent. In several instances, internal QC allowable error limits were set too wide. In others, outdated or non-validated reference intervals, e.g. hematology, were used. In microbiology and transfusion medicine, method related errors tend to be associated with inadequately documented processes or procedures. To achieve the correct result or outcome in these disciplines, there is often a requirement for reflexive testing based on the results of an initial test. This essential information is frequently not documented as part of the procedure. In addition, changes in NCCLS standards require frequent revisions to the procedures and laboratory in-service education, which were not always evident.

Technical Errors

Technical errors are most commonly associated with specimen preparation, failure to act on QC results, failure to follow documented procedures, inexperience or simply poor technique.

Random Error

In many cases, participants identified a problem as a random error largely because the cause was unknown. However, closer scrutiny of the investigation revealed that a repeat test performed on the EQA sample produced the same results as originally reported, indicating that the error was repeatable and, therefore, likely to be systematic. A systematic error is one that occurs repeatedly over time and is often due to an inherent property of the method or reagents. In contrast, a random error occurs without pattern and may be associated with human error. In short, a random error may be unexplained but not all unexplained errors are random in nature. The Discordant Finding Form will be revised to reflect this.

Root Cause

The root cause for the discordant finding was frequently not identified in participant responses. In many instances, reasons listed in this section were actually contributing causes. The root cause most commonly cited was lack of awareness or understanding in the laboratory. In addition to this, the literature cites the following as major causes of error ¹:

- Inadequate training of laboratory staff.
- Inadequate number of laboratory staff.
- Lack of communication between the laboratory director and laboratory staff.
- Inadequate equipment.
- Insufficient space.

These, or similar causes are considered to be organizational. Revisions to the Discordant Findings Form will include the most commonly encountered organizational causes.

Corrective Action

Most corrective actions were appropriate, and included re-writing procedures and re-education and training of staff. Problems may recur in those laboratories reporting random, unexplained error.

Collation and evaluation of this information was a learning experience for QMP-LS staff. We intend to make this information available as supplementary Committee Comments following future surveys. In this way, laboratories, collectively, may be able to benefit from the investigation and actions of individual participants. In addition, those participants initially unable to identify causes may recognize them when reported by others.

LATE AND NON-REPORTING LABORATORIES

During 2003, QMP-LS continued to monitor laboratory participation in EQA surveys for the second full year. The process for monitoring participation was published in the November 13, 2001 edition of *QMP-LS News* (No. 21). The major reasons for laboratories failing to respond or responding late without acceptable reasons (as described in the article) are listed in Tables 6 and 7. As can be seen from the results, there has been a 40% reduction in late and non-participation over the two years, which demonstrates that Ontario participants are proactively monitoring and improving processes associated with receipt and handling of EQA samples. Recognizing the fact that some facilities have difficulty in assuring the correct delivery of material to the laboratory, once on-site, prompted QMP-LS to include the week of delivery in the 2004 Testing Schedule and post it on the QMP-LS Web site for ease of access.

Table 6. Reasons for Late Participation in EQA Surveys

Reason for Late Participation	2002 (Jan-Dec)	2003 (Jan-Dec)
Missed or confused survey due date	20	2
Forgot to fax worksheets	10	7
No reason given	10	14
Unsuccessful fax transmission	9	7
Worksheets lost/misfiled/on supervisors desk	5	3
Responsible person sick/on vacation	5	2
Faxed wrong worksheet	4	1
Communication breakdown (between staff or sites)	1	3
Total	64	39

Table 7. Reasons for Non-Participation in EQA Surveys

Reason for Non-Participation	2002 (Jan-Dec)	2003 (Jan-Dec)
Lost record of survey	0	1
Left material in refrigerator	0	1
Misplaced material on site	5	1
Total	5	3

1. Rej R. Proficiency testing and external quality assurance: crossing borders and disciplines. *Accred Qual Assur* 2002;7:335-340.

CHEMISTRY DISCIPLINES

CHEMISTRY-GENERAL

TESTING MODEL

Surveys for routine serum analytes, urine chemistry, blood gases, HbA_{1c}, albumin excretion rate and a pilot survey for iron (total iron, unsaturated iron binding capacity and total iron binding capacity) were distributed in 2003.

The computer flagging rules for bias remained the same as those used in 2002. New rules were put into use for flagging imprecise results for duplicate vials in the routine serum analyte surveys.

ASSESSMENT OF PERFORMANCE

Routine Serum Analytes

Surveys CHEM-0301, CHEM-0305 and CHEM-0310 each included three vials of previously frozen serum supplemented with specific concentrations of the routine serum analytes. The analytes tested are listed in Appendix G. Participants were requested to test the samples on specified days.

Committee Comments published in 2003 summarized the data and trends observed in each of the three surveys. However, it is noteworthy that data collected in 2002 and 2003 indicate that measurement of serum creatinine, magnesium and calcium continues to challenge participants.

The number and distribution of analytes flagged for bias in each survey and the number of laboratories receiving correspondence are summarized in Table 8.

Table 9 provides a summary of the number of laboratories flagged for imprecision in survey CHEM-0305. In this survey, duplicate specimens (vials A and C) were provided to participants, and instructions were given to permit assessment of between-run reproducibility. A similar study completed in 2002 illustrated that the performance flag of 10% imprecision was too wide and laboratory between-run precision was excellent. The committee reviewed the precision flagging criteria and has proposed the changes indicated in Table 9 based upon laboratory observed precision levels and analyte biological variation.

Chemistry (Routine, Quantitative Urine Chemistry, Albumin Excretion Rate, HbA_{1c}, Blood Gases)

No. of Participants (Dec. 2003)	206
No. of Participants (Dec. 2002)	212
No. of Surveys Conducted in 2003	13

Drug Monitoring (Routine, Cyclosporine, Drugs of Abuse)

No. of Participants (Dec. 2003)	169
No. of Participants (Dec. 2002)	168
No. of Surveys Conducted in 2003	13

Enzymes, Cardiac Markers & Lipids

No. of Participants (Dec. 2003)	Enzymes.....	198
	Lipids	135
No. of Participants (Dec. 2002)	Enzymes.....	205
	Lipids	144
No. of Surveys Conducted in 2003		10

Endocrinology

No. of Participants (Dec. 2003)	123
No. of Participants (Dec. 2002)	126
No. of Surveys Conducted in 2003	5

Immunology

No. of Participants (Dec. 2003)	71
No. of Participants (Dec. 2002)	99
No. of Surveys Conducted in 2003	5

Maternal Serum Screening

No. of Participants (Dec. 2003)	7
No. of Participants (Dec. 2002)	7
No. of Surveys Conducted in 2003	3

Point-of-Care Testing (Glucose Meters)

No. of Participants (Dec. 2003)	196
No. of Participants (Dec. 2002)	186
No. of Surveys Conducted in 2003	1

Table 8. Summary of Laboratories Flagged for Bias and the Number Receiving Correspondence by Analyte for Surveys CHEM-0301, CHEM-0305 and CHEM-0310

Analyte	CHEM-0301			CHEM-0305			CHEM-0310		
	No. of Laboratories	No. of Laboratories Flagged	No. of Laboratories Receiving Correspondence	No. of Laboratories	No. of Laboratories Flagged	No. of Laboratories Receiving Correspondence	No. of Laboratories	No. of Laboratories Flagged	No. of Laboratories Receiving Correspondence
Bicarbonate	154	6	2	148	4	3	147	5	1
Chloride	204	0	0	201	3	1	200	2	0
Sodium	207	3	0	204	11	1	204	5	0
Potassium	207	5	1	204	1	1	204	2	1
Glucose	207	2	0	204	2	1	204	7	0
Urea	203	33	1	200	24	1	200	22	1
Creatinine	205	14	2	202	13	2	202	9	3
Bilirubin	...	...	...	194	71	4	...	...	...
Calcium	192	45	5	192	45	7	191	16	8
Phosphate	170	2	2	171	22	0	171	3	3
T. Protein	184	13	1	184	8	2	184	10	0
Albumin	182	11	0	183	9	0	183	9	2
Urate	180	1	0	174	8	0	174	0	0
Magnesium	130	36	3	133	29	4	132	16	10

Calcium

The highest number of flags generated in routine chemistry surveys resulted from measurement of calcium. A total of 119 flags were recorded over the three surveys. Many Ortho Vitros results continued to flag on the survey samples with elevated calcium concentrations distributed in surveys CHEM-0301 and CHEM-0305, in spite of the Committee Comments for survey CHEM-0210 and the 2002 Review that indicated that the bias may be related to the dilution protocol.

Creatinine

Creatinine results are compared to the analytical principle mean rather than the all-methods' mean (AMM) due to the continuing positive bias on the results reported by the Ortho Vitros users.

Reference values for creatinine are obtained from the Ortho Clinical Diagnostics Inc. reference laboratory in Rochester, NY, using high performance liquid chromatography (HPLC). The mean of the results reported by the non-Ortho users was in agreement with the HPLC results reported for the nine survey vials. Forty-two (2.3%) of the 1827 creatinine results reported in the three surveys were flagged for bias.

Magnesium

Quantitation of magnesium continues to be a challenge for manufacturers and laboratories alike. The total number of flags decreased in 2003, but still remains higher than most other routinely measured analytes. Data submitted by participants were compared to results received from a reference laboratory using an atomic absorption assay. The calculated AMMs were similar to the atomic absorption generated data, although there was a slight positive bias. Bias was noted in method groups including Dade Behring (negative bias) and Beckman Coulter (positive bias).

Iron Pilot Survey

A pilot survey (CHEM-0305-IR) containing one sample of previously frozen serum for the measurement of iron, unsaturated iron binding capacity (UIBC), total iron binding capacity (TIBC) and transferrin saturation was distributed in May.

Table 9. Summary of Laboratories Flagged for Imprecision in the Results Reported for the Duplicate Vials CHEM-0305-A and CHEM-0305-C

Analyte	CHEM-0305 Between-Day Precision		
	Precision Flagging Limit (%)	No. of Laboratories	No. of Laboratories Receiving Correspondence
Bicarbonate	12	148	3
Chloride	4.5	200	1
Sodium	3	204	4
Potassium	5	204	2
Glucose	7.5	204	1
Urea	10	200	0
Creatinine	6	202	1
Bilirubin	10	194	9
Calcium	4.5	192	5
Phosphate	9	171	3
T. Protein	6	184	8
Albumin	7.5	183	0
Urate	9	174	1
Magnesium	6	133	7

A summary of results generated was published in the Committee Comment for CHEM-0305-IR. Reporting practices for iron testing varied among the participants. Nine of the 77 participating laboratories only report total iron. Twelve do not include the transferrin saturation on their patient reports and, therefore, did not report results on the Analysis Worksheet. Although no correspondence was sent as an outcome of this pilot survey, it was recommended that all laboratories review their methods and reporting practices for assessment of iron overload with their clinicians. Two surveys are planned for 2004.

Urine Chemistry

In 2003, urine chemistry surveys were distributed on two occasions, in March and July. CHEM-0303-UC and CHEM-0307-UC contained two samples of patients' urine and participants were requested to assay the samples for protein, sodium, potassium, creatinine and osmolality (CHEM-0303-UC only).

Protein

Eighty-eight laboratories reported results for urine protein. Three methods are in use — benzethonium chloride (20 users), pyrogallol red (32 users) and pyrocatechol violet (36 users). The pyrocatechol violet results appear to have a positive bias compared to the benzethonium chloride and pyrogallol red results at low protein concentrations. However at higher concentrations, results from the three methods are comparable.

Three laboratories received correspondence for discordant results in the March survey and four for the July survey. One participant was sent correspondence for a calculation error in the July survey.

Sodium and Potassium

There were 107 laboratories reporting sodium and potassium in 2003, down from 116 in 2002.

Performance was generally satisfactory on both surveys. Three responses to the correspondence sent in March by QMP-LS for sodium or potassium discordant results revealed that urine controls were not assayed as part of the laboratory's quality control (QC) program. Three memoranda were sent to participants for discordant results in the July survey and two of the laboratories were not using urine controls. All five laboratories were assigned significant errors for having an inadequate QC program.

Creatinine

Performance was generally satisfactory for the 2003 surveys. Of the 140 laboratories reporting creatinine in March, three laboratories received correspondence, of which one was for a calculation error. The one participant who received correspondence for creatinine results in the July survey had mixed-up the vials.

Osmolality

Osmolality testing was requested in the March urine survey. All but two of the 66 laboratories were within 3% of the AMM and all but one within 5% of the AMM on both vials.

The committee is concerned about the number of laboratories that do not assay urine-based QC material when urine chemistries are tested. Pre-analytical steps in urine analysis must be monitored by appropriate material and usually serum-based controls do not include a pre-analytical step. Significant errors are assigned when appropriate QC material is not tested.

Blood Gases

One blood gas survey was conducted to test all blood gas instruments within an institution, including point-of-care devices.

CHEM-0305-BG consisting of two ampoules of commercially-prepared aqueous material was distributed in May 2003. Sufficient samples were distributed to test all of the instruments within an institution, including point-of-care devices. Duplicate samples were forwarded to participating facilities to assess between-day precision. All participants were requested to report pH, pCO₂, and pO₂. Also, facilities were requested to report sodium, potassium, glucose and ionized calcium results if they reported patient samples from their instruments. Results from 157 hospitals using 278 analyzers were obtained.

Tables 10 and 11 summarize all of the results for this survey according to the manufacturer of the analyzer used. Results for specific analyzers are shown if there was a minimum of five instruments in a specific group.

Table 10. Summary of Results for pH, pCO₂ and pO₂ in Blood Gas Survey CHEM-0305 (SD and %CV in Brackets)

Method	n	Vial X			Vial Y		
		pH	pO ₂ mm Hg	pO ₂ mm Hg	pH	pCO ₂ mm Hg	pO ₂ mm Hg
All	278	7.17 (0.022, 0.3)	64.5 (2.5, 3.9)	70.1 (9.2, 13.1)	7.17 (0.023, 0.3)	64.7 (2.6, 4.0)	69.4 (8.6, 12.5)
Radiometer	145	7.16 (0.009, 0.1)	64.8 (1.5, 2.3)	72.4 (8.3, 11.5)	7.15 (0.008, 0.1)	65.1 (1.3, 2.0)	71.1 (7.5, 10.6)
Nova	57	7.20 (0.012, 0.2)	62.0 (3.0, 4.8)	64.5 (4.4, 6.8)	7.20 (0.012, 0.2)	62.6 (3.3, 5.2)	64.7 (4.5, 6.9)
Bayer	47	7.16 (0.028, 0.4)	69.7 (5.2, 7.4)	65.7 (11.4, 17.3)	7.16 (0.029, 0.4)	70.5 (5.5, 7.7)	64.9 (10.8, 16.6)
iSTAT	25	7.18 (0.013, 0.2)	63.4 (3.1, 4.9)	78.3 (6.4, 8.2)	7.18 (0.011, 0.2)	63.5 (2.8, 4.4)	78.4 (4.4, 5.6)

Table 11. Summary of Results for Sodium, Potassium, Glucose and Ionized Calcium in Blood Gas Survey CHEM-0305-BG (SD and %CV in Brackets)

Method	n	Vial X				n	Vial Y			
		Sodium mmol/L	Potassium mmol/L	Glucose mmol/L	Ionized Calcium mmol/L		Sodium mmol/L	Potassium mmol/L	Glucose mmol/L	Ionized Calcium mmol/L
All	80	162.8 (1.9, 1.2)	6.25 (0.10, 1.6)	15.61 (0.92, 5.9)	1.515 (0.089, 5.9)	58	162.9 (2.2, 1.3)	6.26 (0.11, 1.7)	15.69 (0.94, 6.0)	1.512 (0.086, 5.7)
Nova	24	164.4 (1.0, 0.6)	6.53 (0.25, 3.8)	16.41 (0.75, 4.6)	1.522 (0.047, 3.1)	20	164.3 (1.6, 1.0)	6.52 (0.26, 4.0)	16.55 (0.74, 4.5)	1.526 (0.043, 2.8)
Radiometer	23	162.2 (1.3, 0.8)	6.20 (0.04, 0.6)	14.63 (0.55, 3.8)	1.618 (0.026, 1.6)	17	161.8 (1.5, 0.9)	6.20 (0.04, 0.6)	14.71 (0.59, 4.0)	1.610 (0.023, 1.4)
iSTAT	12	163.2 (1.5, 0.9)	6.27 (0.07, 1.1)	...	1.426 (0.035, 2.4)	3	163.4 (2.0, 1.2)	6.31 (0.09, 1.4)	...	1.423 (0.017, 1.2)
Bayer	21	161.8 (2.0, 1.2)	6.20 (0.07, 1.1)	15.63 (0.34, 2.2)	1.430 (0.026, 1.8)	17	162.1 (2.5, 1.5)	6.21 (0.07, 1.1)	15.59 (0.32, 2.1)	1.427 (0.031, 2.2)

Performance on this survey was similar to that seen in previous surveys. It was generally satisfactory. The all-methods' calculated precision varied from 0.3% to 4.0% for all of the analytes except for pO₂. The per cent coefficient of variation (CV) for pO₂ was 13.1% and 12.5% and this finding, as seen in previous surveys, appears to be related to sample handling. For Bayer Rapidpoint 400 users there was a negative bias on pH results and a positive bias on pO₂ and pCO₂ compared to other Bayer analyzers. This is probably due to the different technology used by the Bayer Rapidpoint 400.

Two facilities reported ionized calcium results corrected for pH and this resulted in bias flags for these facilities.

Between-day precision of the results was satisfactory. Most of the flagging for imprecision occurred with the pO₂ results due to sample handling problems.

Two blood gas surveys are planned for 2004.

Hemoglobin A_{1c}

Two samples of whole blood from diabetic donors were distributed in January (CHEM-0301-HB), July (CHEM-0307-HB) and October (CHEM-0310-HB).

Two methods are being used by the participants to assay HbA_{1c}. Twenty laboratories use an HPLC method and the remainder (34) use an immunochemical method. Reference values for the six survey samples were obtained from the National Glycohemoglobin Standardization Program (NGSP) at the University of Missouri–Columbia’s Diabetes Diagnostic Laboratory. The AMMs were the same as the reference values for four of the six vials (one result varied by 0.001 and the other by 0.003).

Flagging limits are currently set at 7.5% of the reference result, allowing a 3.75% CV between laboratories for total error (inaccuracy and imprecision). This year, 39 of 316 (12%) results submitted for the three surveys were flagged. Correspondence was sent to laboratories for 15 of these results. Twenty-one of the flagged results occurred on survey vial CHEM-0307-HB-1. Many of the immunochemical methods for HbA_{1c} reported results on this vial significantly higher than those reported by HPLC or the reference laboratory. As there were no significant differences in vial 2 of this survey, it was concluded that vial 1 contained an interfering substance that led to a positive bias in some of the immunochemical methods and a negative bias in another assay, suggesting that HPLC is a more robust methodology for HbA_{1c}.

In the January survey (CHEM-0301-HB), four laboratories performing HbA_{1c} tests using Beckman Coulter CX4 and LX20 instrumentation reported low results for both vials. In the second survey (CHEM-0307-HB), all laboratories using these instruments reported high results for vial 1 but results for vial 2 were within the acceptable limits. By the third survey of the year (CHEM-0310-HB), all of the results from these instruments were within the acceptable limits for both vials. In contrast, all but two results reported by laboratories using Hitachi systems were above the highest HPLC result for vial 1 of the January survey, while the two laboratories using the Integra 400 reported the highest results for both vials on the October survey. The results reported by the Integra 800 systems were within the acceptable limits for this survey.

All manufacturers report that their calibration material is standardized against the NGSP reference method. Nevertheless, the responsibility rests with each individual laboratory to adequately validate each lot of calibrator and reagent to ensure that performance is adequate. Third party control material, with target values assigned by a certified reference laboratory, can be very useful in this regard.

In November 2003, the Canadian Diabetes Association released new recommendations suggesting that the target HbA_{1c} concentration be set at 0.07 for most patients and lowered to 0.06 for those individuals in whom this level can be safely achieved. This requires laboratories to ensure that adequate analytical performance can be delivered at these low levels.

In summary, HbA_{1c} has historically been an assay with technical issues limiting between-laboratory performance. However, the performance has now improved enough to warrant a flagging level of 7.5% on survey results which demands a between-laboratory total allowable error (inaccuracy and imprecision) of 3.75%. Excluding the aberrance observed in vial 1 of the July survey, 94.3% of HbA_{1c} results were within the QMP–LS flagging limits this year.

Albumin Excretion Rate

Albumin excretion rate surveys were distributed in January, July and October. Each survey contained four vials of urine for the measurement of albumin and creatinine. Participants were requested to calculate the albumin:creatinine ratio and interpret the ratio as being normal or abnormal using their own reference range.

The albumin excretion rate (AER), commonly called “microalbumin,” was measured in 28 laboratories using nephelometry (16), turbidimetry (10), radioimmunoassay (1) and enzyme immunoassay (1). Three surveys of four urine samples each were distributed in January, July and October with albumin concentrations ranging from 2.7 to 127 mg/L, and AERs ranging from 0.8 to 35.7. A flagging limit of >15% from the all-methods’ median is currently employed for total error for the albumin concentration and >15% from the AMM for the AER. Imprecision across

duplicate vials is flagged at >10% difference in the results. The percentage of albumin results >15% from the all-methods' median ranged from 7.7% (albumin 78.9 mg/L) to 32% (albumin 38.95 mg/L) for the 12 vials. The percentage of flagged AER results ranged from 12.5% (AER 35.7) to 34.8% (AER 9.2). Since urine creatinine results are typically very good, improvement in the method needs to focus directly on the albumin determinations.

Handling of low albumin concentrations for AER remains inconsistent. On a vial with a concentration of 2.70 mg/L albumin, 11 laboratories reported their results as <2.0, <3.0, <5.0, <6.0 or <8.0 mg/L. Presumably, these are the method detection limits. The Canadian Diabetes Association guidelines suggest that an AER >2.0 for men or >2.8 for women in a random daytime urine be followed up with repeat testing. Given that urinary creatinine concentrations may be as low as 3 mmol/L, urine albumin assays should have an analytical sensitivity of <6 mg/L. Four of the 11 laboratories that reported their albumin result as below the detection limit, reported the ratio as less than the calculated result, while six other laboratories did not report a ratio.

Laboratories were asked to interpret their AER results, based on the provided gender, age and weight, for the specimens using their laboratory's reference range. The 2002 Review stated that the committee anticipates that interpretations close to the decision limits would not be consistent. This was evident in the January survey for three of the four vials. A few laboratories are not using the Canadian Diabetes Association guidelines for the ratio. Ratios ranging from 2.1–2.8 reported for vial CHEM-0301-AE-1 were interpreted as normal for a male urine sample. In vials 2 and 3 of the same survey, ratios of 2.9–3.4 were interpreted as normal by three laboratories for a male sample.

DISCORDANT FINDINGS

Beginning with the 2002 surveys, in an attempt to highlight the reasons for poor performance on survey samples, participants were asked to complete a Discordant Findings Form. The committee reviewed these responses regarding bias and/or imprecision and classified them as follows:

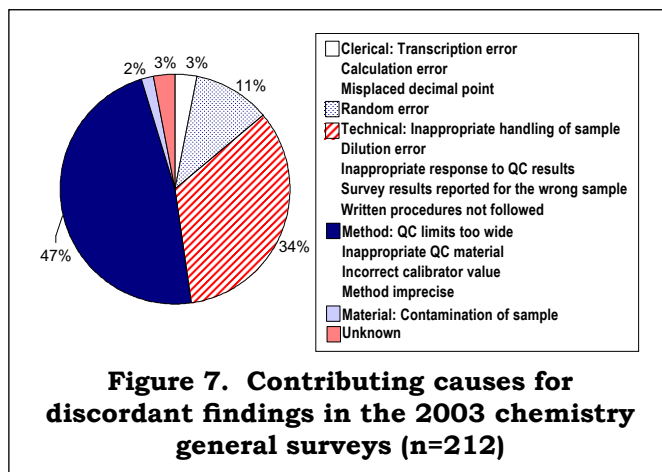
- Clerical error
- Method problem
- Technical problem
- Random error
- Material problem
- Unknown

Table 12 displays the number of results reported for the chemistry surveys (routine, blood gases, HbA_{1c}, albumin excretion rate and urine chemistry), the number of results generating correspondence and the error rate for the year.

Figure 7 displays the contributing causes by percentage for the 212 discordant results.

Table 12. Number of Results Reported for 2003, the Number of Results Generating Correspondence and the Error Rate

Discipline	No. of Results Reported	No. of Results Generating Correspondence	Error Rate (%)
Chemistry	29 203	212	0.73



DRUG MONITORING

TESTING MODEL

Previously frozen serum supplemented with specific drugs continued to be used for the five routine surveys in 2003. Samples of pooled urine were distributed for each of the drugs of abuse surveys. Whole blood samples were distributed for each of the five cyclosporine/tacrolimus surveys. Two samples were distributed for the drugs tested in each of the surveys. The drugs tested were:

DRUG-0301	Gentamicin, tobramycin, vancomycin, cyclosporine, tacrolimus, drugs of abuse
DRUG-0303	Carbamazepine, phenobarbital, phenytoin, theophylline, valproic acid, cyclosporine, tacrolimus
DRUG-0305	Ethanol, acetaminophen, salicylate, digoxin, lithium, cyclosporine, tacrolimus
DRUG-0307	Carbamazepine, phenobarbital, phenytoin, theophylline, valproic acid, cyclosporine, tacrolimus, drugs of abuse
DRUG-0310	Ethanol, acetaminophen, salicylate, digoxin, lithium, cyclosporine, tacrolimus, drugs of abuse

ASSESSMENT OF LABORATORY PERFORMANCE

Routine drug results with the exception of digoxin are flagged for committee review when >10% from the all-methods' mean (AMM). Digoxin results are flagged if >0.2 nmol/L from the AMM of ≤ 1.5 nmol/L or >10% from an AMM of >1.5 nmol/L. Cyclosporine and tacrolimus results are flagged when >15% from the AMM. Results for drugs of abuse are compared to results reported by a reference laboratory.

Carbamazepine, Phenobarbital, Phenytoin, Theophylline and Valproic Acid

Overall performance appears to be satisfactory. The methods currently used by the participants to measure these drugs are fluorescence polarization immunoassay (FPIA), turbidimetry and enzyme immunoassay. In survey DRUG-0307 the concentrations of carbamazepine, phenobarbital, phenytoin and theophylline were duplicated to investigate imprecision. The Ortho Vitros enzyme immunoassay demonstrated a positive bias for carbamazepine and phenytoin in surveys DRUG-0303 and DRUG-0307. Conversely, the Ortho Vitros colorimetric method displayed a negative bias for theophylline in survey vial DRUG-0303-B (AMM 50 $\mu\text{mol/L}$) but not in DRUG-0307 where the AMMs were 81 $\mu\text{mol/L}$ and 82 $\mu\text{mol/L}$.

Digoxin

In general, digoxin assays still lack precision in the clinical range. However, there appears to be some improvement when compared to the 2002 results. The enzyme immunoassays and turbidimetric assays appear to have between-method imprecision problems. Table 13 summarizes the 2003 survey results.

Acetaminophen

Turbidimetric immunoassay methods showed a positive bias when compared to the AMM in survey DRUG-0305. This positive bias was also seen but to a lesser extent in DRUG-0310. Enzyme and FPIA assays were the

Table 13. Summary of Digoxin Results for Surveys DRUG-0305 and DRUG-0310

Survey Vial	No. of Laboratories	Digoxin AMM (nmol/L)	Standard Deviation	CV (%)	Range of Results (nmol/L)	No. of Flags	No. of Letters
DRUG-0305-A	128	2.13	0.150	7.1	1.7–2.7	13	4
DRUG-0305-B	128	1.36	0.110	7.9	1.0–2.0	5	2
DRUG-0310-A	127	2.00	0.150	7.5	1.5–2.5	13	0
DRUG-0310-B	127	1.29	0.140	10.8	0.7–1.7	11	0

most imprecise with coefficients of variation (CVs) ranging from 6.0%–8.6%. The CVs for the colorimetric and turbidimetric assays ranged from 1.2%–4.8%.

Salicylate

Salicylate testing was generally acceptable with the exception of the Dade-Behring method that continues to show a significant positive bias relative to the AMMs. Survey DRUG-0310 contained one sample that was not supplemented with salicylate. The results reported demonstrated that there is a wide range of lower reporting limits in use throughout Ontario laboratories.

Ethanol

In general, testing for ethanol is performed well.

Lithium

Lithium results for surveys DRUG-0303 and DRUG-0310 continue to demonstrate a positive bias with Ortho Vitros colorimetric methods relative to the ion selective electrode, flame photometry and atomic absorption assays. Survey DRUG-0310 contained one sample that was not supplemented with lithium and the results also indicated that there is a wide range of lower reporting limits for lithium in use.

Gentamicin, Tobramycin, Vancomycin

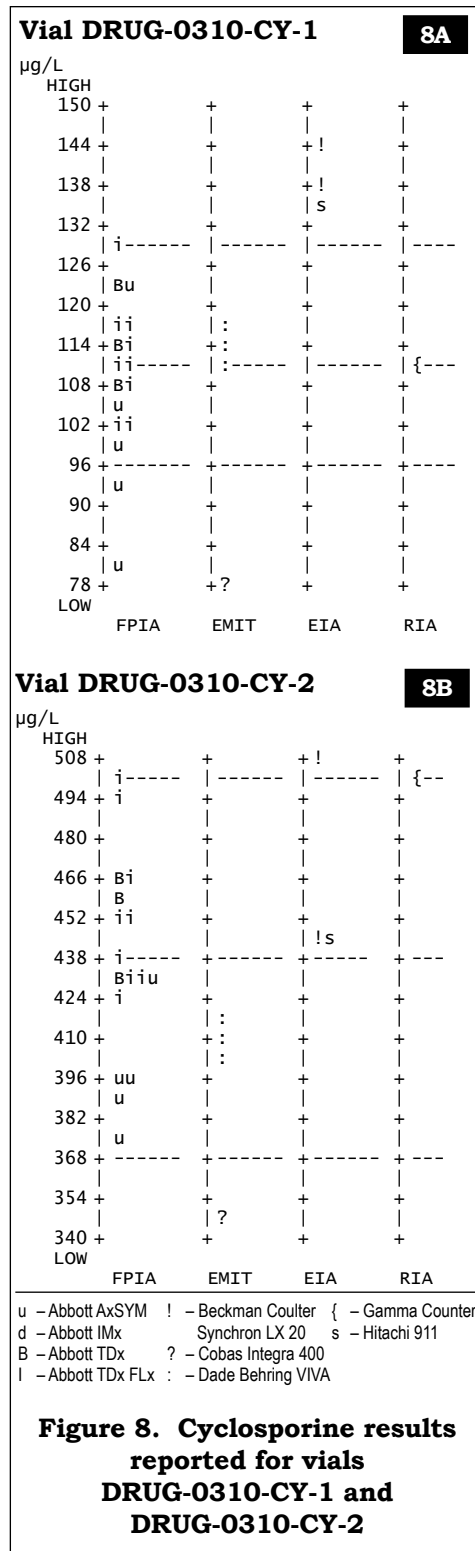
The overall performance of gentamicin, tobramycin and vancomycin testing is good.

Cyclosporine and Tacrolimus

Five surveys containing two samples each were conducted. QMP–LS offers cyclosporine surveys to both Ontario and out-of-province laboratories. Twenty-five laboratories participated (8 in Ontario, 11 in British Columbia, and 1 each in Alberta, Saskatchewan, Manitoba, Quebec, Nova Scotia, and New Brunswick). Fourteen laboratories report results for tacrolimus using three different instrument systems.

There is concern over the precision and accuracy of cyclosporine methods, particularly at lower concentrations. Survey DRUG-0310 was designed as an accuracy study for cyclosporine. Vial 1 was from a liver transplant patient on tacrolimus with 100 µg/L of cyclosporine added to it. Vial 2 was a sample from a kidney transplant patient with 400 µg/L of cyclosporine added. Figures 8A and 8B display the cyclosporine results reported for these vials.

Figure 9 illustrates the biases and range of results obtained by the various methods for all cyclosporine surveys in 2003. The per cent inaccuracy was calculated by subtracting the AMM from the submitted results and dividing by the AMM and multiplying by 100. All results for both vials of the five surveys are plotted in a



box-whisker plot by instrument system. The box represents 50% of the results, the line through the box is the median, and the upper and lower bars are the extreme values. Figure 10 demonstrates the same information for the results of the tacrolimus surveys in 2003. Tacrolimus assays appear to be more robust.

DRUGS OF ABUSE

Three drugs of abuse surveys were distributed in 2003. Urine drug screen samples were prepared from combined patient samples.

The following observations were noted.

- DRUG-0301-DA-X contained a large amount of ecstasy or methylene-dioxymethamphetamine (MDMA) and some methylenedioxyamphetamine (MDA); however, only two laboratories reported the sample positive for amphetamines.
- DRUG-0307-DA-Y contained oxycodone, a semi-synthetic opioid analgesic. Only 22 of 97 (23%) laboratories reported opiates as positive for this sample.
- DRUG-0310-DA was a relatively straightforward challenge yet a number of false positive results for benzodiazepines, cannabinoid metabolites, cocaine metabolites and phencyclidine were reported.

DISCORDANT FINDINGS

Table 14 summarizes the number of results received for the drug surveys, the number of results generating correspondence and the error rate.

Figure 11 displays the contributing causes by percentage for the 148 discordant results.

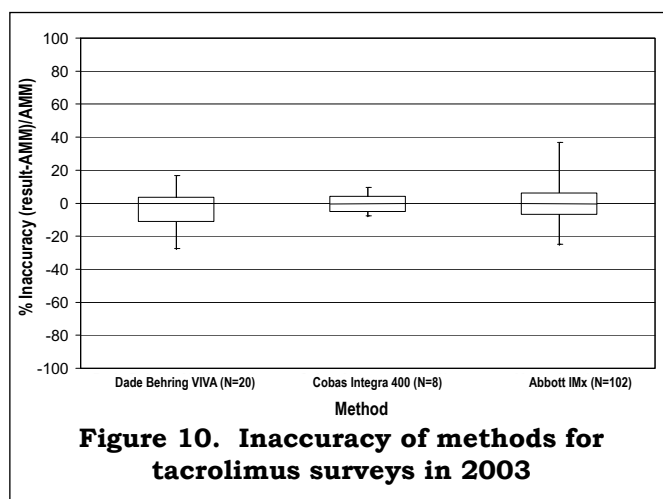
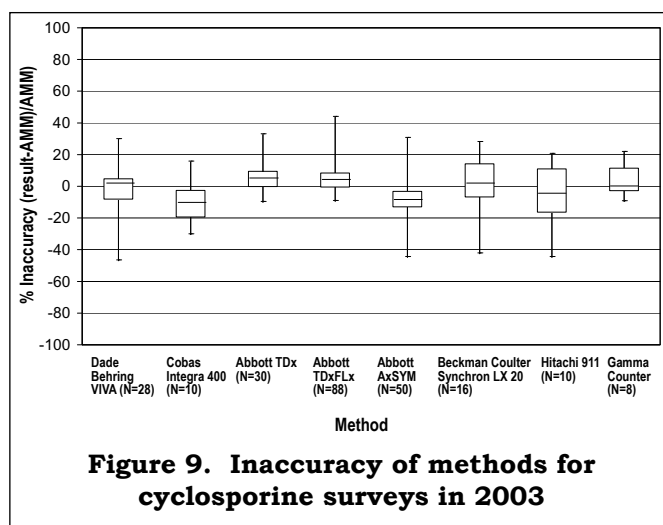
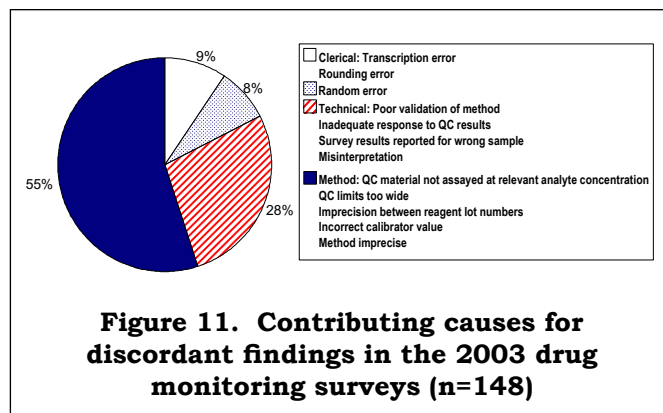


Table 14. Number of Results Reported for 2003, the Number of Results Generating Correspondence and the Error Rate

Discipline	No. of Results Reported	No. of Results Generating Correspondence	Error Rate (%)
Drug Monitoring	8739	148	1.7



ENZYMES, CARDIAC MARKERS AND LIPIDS

ENZYMES AND CARDIAC MARKERS

Testing Material

Reconstituted lyophilized human serum was distributed to test alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma glutamyl transferase (GGT), and lactate dehydrogenase (LD). Previously-frozen supplemented serum was distributed for the analysis of cardiac markers, amylase and lipase. The material used for the homocysteine survey was EDTA plasma from two donors.

The survey samples are sent by overnight courier and participants are requested to analyze them within 24 hours of receipt.

Testing Model

Two surveys each for enzymes, cardiac markers and troponin T (cTnT) were distributed. Only one homocysteine survey was conducted. The enzymes and cardiac markers tested were:

ENZY-0301	ALP, ALT, AST, GGT and LD
ENZY-0303-CM, ENZY-0303-HC, ENZY-0303-TT	Total creatine kinase (CK), CK-2, myoglobin, troponin I, troponin T and homocysteine
ENZY-0306	Amylase and lipase
ENZY-0310-CM, ENZY-0310-TT	Total CK, CK-2, myoglobin, troponin I and troponin T

Assessment of Laboratory Performance

Cardiac Markers

Five vials of previously-frozen serum supplemented with CK-2, CK-3, myoglobin and troponin I (cTnI) were distributed for each of the cardiac marker surveys. There was one set of duplicate vials in each survey to test within-run precision. Participants are allowed to assay the five vials within the same test run.

Total CK

There were 198 participants in survey ENZY-0303-CM, and 195 in ENZY-0310-CM. Over 94% of the participants use instruments and reagents supplied by three vendors (Ortho, Beckman-Coulter and Roche). Agreement was good among all laboratories, as the all-methods' coefficients of variation (CVs) for all ten vials were between 5.0% and 6.1%. Precision based on the results for duplicate vials was very good with 96% of the laboratories achieving a difference of $\leq 5\%$.

This level of performance was similar to the 2002 CK surveys.

CK-2

CK-2 results were reported by 132 participants in survey ENZY-0303-CM and 131 in ENZY-0310-CM. Eighteen laboratories use a point-of-care device to assay CK-2.

Agreement among participants' results is fair. Three populations of results are evident within the chemiluminescence group. The Beckman Coulter Access and DPC Immulite users report the highest results and the Ortho Eci users report the lowest results. Results from the Roche Elecsys, the Bayer ACS 180 and ADVIA Centaur are in the middle range. The previously observed positive bias with the Ortho Vitros immunoinhibition method at 10 U/L was evident. The bias was not present at levels higher than 20 U/L.

The precision of CK-2 results is not as good as total CK. Only 90% of the participants achieved a difference of $\leq 8\%$ in the results reported for the set of duplicate vials in survey ENZY-0303-CM. The all-methods' medians for these vials were 67 and 66. In survey ENZY-0310-CM, the CK-2 activity in the duplicate set of vials was too low to make a valid precision assessment.

Myoglobin

Forty-eight laboratories reported results in the March survey (ENZY-0303-CM) and 37 laboratories in ENZY-0310-CM. Forty-nine laboratories participated in the last myoglobin survey in 2002. Twenty-three participants used a point-of-care device in the March survey compared to 12 in the October survey (ENZY-0310-CM).

The disagreement in results between methods, within methods and the imprecision of the results continued. Very often results from within the same method had CVs of 20% or more. Perhaps this is the reason that the number of participants measuring myoglobin has decreased dramatically.

Troponin I

There were 109 participants in survey ENZY-0303-CM and 111 in ENZY-0310-CM. The three major vendors for cTnI methods are Beckman-Coulter, Biosite and Abbott, supplying approximately 80% of the participants. The major disagreement between the results continued. Table 15 shows a typical range of results from three methods.

Table 15. Comparison of Troponin I Results for Survey Vial ENZY-0303-CM-A Reported by Participants Using Three Methods

Vial ENZY-0303-CM-A	Median (µg/L)	Minimum (µg/L)	Maximum (µg/L)	CV (%)
Beckman-Coulter Access (n=39)	2.83	2.60	3.30	4.5
Biosite Triage (n=22)	1.10	0.70	1.50	16.9
Abbott AxSYM (n=25)	19.8	17.2	25.2	10.3

Among the cardiac markers, cTnI is the assay that is not standardized. Laboratories must caution their clients that the numerical result must be interpreted with the caveat that the reference range is method specific.

Within-laboratory precision was similar in the two surveys. Nineteen (17.4%) sets of results for the duplicate vials in the March survey and 21 (23%) sets in the October survey had a difference of greater than 10%.

Troponin T

Two surveys were distributed for cTnT: one in March (ENZY-0303-TT) and the other in October (ENZY-0310-TT). Each survey consisted of five vials of previously frozen serum supplemented with cTnT.

In the March survey (22 participants), the results for vial ENZY-0303-TT-1 showed a median of 0.395 µg/L and a range of 0.30 to 0.54 µg/L. Vial 2 had a median of 0.09 µg/L with the range from 0.06 to 0.12 µg/L. Vials 3 and 4 had no detectable amount of cTnT. Many laboratories reported the results as <0.01 µg/L. Vial 5 had results similar to that of vial 2. The median was 0.09 µg/L and the range from 0.06 to 0.13 µg/L.

Agreement among participants was worse than that observed last year. At levels close to the diagnostic threshold of 0.10 µg/L, the CVs were 15.6% and 17.8%, in contrast to the 12% noted in the 2002 survey.

In the October survey (ENZY-0310-TT), there were 24 participants. The results are summarized in Table 16.

There is an increasing number of laboratories in Ontario that offer cTnT as a biochemical marker for

Table 16. Summary of Troponin T Results Reported by Participants for Survey ENZY-0310-TT (n=24)

Vial	Median (µg/L)	Minimum (µg/L)	Maximum (µg/L)	CV (%)
ENZY-0310-TT-1	1.365	1.05	1.54	7.9
ENZY-0310-TT-2	12.48	10.57	14.70	10.3
ENZY-0310-TT-3	0.68	0.59	0.88	10.9
ENZY-0310-TT-4	0.685	0.55	0.87	10.0
ENZY-0310-TT-5	0.12	0.10	0.17	13.8

myocardial damage. The agreement among these laboratories is fair and similar to 2002 surveys. Roche has a 9-minute and an 18-minute assay. For the October survey, 22 participants indicated on the Analysis Worksheet that they were using the 9-minute assay and two indicated the 18-minute assay. This did not appear to influence the results.

The large variation in the reference ranges reported by laboratories was again similar to that reported in 2002. QMP-LS strongly urges participants to review their reference ranges and work with their clinicians to arrive at values that are relevant to their local environment.

Homocysteine

One homocysteine survey was conducted in 2003. Two vials of donor EDTA plasma were distributed to seven participants, and the results reported are summarized in Table 17. Agreement was satisfactory among the different methodologies. They included enzyme immunoassay (3 users), FPIA (3 users) and tandem mass spectrometry (1 user).

This analyte has been removed from the testing menu because of the small number of laboratories measuring homocysteine, the generally good performance, and the substantial survey cost.

Table 17. Summary of Homocysteine Results Reported for Survey-0303-HC (n=7)

Vial	Median (μmol/L)	Minimum (μmol/L)	Maximum (μmol/L)	CV (%)
X	8.0	7.0	9.4	11.1
Y	7.0	5.0	7.8	17.0

ALP, ALT, AST, GGT and LD

Five vials of reconstituted lyophilized serum were distributed in January (Survey ENZY-0301) to assay these enzymes. Vials A and C were duplicates. Determination of these enzymes appears to be adequate with only a few participants receiving correspondence for bias and/or imprecision in their results. However, reference ranges continue to differ between laboratories using the same method.

Amylase and Lipase

Five vials of previously-frozen serum supplemented with pancreatic amylase and lipase were distributed in survey ENZY-0306. Vials B and E were duplicates.

Determination of amylase (183 participants) appears to be satisfactory. Only one participant received correspondence for bias.

Lipase was reported by 48 laboratories, of which 29 use the Ortho Vitros method. The Ortho results are analyzed separately. Again, performance appears to be satisfactory with only two participants receiving correspondence for biased and imprecise results.

DISCORDANT FINDINGS

Table 18 displays the number of results reported over the year, the number of results requiring correspondence and the error rate. Figure 12 displays the contributing causes by percentage for the 103 discordant results.

Table 18. Summary of the Number of Results Reported for the Year, the Number of Results Generating Correspondence and the Error Rate

Discipline	No. of Results Reported	No. of Results Generating Correspondence	Error Rate (%)
Enzymes and Cardiac Markers	10 804	103	0.95

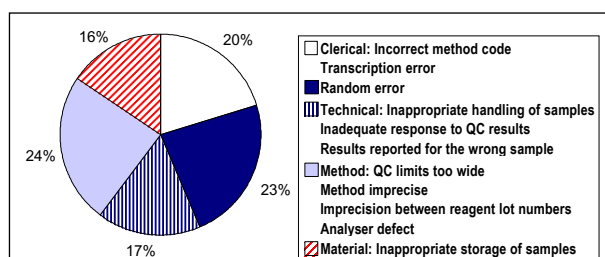


Figure 12. Contributing causes for discordant results in the 2003 enzyme surveys (n=103)

LIPIDS

TESTING MODEL

Three lipid surveys were conducted using fresh human serum from four donors for each survey. The 139 participants were split into two groups and each group received two of the samples. The survey samples closely mimic the samples analyzed in Ontario laboratories. Artifacts due to freeze/thaw cycles, pooling of samples, or lyophilization are avoided. The samples are shipped by overnight courier and the majority of laboratories receive the samples within 24 hours.

ASSESSMENT OF LABORATORY PERFORMANCE

Three reference laboratories analyzed aliquots of each sample for cholesterol, HDL-cholesterol and triglycerides. The mean of the reference laboratories' results was used as the target value. Some difficulty was encountered in obtaining consistent services of the reference laboratories. Reference results were obtained from at least two laboratories.

Flagging against target values, as opposed to all-methods' mean (AMM) values, highlights biases in various manufacturers' methods. This is of concern, since lipid values should be interpreted using nationally (and internationally) set reference criteria, as opposed to local or method specific reference ranges. For this reason, HDL-cholesterol continues to be an analyte of concern to the committee. Beckman-Coulter users' results displayed a negative bias that appeared to have been corrected by the last survey of the year (LIPS-0310). Roche and Ortho users' results displayed a positive bias on some of the vials.

Figure 13 presents the percentage of cholesterol, triglycerides, and HDL-cholesterol results flagged for the years 1997–2003. The increase in flags in the last two years reflects the change to using target values as opposed to AMM values. Previously, when the AMM was used for flagging results, a method used by the majority of the participants could influence the mean. The flagging rules have not changed.

DISCORDANT FINDINGS

The number of results received, the number of results generating correspondence and the error rate is shown in Table 19. Figure 14 displays the contributing causes by percentage for the 84 discordant results.

Table 19. Summary of the Number of Results Reported for the Year, the Number of Results Generating Correspondence and the Error Rate

Discipline	No. of Results Reported	No. of Results Generating Correspondence	Error Rate (%)
Lipids	6651	84	1.3

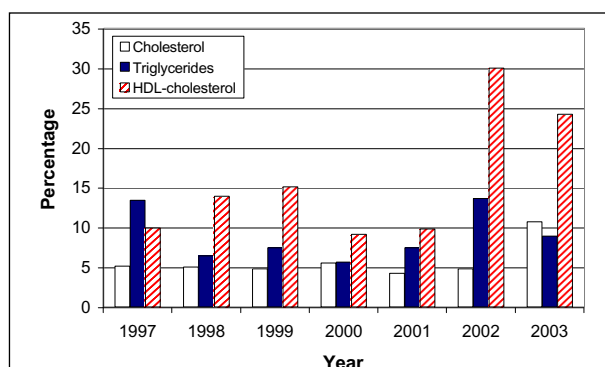


Figure 13. Comparison of the percentage of results flagged for cholesterol, triglycerides and HDL-cholesterol from 1997–2003

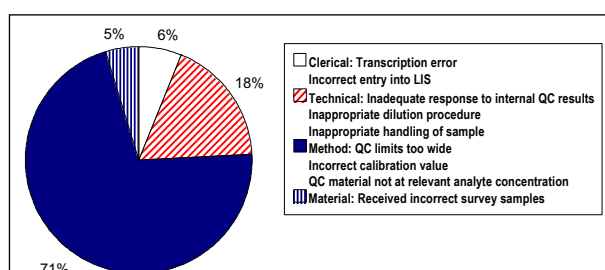


Figure 14. Contributing causes for discordant results in the 2003 lipid surveys (n=84)

ENDOCRINOLOGY

TESTING MODEL

In 2003, the five surveys conducted each contained two vials of lyophilized human serum. The samples for survey ENDO-0302 were reconstituted before distribution. Analytes assessed using the lyophilized serum were:

Total Triiodothyronine (TT ₃)	Follicle Stimulating Hormone (FSH)
Thyrotropin (TSH)	Luteinizing Hormone (LH)
Free Thyroxine (FT ₄)	Prolactin
Free Triiodothyronine (FT ₃)	Chorionic Gonadotrophin (CG)
Vitamin B ₁₂	Progesterone
Ferritin	Alpha Fetoprotein (AFP)
Cortisol	Estradiol
Testosterone	Dehydroepiandrosterone Sulfate (DHEA-S [only when concentration is appropriate])

Two between-survey precision studies were conducted. The surveys were: ENDO-0304-B and ENDO-0306-A; and ENDO-0306-B and ENDO-0311-A

Fresh serum samples were included in four of the surveys. Analytes assessed using fresh serum were:

PSA and Free PSA	ENDO-0302, ENDO-0309
TT ₃ , TSH, FT ₄ and FT ₃	ENDO-0306
Testosterone and estradiol	ENDO-0309, ENDO-0311
Cortisol, progesterone and DHEA-S	ENDO-0311

The fresh serum sample in ENDO-0309-1 had been distributed on three previous occasions (R-0102-1, R-0111-1 and ENDO-0211-1) allowing a precision study for testosterone and estradiol. Vial ENDO-0309-2 was a duplicate of ENDO-0302-2 and vial ENDO-0302-1 of vial ENDO-0209-1, allowing a between-survey precision study of PSA and Free PSA.

ASSESSMENT OF LABORATORY PERFORMANCE

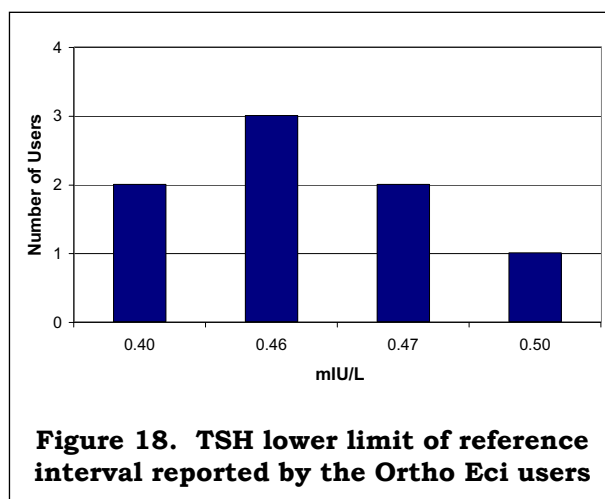
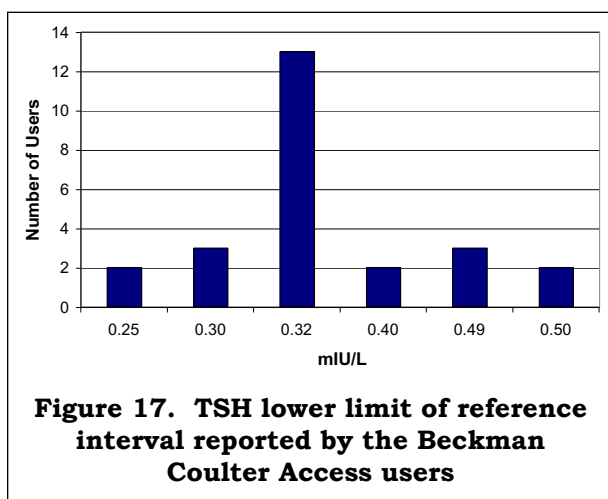
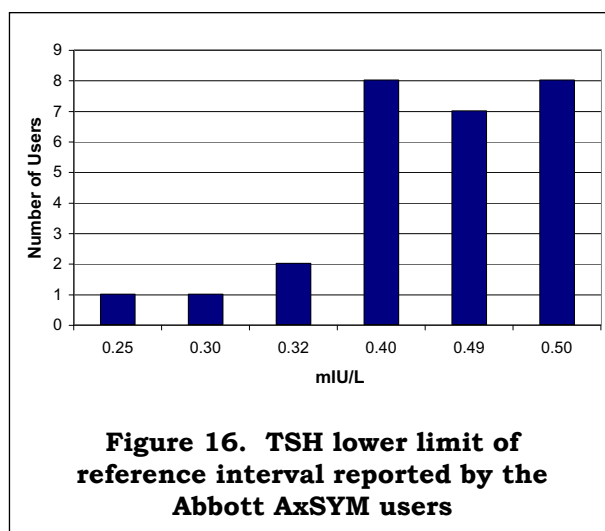
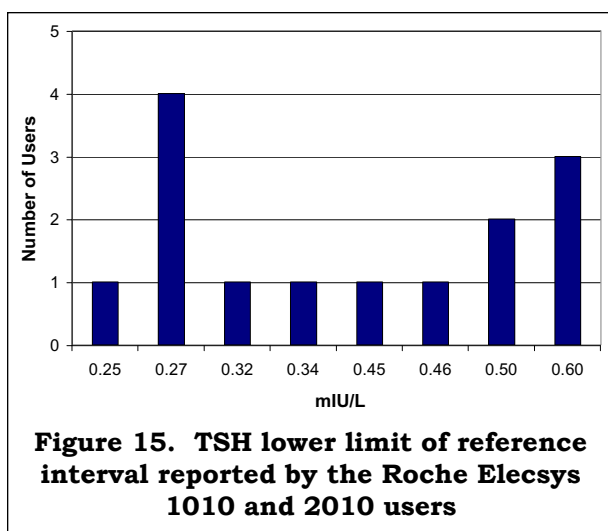
The computer flagging rules for bias remained the same as in previous years. Precision flagging rules were those implemented in 2002.

Thyroid Function Tests

Thyroid tests (TT₃, TSH, FT₄ and FT₃), were evaluated in five surveys using lyophilized samples, and in survey ENDO-0306 using two fresh serum samples from donors. Vial ENDO-0306-1 was from a female donor with subclinical hypothyroidism; vial ENDO-0306-2 was from a female donor diagnosed with Hashimoto's disease. Both donors were receiving therapy.

Overall performance within instrument groupings was very good for all analytes. Method-related biases are still apparent on lyophilized material but less so with fresh sera.

Once again QMP-LS recommends that participants review their lower reference limits for TSH. It was noted that variability in quoted lower limits of reference intervals within a method group would lead to differences in interpretation of the result. The all-methods' median (AMM) for ENDO-0306-2 was 0.42 mIU/L and results ranged from 0.31–0.62 mIU/L. Figures 15–18 display the lower limit of the reference interval reported by the users of four instrument systems.



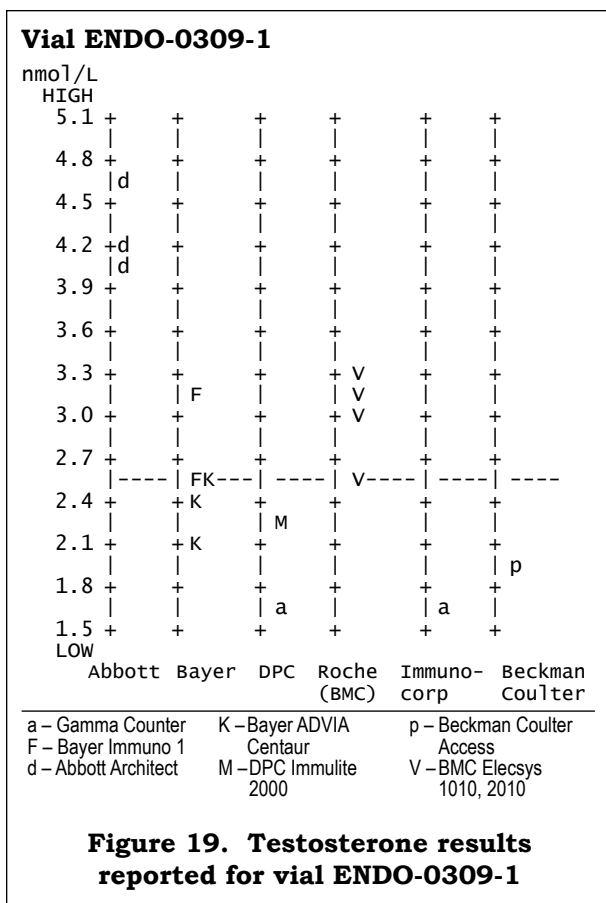
Steroid and Protein Hormones

Cortisol

Nine different instruments from six manufacturers were used by the 24 participants reporting cortisol results. Two fresh serum samples were distributed in survey ENDO-0311 to determine whether the biases in results between methods using the lyophilized serum were due to matrix effect. The between-assay performance is actually better for the lyophilized samples than for the fresh sera. This would indicate that the variability in the results is not due to matrix effect, but reflects the current performance of cortisol assays. The results for the precision studies were satisfactory.

Testosterone

Sixteen laboratories report testosterone results using eight different assays making it difficult to analyze the results reported for the lyophilized serum samples due to possible matrix effects. The fresh serum sample distributed on four occasions, including survey ENDO-0309, was from a post-menopausal female. Figure 19 displays the results reported for survey vial ENDO-0309-1. The results ranged from 1.6 nmol/L to 4.6 nmol/L. Results from the Abbott Architect method continue to have a positive bias, however the Architect female reference range partially compensates for the bias. Three Elecsys users and one Bayer Immuno 1 user reported results ranging from 3.0–3.3 nmol/L. Of the 16 participants, 15 achieved a difference of ≤ 0.7 nmol/L in their results reported on the replicate vials.



Two fresh serum samples distributed in the November survey were from female donors. Although all of the results were within the female reference range there was considerable variation. The results for vial ENDO-0311-1 ranged from 0.5–2.2 nmol/L and the results for vial 2 ranged from 0.6–2.3 nmol/L.

Estradiol

This analyte was measured by 21 laboratories using eight different analytical systems from seven different manufacturers. Results for estradiol continue to be unsatisfactory on both lyophilized and fresh serum samples. The CVs for the lyophilized serum sample results ranged from 20%–30% and from 18%–30% on the fresh serum samples.

Two Abbott Architect users' results were flagged for imprecision on the replicate fresh serum vials. Abbott is investigating the reason for the imprecision.

DHEA-S

This analyte is reported by 12 laboratories that use four different analytical systems from two manufacturers (DPC and Roche). There was a method bias between the two manufacturers' results on the two fresh serum

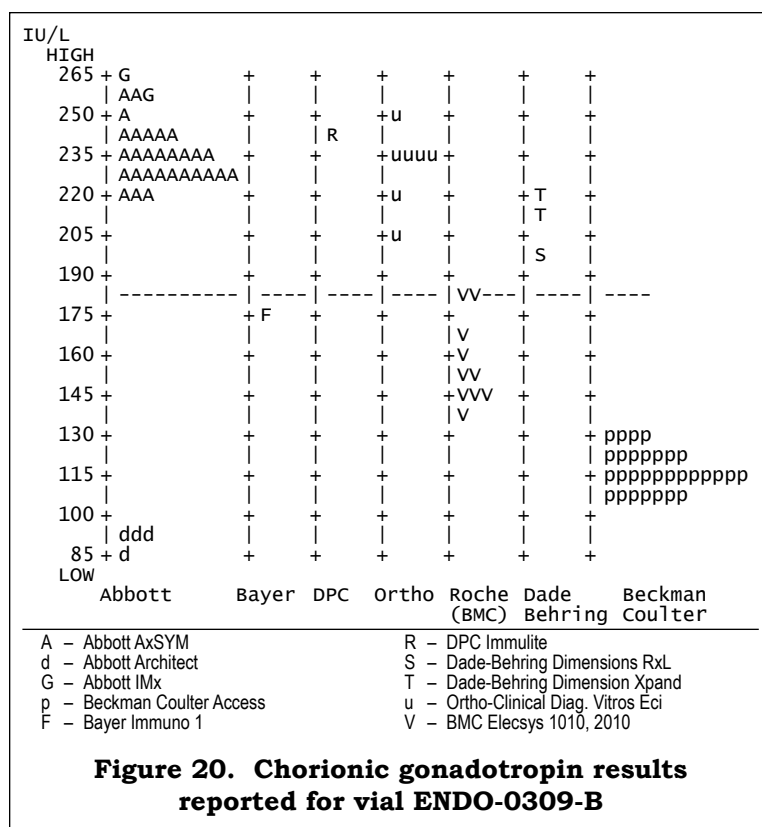
samples distributed in survey ENDO-0311. The range of results for the DPC methods was 4.1–6.1 $\mu\text{mol/L}$ for vial 1 and 5.6–6.9 $\mu\text{mol/L}$ for vial 2. The Roche results ranged from 7.0–8.4 $\mu\text{mol/L}$ for vial 1, and 7.7–11.2 $\mu\text{mol/L}$ for vial 2. This bias cannot be attributed to a matrix effect.

Progesterone

Seventeen laboratories report results for progesterone. Seven different instrument systems were used from five manufacturers. Comparing the results for the lyophilized and fresh serum samples in survey ENDO-0311 revealed that performance was better for the lyophilized serum samples. The results reported for vial A of this survey had an AMM of 18 nmol/L and a CV of 9.4%. The AMMs for vials 1 and 2 were 15 nmol/L and 22 nmol/L, respectively. The CVs were 24.1% and 15.5% for the two samples.

Chorionic Gonadotropin (CG)

Five surveys with ten challenges were distributed. The median concentrations ranged from 13 to 376 IU/L (3 challenges with median <100 IU/L, 6 between 100–300 IU/L and 1 >300 IU/L). The 88 reporting laboratories use seven different manufacturers' systems: Abbott (3), Beckman Coulter and Dade Behring (2), and Bayer, DPC, Ortho, and Roche all with one. In all surveys, the highest concentrations were reported by laboratories using Abbott AxSYM analyzers and the lowest by laboratories using Abbott Architect analyzers. Figure 20 displays the results reported for vial ENDO-0309-B. The mean concentrations for AxSYM were about three times higher than those for Architect. This may be due to the fact that AxSYM measures the total β -CG using MEIA technology and the Architect measures the intact CG as well as free β -CG subunits using chemiluminescence technology. The Endocrinology Committee will investigate a source of fresh serum for surveys in 2004.



Vial 1 was a duplicate of vial ENDO-0209-1. In ENDO-0302 survey, 60 and 24 laboratories respectively reported total and free PSA results. Fifty-four of these used various systems from the three most popular manufacturers: Abbott (30), Beckman Coulter (16) and Roche Diagnostics (8). Although overall performance was good there were clearly biases between these methods, with the Beckman Coulter Access results being the highest. This reflects differences in standardization. Abbott and Roche methods are standardized against the WHO 90/10 standard whereas Beckman Coulter's method is calibrated against the old pioneer Hybritech assay, which is no longer used by any laboratory in the province. Acceptable precision was noted with no laboratory falling outside a 25% difference on the duplicate vials. A review of past precision studies resulted in lowering the flagging limit to 20% for future total PSA challenges. Survey vial ENDO-0309-2 again reflected the method-specific biases with Beckman Coulter and Ortho Eci users reporting the highest results.

The results for total PSA for the two surveys are summarized in the Table 20.

Free PSA performance was acceptable. In ENDO-0302, the distribution of the free/total PSA ratio was clearly bimodal in both vials with the Abbott user group having a higher median ratio of 0.29 for vial 1 and 0.18 for vial 2,

Table 20. Summary of Total PSA Results Reported for Survey Vials ENDO-0302-1, ENDO-0302-2 and ENDO-0309-2

Survey	Manufacturer	No. of Participants	Median (µg/L)			
			Vial 1	Range	Vial 2	Range
ENDO-0302	All Results	60	9.25	7.7–11.1	9.3	6.7–10.9
	Abbott	30	8.7	7.7–10.3	9.0	7.6–10.6
	Beckman Coulter	16	10.45	10.1–11.1	10.0	9.5–10.7
	Roche	8	8.9	8.3–11.0	8.6	8.0–10.9
ENDO-0309	All Results	61	...	...	9.2	7.7–10.9
	Abbott	28	...	...	8.65	7.7–9.8
	Beckman Coulter	18	...	...	9.8	9.4–10.5
	Roche	8	...	...	8.9	7.8–9.5
	Ortho	3	...	...	10.5	10.0–10.9

FSH, LH and Prolactin

Fresh serum samples were not distributed. There are method differences in the results reported for FSH and LH on lyophilized samples. Prolactin results also demonstrate between-method biases on the lyophilized samples, which may be a matrix effect. Precision of the results reported for the duplicate vials for these analytes was satisfactory.

Total and Free PSA and PSA Ratio

PSA testing was assessed using fresh serum only. Specimens from two donors, both with clinical and biopsy-proven benign prostatic hyperplasia (BPH), were distributed in February (ENDO-0302) and September (ENDO-0309). Two vials were distributed in ENDO-0302, one from each donor and one of these vials (vial 2) was re-distributed again in ENDO-0309 to determine precision.

compared to median ratios of 0.23 and 0.13 for the other methods. The higher Abbott free/total ratio was more compatible with the benign disease diagnosis in the donors. However, when vial 2 was retested in ENDO-0309 the bimodal distribution was no longer apparent. There is no clear explanation for this change. Figures 21A and 21B display the PSA ratio results for vials ENDO-0302-2 and ENDO-0309-2.

21A	21B
Vial ENDO-0302-2	Vial ENDO-0309-2
HIGH	HIGH
0.30+	0.34+
0.29+	0.33+
0.28+	0.32+
0.27+	0.31+
0.26+	0.30+
0.25+	0.29+
0.24+	0.28+
0.23+	0.27+
0.22+	0.26+
0.21+	0.25+
0.20+ AL	0.24+
0.19+ AA	0.23+
0.18+ AALAH	0.22+
0.17+ AAAA	0.21+
0.16+	0.20+ AA
0.15+ c	0.19+ A
0.14+ CCC	0.18+ AA
0.13+ CCHHC	0.17+ AAAA
0.12+	0.16+ CCHCAA
0.11+ H	0.15+ CHCAC
0.10+	0.14+ LCHHC
0.09+	0.13+ H
0.08+	0.12+
0.07+	0.11+
0.06+	0.10+
LOW	LOW

A - Abbott	H - Roche (BMC)
c - Wallac	L - DPC
C - Beckman Coulter	

Figure 21. PSA ratio results reported for vial ENDO-0302-2 and ENDO-0309-2

Vitamin B₁₂ and Ferritin

Five surveys required testing of lyophilized serum for vitamin B₁₂ and ferritin. Approximately 50 laboratories are reporting vitamin B₁₂ and 75 ferritin. The largest group of users for vitamin B₁₂ was Beckman Coulter (28). For ferritin there were 12 different systems from seven manufacturers with Abbott and Beckman Coulter methods forming the two largest groups. Although within-reagent agreement was reasonably good in all surveys, there were clearly differences between the different systems for both analytes. It is assumed that these unique matrix effects in the lyophilized material are the cause of these differences. The performance of vitamin B₁₂ testing has room for improvement, since the spread of results between the lowest and highest value for the large user group was commonly about 32%–44% within one survey. The average %CV for ferritin was 12%–13%.

Two between-survey precision studies were conducted. Vials ENDO-0304-B and ENDO-0306-A and vials ENDO-0306-B and ENDO-0311-A were duplicate samples. The vitamin B₁₂ AMMs were 622 pmol/L for both vials in the first precision study and 265 pmol/L and 266 pmol/L in the second study, reflecting no change in material during storage. A difference of >25% in the

results on the duplicate vials is the flagging limit. One of 48 sets of results in the first precision study and two of 51 sets of results were flagged in the second study. The corresponding AMMs on the duplicate vials for ferritin were 148 and 145 µg/L in the first study and 45 and 46 µg/L in the second study. With an imprecision flag of >25% difference in the results, only two out of 70 laboratories flagged in the first study and five of 72 laboratories in the second study. These flags represent <5% of reporting laboratories, which suggests that assays for these two analytes are precise.

Alpha Fetoprotein

Sixteen laboratories report results for AFP using seven different analytical systems. The lyophilized serum results reveal variation in the results between the analytical systems as well as within an instrument group. Evaluating the results for bias is a problem with less than five participants within each instrument group.

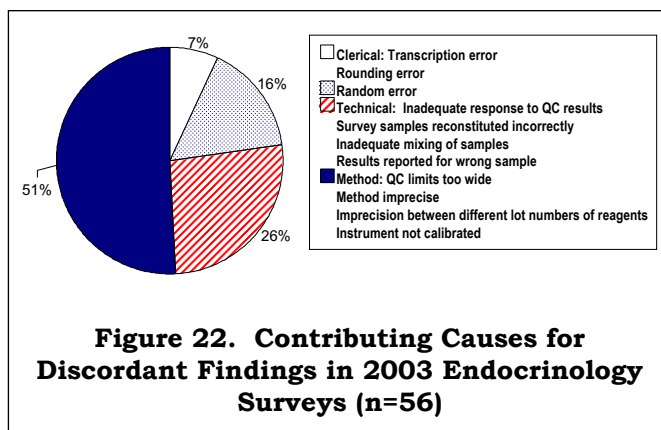
DISCORDANT FINDINGS

Table 21 displays the number of results reported in the five endocrinology surveys, the number of results generating correspondence and the error rate for the year.

Figure 22 shows the contributing causes by percentage for the 56 discordant results.

Table 21. Summary of the Number of Results Reported for the Year, the Number of Results Generating Correspondence and the Error Rate

Discipline	No. of Results Reported	No. of Results Generating Correspondence	Error Rate (%)
Endocrinology	7464	56	0.75



IMMUNOLOGY

TESTING MODEL

The analytes tested (Appendix G) were the same as in previous years. However, testing for RF “screen only” assay was removed which decreased the number of laboratories participating from 99 at the end of 2002 to 78 for the first survey in 2003. One vial of fresh serum from a commercial source was distributed on five occasions during 2003.

The disease state represented in the survey samples were:

IMGY-0302: Positive antinuclear antibody (ANA), centromere pattern

IMGY-0304: IgM kappa monoclonal protein, positive ANA (speckled pattern) and rheumatoid factor (RF)

IMGY-0306: Positive ANA (centromere pattern), anti thyroid peroxidase (TPO), anti microsomal and elevated IgE.

IMGY-0309: Two IgG kappa monoclonal immunoglobulin abnormalities

IMGY-0311: Hypogammaglobulinemia, positive RF.

All samples had varying levels of specific proteins and electrophoretic fractions.

Table 22 displays the number of participants reporting each analyte in 2003 compared to 2002. As mentioned above, the large decrease in the number of laboratories testing RF is due to the RF “screen only” assay being removed from the test menu.

Table 22. Number of Participants Testing Immunology in 2002 Compared to 2003 by Analyte

Analyte	2002	2003	% Difference
ANA	30	33	10
Anti ds-DNA	19	22	15.7
IgE	16	15	-6.3
C3,C4	28	27	-3.6
CRP	28	29	3.6
hs CRP	6	7	16.7
RF	88	56	-36.4
MAH	9	10	11.1
Anti TPO	7	6	14.3
IgG, IgA, IgM	36	36	0
PEP*	42	41	-2.4

* Protein Electrophoresis

ASSESSMENT OF RESULTS

The computer flagging rules remained the same as in 2002. However the rules for the quantitative assays have been revised and will be implemented in the first survey in 2004. As always, flagged results are reviewed by the committee prior to any correspondence or error assignment.

LABORATORY PERFORMANCE

In general, performance was satisfactory for the Immunology surveys. Participants were requested to report their IgE results using µg/L (SI units) as the reporting unit beginning with survey IMGY-0302. Two participants in survey IMGY-0306 and one in survey IMGY-0309 failed to convert their results to µg/L. Three laboratories in survey ENDO-0302 and one in ENDO-0306 identified the ANA pattern incorrectly.

Protein Electrophoresis

In survey IMGY-0309, 41 laboratories reporting protein electrophoresis results identified a large monoclonal band in the gamma region. Thirty-two of these participants reported immunoelectrophoresis results. Of these, 21 (65.6%) reported a single IgG kappa band in the gamma region while six (18.8%) participants reported the one in the gamma region as well as a smaller IgG kappa band in the beta region. The remaining five (15.6%) laboratories reported the two bands as well as the presence of free kappa light chains. This variability in detecting the bands has clinical significance when patients are being monitored.

There is considerable variation in the interpretation/comments provided on the Survey Reports for the protein electrophoresis. Assuming these interpretations reflect actual practice on patient reports there is a need to bring more standardization to these reports. For example, for survey IMGY 0311, the sample was hypogammaglobulinemic. The

participants' comments ranged from 'no comment' to 'hypogammaglobulinemia' all the way to a recommendation for urine studies to rule out light chain myeloma. This recommendation for urine studies for a hypogammaglobulinemic sample is supported by the literature.

Titre Assays

The committee will be reviewing the practice for the various titre assays. Even within the same method there is variability in the reporting of the results. Some participants perform a set titre and report positive results as greater than this titre, while other laboratories titrate to a final result. This explains the large range of titre values on the survey histograms. Because of these practices the interpretation rather than the titre value will be flagged in the 2004 surveys.

C-reactive Protein (CRP) Assays

There is a wide range of assays for CRP. The reported procedures are CRP "screen only," CRP titre, CRP, and sensitive CRP. The committee is concerned as to whether the health-care providers serviced by the laboratories are aware of the sensitivity performance of the laboratory providing the results.

FUTURE SURVEYS

In 2004, the number of surveys will be decreased from five to three surveys per year; however, each survey will include two samples.

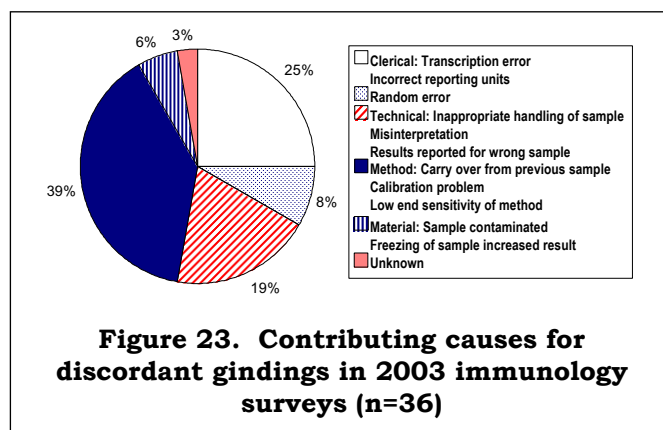
DISCORDANT FINDINGS

The number of results received for the immunology surveys, the number of results generating correspondence and the error rate for the year is shown in Table 23.

Figure 23 displays the contributing causes by percentage for the 36 discordant results.

Table 23. Summary of the Number of Results Reported for the Year, the Number of Results Generating Correspondence and the Error Rate

Discipline	No. of Results Reported	No. of Results Generating Correspondence	Error Rate (%)
Immunology	2162	36	1.7



MATERNAL SERUM SCREENING

TESTING MODEL

Since 1993, QMP-LS has provided second-trimester serum and amniotic fluid prenatal screening external quality assessment challenges. The testing model was designed to monitor quality assurance (QA) indicators and analytical and interpretive performance. QMP-LS also has an expanded mandate to monitor the performance of the laboratories based on the Ontario MSS Database of patient results.

Since 1999, QMP-LS has been monitoring the transition from second-trimester triple marker screening to enhanced screening modalities. The new markers are biochemical and ultrasound based. The reported advantages of these new modalities are that they will decrease the false positive rate associated with screening while possibly increasing the detection rate. These changes should result in improved patient care. This shift in practice will have an impact on the QMP-LS EQA program.

The EQA model remained unchanged in the number of surveys (four) and analytes monitored—alpha fetoprotein (AFP), chorionic gonadotropin (CG) and unconjugated estriol (μE_3). Single donor fresh serum samples were sourced from patients in their second trimester. This type of testing material has completely replaced the prepared sera model and limits the number of laboratories that can participate in each survey. Each serum sample was distributed to participants with the requisite “patient” demographic and clinical information required to generate a complete interpretive report. A facsimile of the Ontario MSS program requisition was utilized to transmit the demographics to the laboratories. The laboratories were required to submit their results on the QMP-LS survey material in the same format, as they would report patient results to physicians.

The Maternal Serum Screening (MSS) serum-testing model was designed to monitor QA indicators and analytical, and interpretive performance. To determine within-laboratory variations (imprecision), identical testing materials were submitted to participants on two or more occasions.

The survey model has previously included two challenges of amniotic fluid for AFP testing. However, no amniotic fluid challenges were available in 2003.

As an added feature, patterns-of-practice surveys are conducted. Since the MSS program requires close liaison between clinical and laboratory service providers, the completion of these surveys often requires close collaboration between these services.

QMP-LS has a mandate to monitor the performance of the laboratories through the Ontario MSS Database of patient results. Each of the seven regional laboratories transfers their patient results to the database on a monthly basis. QMP-LS conducts a monthly performance review of the medians (AFP, CG and μE_3) and positive rates (Trisomy 21, Open Neural Tube Defects [ONTD] and Trisomy 18). The monthly volumes are also monitored.

LABORATORY PERFORMANCE

Each challenge was assessed for analytical accuracy and appropriate clinical interpretation. Within Ontario, analysis of specimens for the three markers—AFP, CG and μE_3 —has been within acceptable limits. The laboratories continue to perform well on the quality assessment indicators and interpretive component of the MSS challenges.

For each survey, Committee Comments regarding the analytical and interpretive performance are published and histograms provided to enable peer comparison.

The QMP-LS MSS program includes both the clinical and laboratory components, as they are critically dependent on both disciplines. The program evaluates the patterns of practice on both clinical and technical issues within the

provincial program. Publishing the survey results in Committee Comments enables a unique opportunity for MSS staff to discuss and review their practices compared to provincial peers and implement changes.

Material procurement problems and the developments around enhanced prenatal screening resulted in the cancellation of two of the four surveys (September and December) and a suspension of the existing wet testing model for 2004. The patterns of practice and patient database review processes will continue.

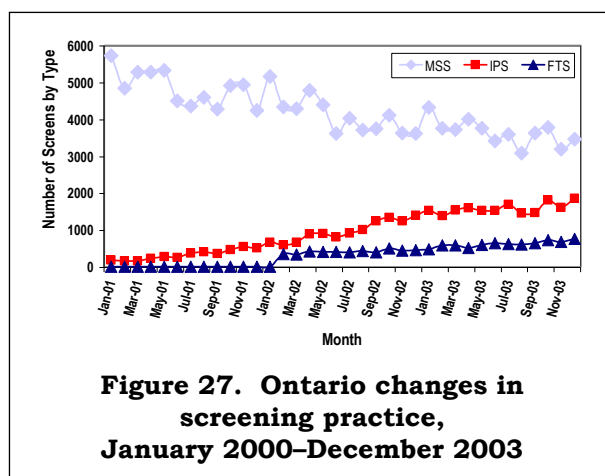
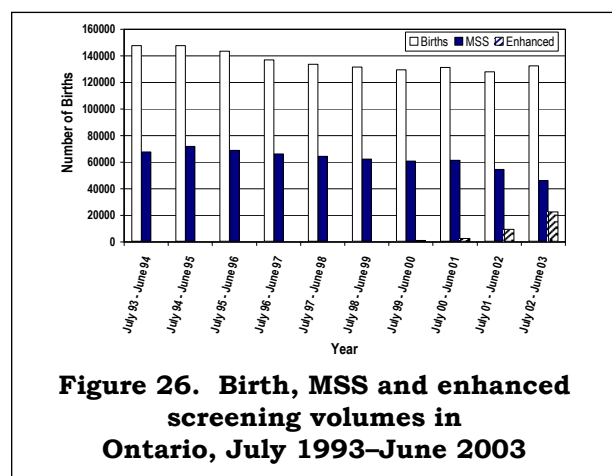
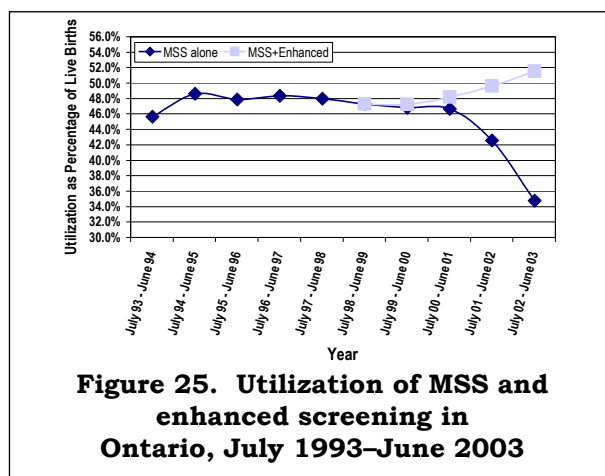
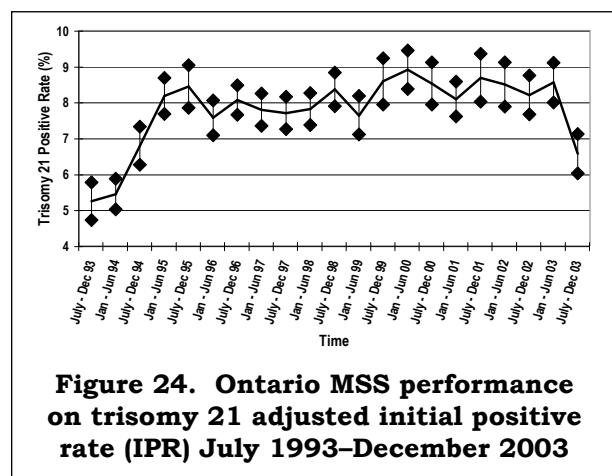
ONTARIO MSS DATABASE

The MSS Database provides outcome assessment on the basis of the initial positive rate (IPR). As shown in Figure 24, the fluctuation (error bars) for Trisomy 21 PR has remained fairly constant, as has the detection rate (DR). However, in the last six months of 2003, there was a drop in the mean positive rates from over 8% in the previous six months to approximately 6.5%. This may reflect a change in screening practice, whereby high risk pregnancies are removed from the screening population (i.e. via stand-alone ultrasound or the addition of inhibin) with a concordant decrease in the positive rate.

The ONTD PR and DR also remain the same. However, a substantial decline in the prevalence of ONTD has been noted.

While the overall uptake of prenatal screening as a function of live-births has not changed, the proportion of screened patients who elect to undergo enhanced screening versus traditional MSS has increased (Figure 25).

Figure 26 outlines the volume of births and screens (MSS and enhanced). Figure 27 illustrates the changes in screening practice in Ontario based on the type of screening method (second trimester MSS, integrated prenatal screening [IPS] or first trimester screening [FTS]).



ENHANCED PRENATAL SCREENING

Since 1999, several of the seven sites have been offering new additional markers to their available protocols to improve the sensitivity and specificity of the screening service. The additional markers are pregnancy-associated plasma-protein A (PAPP-A), free beta hCG (a derivative of hCG), dimeric inhibin A (DIA) and nuchal translucency (NT) of the fetal neck as measured by ultrasound. It is likely that these markers will continue to change the method of evaluating pregnancies and any quality assessment system must be prospectively designed to accommodate these changes.

To date, enhanced service is offered by six of the seven designated MSS laboratories. Each site provides multiple screening methods. This is a state of transition with each of the laboratories at different stages of evaluation and implementation of the new markers.

In the fall of 2003, The Ontario Women's Health Council awarded a grant to QMP-LS through the Ontario Medical Association to develop a quality assurance program for new biochemical and early ultrasound markers used to screen expectant mothers at risk of having children with birth defects. The project will be completed by the fall of 2004. The project objectives are:

- to recommend an evidence based EQA program for enhanced MSS;
- to develop a secure, centralized, Web-enabled database of qualified sonographers;
- to develop an accountability mechanism for the combined MSS report.

It is expected that a report would be produced that evaluates the outcome of the project objectives, describes the development of appropriate evidence-based statistical models for quality assessment of screening methods in pregnancy and recommends actions for sustainability of these programs for future development to include both biochemical markers and NT.

OTHER ACTIVITIES

QMP-LS is represented on the Ontario MSS Consultative Group, which oversees the Ontario MSS program. This group meets semi-annually.

The Ontario MSS Consultative Group has a Chemistry Subcommittee. To enhance communications between QMP-LS and this subcommittee, a representative is invited to each QMP-LS MSS committee meeting to share information. Since 1998, the provincial MSS Chemistry Subcommittee has tabled a report at each meeting.

POINT-OF-CARE TESTING

GLUCOSE METERS

Testing Model

Two surveys were planned for 2003 to test the performance of glucose meters, but the May survey was cancelled due to the restriction of hospital staff activity as a result of the Severe Acute Respiratory Syndrome (SARS) outbreak. The single survey conducted was distributed in September (POCT-0309-GL) and consisted of three vials of a commercially prepared suspension of stabilized human red blood cells and known levels of glucose (low and elevated) in a buffered medium containing preservatives. Sufficient material was sent to test all of the glucose meters within an institution. The survey contained one set of duplicate vials for a precision study at a low level of glucose.

Participation in the surveys remains voluntary at this time with 196 institutions participating. Ten participants are institutions without laboratories. The users of the glucose meters are expected to perform the testing.

Survey Assessment

The computer flagging rules for bias remained the same as those published previously:

Bias

- Glucose ≤ 5.0 : results >1.0 mmol/L from specific glucose meter model mean
- Glucose >5.0 : results $>20\%$ from the glucose meter model mean

If a result is $>15\%$ from the mean of the results reported from within an institution for a specific glucose meter model, it will be flagged.

The Chemistry Committee reviewed the results and recommended the following computer flagging rules for imprecision:

Imprecision

- Glucose ≤ 5.0 : results >1.0 mmol/L difference in results reported on duplicate vials
- Glucose >5.0 : results $>15\%$ difference in results reported on duplicate vials

Results are compared to the glucose meter model mean rather than the all-methods' mean (AMM), due to matrix effects with the survey material.

Glucose Meter Performance

The number of glucose meters from which results were reported increased to 2863 from 2578 reported for POCT-0209-GL in 2002. The participants used 24 different glucose meters. The most popular glucose meter (by test volume) is the Precision PCx, followed in order by the Surestep Flexx, AccuData Inform, Glucometer Elite 3903E and the AccuData GTS/Advantage. The data for some manufacturer models demonstrate greater variability in test results than others, where the CV ranged from 2.8% to 11.3% at low levels of glucose and 1.8% to 6.4% at elevated levels of glucose. Many meters have a low value cut-off and when a glucose result meets that level, the meter will provide an indication that the result is "low" or "less than" a certain value. Vials 1 and 3 tested this cut-off limit for meters with a total of 481 (16.8%) results reported as "low" or "less than" values. Vials 1 and 3 were duplicates with glucose meter means ranging between 1.1–3.8 mmol/L. The range for vial 2 was 14.0–18.6 mmol/L. The number of results that were flagged for bias and imprecision are shown in Table 24. Correspondence was sent to 6 (3.0%) institutions for either results on the duplicate vials with a difference >1.0 mmol/L or for bias from the glucose meter model mean.

Table 24. Number of Results Flagged for Bias and Imprecision for Survey POCT-0309-GL

POCT-0309-GL (n = 2863)	No. of Results >20% or ±1 mmol/L from Glucometer Mean	No. of Results >15% from Site Mean	No. of Precision Flags on Duplicate Vials 1 and 3
Vial 1 (low glucose)	1	65	5
Vial 2 (elevated glucose)	4	6	NA
Vial 3 (low glucose)	2	64	...

Testing Material Suppliers**Chemistry**

Instrumentation Laboratory (Canada) Ltd., Richmond Hill, Ontario
 Hamilton Regional Laboratory Medicine Program, Hamilton, Ontario
 The Credit Valley Hospital, Mississauga, Ontario

Drug Monitoring

Centre for Addiction and Mental Health, Toronto, Ontario
 Toronto General Hospital, University Health Network, Toronto, Ontario

Endocrinology

Randox Laboratories, Mississauga, Ontario
 RCPA-AACB Chemical Pathology QAP, Flinders Medical Centre, Bedford Park, Australia
 Toronto General Hospital, University Health Network, Toronto, Ontario

Enzymes, Cardiac Markers & Lipids

Hamilton Regional Laboratory Medicine Program, Hamilton, Ontario
 Kingston General Hospital, Kingston, Ontario
 The Credit Valley Hospital, Mississauga, Ontario

Immunology

Hamilton Regional Laboratory Medicine Program, Hamilton, Ontario
 Biomedical Resources, Hatboro, Pennsylvania

Maternal Serum Screening

North York General Hospital, Toronto, Ontario

Point-of-Care Testing (Glucose Meters)

Hematronix Inc., Plano, Texas

HEMATOLOGY DISCIPLINES

ROUTINE HEMATOLOGY

TESTING MODEL

Testing material for routine complete blood count (CBC) and automated leukocyte differential counts, representing clinical samples, was obtained from R&D Systems, Inc. of Minneapolis, Minnesota. Survey material included realistic clinical low, normal and high values. The material consisted of human erythrocytes with mammalian leukocytes and thrombocytes in a plasma-like fluid. The variety of blood cell analyzers used in Ontario continues to pose a challenge for this survey since there is no single material that is compatible with all instruments. For this reason, participants were divided into eight groups and each received material compatible with their reported blood cell analyzer (Table 25). As noted in previous reports, depending on the instrument, the CBC and automated leukocyte differential may vary, specifically the hematocrit (Hct), mean cell volume (MCV), thrombocyte and automated leukocyte differential. The committee continues to have difficulty assessing results from laboratories where there are only a few users of a specific instrument or in some cases where the laboratory is the only user of an instrument. To assist with this, a whole blood survey is being planned for May 2004. This survey will be distributed to a targeted number of participants who use instruments that cannot be adequately assessed utilizing the current manufactured testing material. The survey will be used to determine if various instruments will produce similar results when the sample used for testing is a fresh K₃EDTA human whole blood sample rather than the current simulated material. The Hamilton Regional Laboratory Medicine Program continues to supply fresh K₃EDTA whole blood for the reticulocyte surveys.

Two minor changes to the testing model were made during 2003. In 2000 the committee chose to reduce the peer method group mean from ten to eight. The peer method group mean serves as the reference against which the laboratories' results are assessed. This decision was made to allow more instrumentation method groups to be assessed against their peer method group mean, thereby decreasing the amount of inconsequential flags. In 2003, in keeping with other EQA programs and the fact that there are now larger instrument groups, the committee has reverted to its previous policy using the following criteria:

The peer group serves as the reference mean against the laboratory's result if there are ten participants. Where there are less than ten participants the all-methods' mean serves as the reference mean.

Table 25. Instrument Groups for Automated Differential Survey Material

Group	No. of Participants
No differential/ Coulter 3-part differential	45
Coulter 5-part differential	86
Cell DYN 5-part differential	58
Sysmex 5-part differential	4
Bayer 3 or 5-part differential	11
Cell-DYN/Sysmex 3-part differential	9
Beckman Coulter AcT 5-part differential	4

Hematology (Routine, Red Cell Disorders, G6PD, Fetal Maternal Hemorrhage, Bone Marrow)

No. of Participants (Dec. 2003)	217
No. of Participants (Dec. 2002)	223
No. of Surveys Conducted in 2003	14

Hematology-Flow Cytometry

No. of Participants (Dec. 2003)	18
No. of Participants (Dec. 2002)	18
No. of Surveys Conducted in 2003	3

Coagulation

No. of Participants (Dec. 2003)	200
No. of Participants (Dec. 2002)	207
No. of Surveys Conducted in 2003	3

Morphology

No. of Participants (Dec. 2003)	206
No. of Participants (Dec. 2002)	214
No. of Surveys Conducted in 2003	5

Transfusion Medicine (Set A and Set B)

No. of Participants (Dec. 2003)	176
No. of Participants (Dec. 2002)	177
No. of Surveys Conducted in 2003	4

Revised flagging criteria were also adopted in 2003. Flagging limits are used to alert the committee to values outside the group mean, unexpected results and/or clinically misleading results. In the past, QMP-LS has used flagging criteria as noted in Table 26. Flags produced by QMP-LS' current scheme were compared with other schemes with regard to specificity and sensitivity. The revised criteria are shown in Table 27. The committee felt that these criteria decreased the number of irrelevant flags while best identifying results outside the group mean, unexpected results, and/or clinically misleading results. These criteria are very similar to the proficiency testing flagging scheme for acceptable analytical performance used by the Clinical Laboratory Improvement Act (CLIA) and the College of American Pathologists (CAP).

LABORATORY PERFORMANCE

At the end of 2003, 217 laboratories participated in the routine survey, compared to 223 in 2002. For reticulocyte counting, 166 laboratories participated in 2003, compared to 172 in 2002. The number of participating laboratories continues to show a slow but persistent decline.

Challenges were conducted in May and October. Each challenge consisted of 4 vials for routine CBC parameters, 2 vials for CBC and automated leukocyte differential counts and 1 vial for reticulocyte counts. In each survey, two of the CBC vials were from the same lot number and precision studies were conducted.

CBC and Automated Leukocyte Differentials

Participants were expected to report leukocyte count, erythrocyte count, hemoglobin (Hb), Hct, MCV, and thrombocyte count for each vial. Laboratories with a 5-part differential instrument were expected to report absolute numbers of lymphocytes, monocytes, granulocytes, eosinophils and basophils. Participants using a 3-part differential instrument were expected to report absolute numbers of lymphocytes, monocytes, and granulocytes. Those using a 1-part differential instrument were expected to report only absolute numbers of lymphocytes.

For both surveys a total of 19578 results were analyzed. As noted earlier, flagging criteria were modified for the second survey and the peer group mean was used as the reference mean. Overall performance was, once again, excellent. Survey error rates for combined CBC and automated leukocyte differential were 0.2% and 0.53% in May and October 2003, respectively. This rate is slightly higher than during the previous two years. The higher error rate in the October survey is largely due to one laboratory incorrectly testing vials from a previous survey.

Reticulocyte Counting

The whole blood sample distributed to participants in May was from an individual with an elevated reticulocyte count. In order to assess participants' ability to report an elevated reticulocyte count, the committee not only examined the reticulocyte count results but also the relationship of each result to the participants' upper limit of their normal reference interval.

Participants were requested to perform erythrocyte and per cent reticulocyte counts on receipt of the sample, and from these results, calculate the absolute reticulocyte count. Of 165 laboratories, 52.4% reported automated

Table 26. Previous Hematology General Flagging Limits

Parameters	Deviation Allowed From Mean (%)
Leukocyte	20
Erythrocyte	10
Hemoglobin	10
Hematocrit	10
MCV	5
Thrombocyte	20
Automated Leukocyte Differential	40

Table 27. New Hematology Flagging Limits

Parameters	Deviation Allowed From Mean (%)
Leukocyte	15
Erythrocyte	6
Hemoglobin	7
Hematocrit	6
Thrombocyte	25
Automated Leukocyte Differential	3 SD or ± 0.5

reticulocyte count results while 47.6% are still using manual microscopic methods. The overall CV for this survey was 21.8% and, perhaps not surprisingly, the automated methods generally yielded lower CVs than the manual methods (Table 28). Seven errors were assessed on this survey with a 1.4% survey error rate. This is comparable to the 1.6% error rate in the previous survey.

Table 28. Results of Survey HEMA-0305-RE, Reticulocyte Count

Method*	Number of Laboratories	Mean† × 10 ⁹ /L	Median × 10 ⁹ /L	CV %†	Reported Range (All Results)
All methods	166	190	185	21.8	32–364
Microscopy, no disc ≤1000 erc	45	213	210	19.0	139–364
Microscopy, no disc >1000 erc	8	223	214	24.3	151–308
Microscopy, with disc ≤1000 erc	18	154	156	32.7	32–261
Microscopy, with disc >1000 erc	8	152	150	18.4	107–190
Beckman Coulter STKS/MAXM	9	218	222	7.9	182–239
Beckman Coulter GEN-S	31	184	182	7.0	135–215
Beckman Coulter LH 750, 755	4	190	185	21.8	160–177
Cell-DYN 3500, 3500R, 3700	16	171	168	16.4	130–248
Cell-DYN 3200	8	168	169	10.9	146–194
Bayer ADVIA 120	10	226	223	10.9	194–264
Flow cytometry	2	190	185	21.8	101–309
Other, specify	7	149	150	3.6	142–155

Other, specify includes the following instruments

Sysmex K-4500	3
Sysmex XE-2100	2
Cell-DYN 4000	2

* Methods performed by less than five participants are not noted

† Outliers removed if n≥8

The committee noted the continued reporting of inappropriate normal reference intervals by some laboratories. Participants are reminded that all reference intervals should either be established by individual laboratories or validated for current patient populations.

A second whole blood survey distributed in October 2003 was from an individual with a normal reticulocyte count. Unfortunately, the survey material was not mixed properly and, therefore, was not a homogenous sample. The results received were erratic and the survey was not analyzed.

Two further challenges will be conducted in 2004.

Discordant Findings Cause Analysis

The contributing causes of discordant findings for routine hematology surveys in 2003 are shown in Figure 28.

Table 29 contains information relating to the number of potential discordant results. It does not indicate the actual number of assigned errors or noted discordant findings.

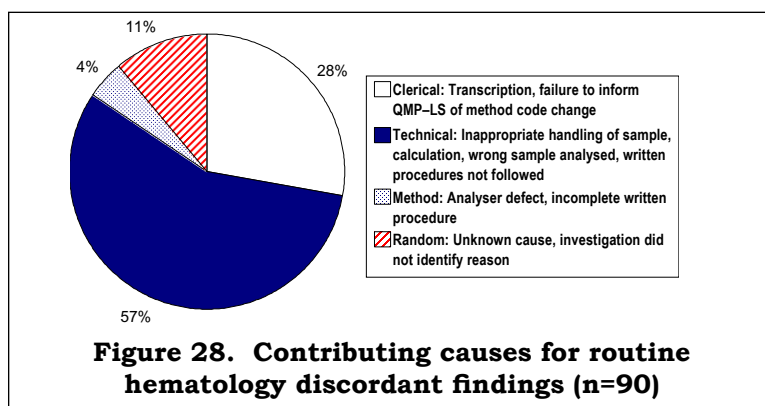


Table 29. Summary of Discordant Results for Routine Hematology

No. of Potential Discordant Results	Type of Discordant Result	No. of Discordant Results	%
20073	Clerical	25	0.12
20073	Technical	51 *	0.25
20073	Method	4	0.02
20073	Random	10	0.05
Total		90	0.44

* 40 of the technical discordant results relate to one laboratory mistakenly analyzing five samples from an old survey that had not been discarded from the participant's refrigerator

RED CELL DISORDERS (HEMOGLOBINOPATHY)

TESTING MODEL

Three surveys utilizing fresh whole blood and one utilizing a paper-based dry challenge were distributed in 2003. Eighty laboratories in Ontario participated in the HbS screening survey and 23 laboratories (including one out of province) submitted results for the Hb fraction quantitation/hemoglobinopathy investigation challenges. The HbS screening survey this year focused on the ability of participants to differentiate a patient who is positive for HbS from a patient who is negative. The Hb fraction quantitation/hemoglobinopathy investigation challenges tested the ability of laboratories to detect Hb E trait and Hb D Punjab trait. The dry laboratory challenge introduced participating laboratories to a case of β -thalassemia trait that was masked by the presence of a δ -chain Hb variant, which split the HbA₂ fraction causing a falsely low HbA₂ level (where the HbA₂ should have been increased, it appeared normal on the high performance liquid chromatography [HPLC]).

LABORATORY PERFORMANCE

Table 30 provides a summary and the reference diagnoses of surveys conducted in 2003.

The April HbS screening survey contained two samples. Vial A was from a patient with a positive sickle cell solubility test and vial B was from a patient negative for Hb S. All participants obtained correct results. Table 31 shows the various HbS screening methods in use in Ontario in 2003. All laboratories follow the QMP-LS recommendation of performing a solubility screen as opposed to a slide-sickling test as their primary screen. One laboratory continues to use the slide-sickling test as an additional screen.

The April Hb fraction quantitation/hemoglobinopathy investigation survey contained a sample from a donor with Hb E trait. Twenty of the 23 laboratories participating in this survey submitted the correct diagnosis of Hb E trait and two reported the acceptable result of hemoglobinopathy detected and recommended referral to a reference laboratory for identification of HbE or C. One laboratory reported a discordant finding of Hb E disease and one laboratory reported the presence of occasional Hb H inclusion bodies leading to a discordant additional interpretation of α -thalassemia trait.

Table 30. 2003 Hemoglobinopathy Reference Diagnoses

Survey	Month	Reference Diagnosis
RCD-0304-HS-A	April	Positive
RCD-0304-HS-B	April	Negative
RCD-0304	April	Hb E trait
RCD-0308	August	Hb D Punjab trait
RCD-0308-E	August	β -thalassemia trait with normal Hb A ₂ level due to a concomitant δ -chain Hb variant.

Table 31. HbS Screening Methods Currently in Use in Ontario 2003

Method	No. of Labs
Solubility Methods	
Ortho Sickledex	49
In-house sodium dithionite solubility	18
Mich Clone Sickle Heme/Sickle Cell Reagent Test Kit	6
Nova Century Scientific Sickle Cell Reagent Test	5
Dade Behring Sickle-Sol	2
Other Sickling Methods	
In-house sodium metabisulfite slide-sickling	0

The September Hb fraction quantitation/hemoglobinopathy investigation survey contained a sample from a donor with Hb D Punjab trait with concomitant iron deficiency causing a microcytic blood picture. All 23 laboratories participating reported acceptable results – Hb D trait (18), other hemoglobinopathy (9) or send to a reference laboratory (5). Some laboratories reported multiple correct interpretations. Table 32 shows the various hemoglobinopathy screening methods used in Ontario in 2003. Of note is that 52% of the laboratories in the province now use the BioRad Variant or Variant II HPLC method rather than Hb electrophoresis. HPLC is the method of hemoglobinopathy investigation recommended in the *Good Practice Guidelines for Laboratory Investigation of Hemoglobinopathies* published by QMP-LS in *Laboratory Hematology* in December 2003. The fact that the majority of Ontario laboratories use this technology is encouraging.

Table 32. Hemoglobinopathy Screening Methods in Use in Ontario in 2003

Method	Kit	Manufacturer	No. of Labs
Electrophoresis	Cellulose Acetate	Gelman	1
Electrophoresis	Cellulose Acetate	Helena	1
Electrophoresis	Cellulose Acetate	Sebia	1
Electrophoresis	Cellulose Acetate	Other	1
Electrophoresis	Agarose Gel	Beckman Coulter	1
Electrophoresis	Agarose Gel	Sebia	4
HPLC	Cation Exchange (β -thalassemia short kit)	BioRad	10
HPLC	Cation Exchange (Variant II Hb A ₂ /Hb A _{1c} dual kit)	BioRad	2

The September educational survey involved an unusual case of β -thalassemia trait that was masked by the presence of a δ -chain Hb variant that split the Hb A₂ fraction causing a falsely low Hb A₂ (normal rather than the expected increased level). Performance on this survey was poor with only six laboratories (26%) identifying the most important hemoglobinopathy, i.e. β -thalassemia trait. This poor performance demonstrates the importance of presenting complex hemoglobinopathy problems in this format as an educational tool.

The HbS screening and Hb fraction quantitation/hemoglobinopathy investigation surveys will be conducted with the same frequency in 2004.

DETECTION OF FETAL CELLS

TESTING MODEL

A single survey containing two vials was conducted in 2003. The survey material was to have contained whole blood, obtained from an Rh-negative adult donor, which had been spiked with ABO compatible Rh-positive cord blood to simulate a fetal-maternal hemorrhage (FMH). Due to a manufacturing error, Rh negative cord blood was used for vial 1 resulting in a false negative rosette result for this vial. Laboratories performing rosette screen testing were instructed not to analyze this vial. There were 48 participants in this survey.

LABORATORY PERFORMANCE

The survey included two samples simulating the following case scenarios:

1. A 45-mL FMH where additional RhIg immune prophylaxis would be required with either two 120 μ g doses or one 300 μ g standard post-partum RhIg dose.
2. A 0-mL FMH where additional RhIg immune prophylaxis would not be required.

Table 33 shows the rosette screen test results for survey RCD-0304-FH-2. Table 34 summarizes the quantitative statistics per vial for % fetal cells and mL fetal blood.

Table 33. Rosette Results for RCD-0304-FH-2

Survey Vial	No. of Laboratories	
	Positive	Negative
RCD-0304-FH-2	0	19

Table 34. Statistics for % Fetal Cell Detected and mL Whole Blood Fetal Maternal Hemorrhage Detected in RCD-0304-FH

	Level of Simulated Hemorrhage	Mean	CV (%)	Low Result	High Result
% Fetal Cell Detected					
RCD-0304-FH-1	0.90%	0.99%	27.60	0.05	2.40
RCD-0304-FH-2	0.00%	0.00%	0.00	0.00	0.20
mL Whole Blood Fetal Maternal Hemorrhage Detected					
RCD-0304-FH-1	45 mL	50.0	28.1	0.4	120.0
RCD-0304-FH-2	0 mL	0.0	0.0	0.0	10.0

One significant and five lesser errors were assigned for this survey. This was the first survey where errors were assigned for inadequate Rhlg prophylaxis due to a failure to follow the American Association of Blood Banks' (AABB) and QMP-LS' published recommendations for the administration of Rhlg. QMP-LS' findings on FMH detection and quantitation and its recommendations for Rhlg prophylaxis were published in 2003 as an article in the *American Journal of Clinical Pathology*. An abridged version was published as a letter in eCMAJ, the *Canadian Medical Association Journal*. Results of the 2003 survey continue to corroborate this published data that:

1. The rosette and acid elution techniques are effective screening techniques to identify the presence of an FMH that may require additional Rhlg prophylaxis.
2. The acid elution techniques lack adequate accuracy and precision for the reliable quantitation of FMH.
3. Following the AABB recommendation of adding a 300 µg dose of Rhlg to the dose required for the volume of FMH detected is an effective strategy for overcoming the limitations of the acid elution techniques.

Fetal-maternal hemorrhage detection will continue as a single two-vial survey in 2004.

GLUCOSE-6-PHOSPHATE DEHYDROGENASE (G6PD) DEFICIENCY DETECTION

TESTING MODEL

One survey, RCD-0308-G6, was conducted in August 2003. The survey contained two vials of frozen whole blood. Vial A contained blood from a normal donor and vial B contained blood that had been treated with cellulose to absorb G6PD, making it a deficient sample. Samples were stored and shipped frozen in cryovials creating a hemolysate. Participants were instructed to process the hemolysate as if it were whole blood.

LABORATORY PERFORMANCE

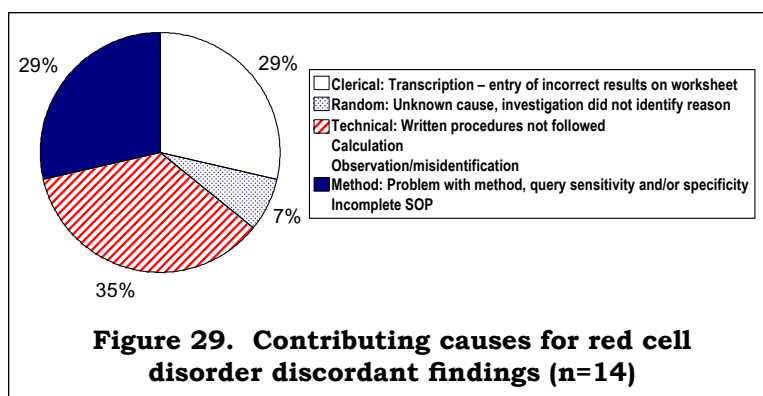
Twenty-seven laboratories reported G6PD results. Of 24 laboratories performing the G6PD screen, 22 reported normal activity on the normal vial. Two laboratories reported deficient activity on this vial. All 24 laboratories reported deficient activity on the deficient vial. All ten laboratories performing the G6PD assay reported normal or near normal activity on the normal vial and deficient activity on the deficient vial.

There continues to be a wide range of reference intervals for the G6PD assay reported in the province with lower and upper limits ranging from 4.6–7.0 U/g Hb to 11.0–20.5 U/g Hb respectively. One laboratory reports its assay results in U/10¹² erythrocytes and has been sent a memorandum suggesting that they consider standardizing their reporting units with the rest of the province.

Performance on this survey was good with only one error reported. A G6PD proficiency survey will be conducted in the fall of 2004.

DISCORDANT FINDINGS

Figure 29 shows the contributing causes of discordant findings for red cell disorder surveys in 2003. Table 35 contains information relating to the number of potential discordant results. It does not indicate the actual number of assigned errors or noted discordant findings.



BONE MARROW EXAMINATION

TESTING MODEL

QMP-LS conducted two bone marrow surveys in 2003. For the March 2003 survey each laboratory received two cases, which had not been previously circulated. Each case included

Table 35. Summary of Discordant Results for Red Cell Disorders

No. of Potential Discordant Results	Type of Discordant Result	No. of Discordant Results	%
354	Clerical	4	1.0
354	Random	1	0.3
354	Technical	5	1.4
354	Method	4	1.0
Total		14	3.7

appropriate clinical and laboratory data, a peripheral blood film and bone marrow material (aspirate and/or biopsy) relevant to the case. The cases used in this survey were a bone marrow submitted for staging of malignant lymphoma and a case of acute myeloid leukemia. Sixty-four laboratories returned their Analysis Worksheets in time, two participants declined to submit and one laboratory returned their Worksheet late but was included in the analyses. A case of megaloblastic anemia in an elderly patient was circulated in the August survey. Sixty-five laboratories responded and two declined to participate. In addition, a Web-based pilot survey utilizing digital images of a case of myelodysplasia was undertaken to assess response to reporting a standardized set of images as opposed to examination of glass slides. The photomicrographs and multiple-choice questions were posted on the QMP-LS Document Server and were available in a controlled (password protected) document through the QMP-LS Web site.

Computer flagging was based only on the clinical interpretation, but the committee considered all aspects of the uniform reporting format. Any laboratory that did not report the reference diagnosis was flagged for review. In addition, any laboratory that reported additional diagnoses, along with the reference interpretation, was also flagged for review. Survey interpretive results that were unexpected were identified as discordant findings. Participant consensus (>80%) of the reference diagnosis was required prior to QMP-LS seeking clarification of discordant findings through correspondence. Participants were asked to review their original slides and to explain the discordance. In the event that less than 80% of participants agreed with the reference diagnosis the survey would be considered educational and no clarification sought.

LABORATORY PERFORMANCE

The overall performance of laboratories in bone marrow evaluation was very good in both the spring and fall surveys. In the March survey (HEMA-0303-BM), 58 of the 65 participating laboratories reported the first case as the reference diagnosis of a normal bone marrow while two reported a diagnosis of lymphoma and were sent memoranda regarding discordant findings. The second case was one of acute myeloid leukemia presenting with a rapid onset of hematuria with generalized petechiae and diffuse bruising. The history emphasized the bleeding complications associated with acute leukemia. Sixty-four of the 65 laboratories reported the reference diagnosis of

acute myeloid leukemia. Four participants suggested a diagnosis of acute promyelocytic leukemia (AML-FAB-M3) in addition to acute myeloid leukemia and one participant reported only acute promyelocytic leukemia. However, the morphological features of this case did not indicate acute promyelocytic leukemia and since the diagnosis of this subtype of acute myeloid leukemia alters the treatment for the patient, this response was regarded as a discordant finding. Although it is likely that confirmatory molecular testing would be performed on these cases, the results may not be available prior to initiating ATRA therapy.

In the August slide-based rotational survey, 54 of the 65 responding participants reported the reference diagnosis of megaloblastic anemia with 23 participants suggesting the possibility of myelodysplasia syndrome (MDS). The Committee Comments discussed the features of both conditions and highlighted the finding that marked elevations in the MCV, as present in this case, are more often associated with the diagnosis of megaloblastic anemia. MDS was considered an acceptable diagnosis to “exclude” in this case and in this age group. Participants receiving correspondence noting a discordant finding only reported an interpretation of MDS and did not include vitamin B₁₂ and folate testing as part of a follow-up or further investigation.

The responses to the Web-based pilot survey HEMA-0308-BM indicated several technical difficulties associated with accessing the photomicrographs of the peripheral blood and the bone marrow aspirate. Feedback from participants was mixed; although some noted this type of survey was a good model, the quality of stain/colour could be improved. Others noted this was a good educational tool but resolution may be affected by quality of monitor. Many felt the images were not crisp and affected the ability to interpret the findings.

Performance on the interpretation of the photomicrographs was excellent with nearly all of the multiple-choice questions being answered correctly.

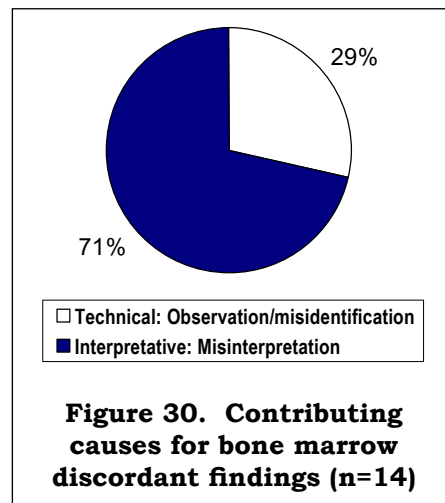
The committee is still faced with the problem of acquiring suitable bone marrow material for the 2004 slide-based rotational surveys. Participants are requested to submit interesting cases to QMP-LS and should contact QMP-LS to find out whether the case would be suitable for proficiency testing. At least 24 well-made, stained and coverslipped peripheral blood and bone marrow aspirate and/or biopsy preparations are required.

DISCORDANT FINDINGS

Figure 30 shows the contributing causes of discordant findings for bone marrow surveys. Table 36 contains information relating to the number of potential discordant results. It does not indicate the actual number of assigned errors or noted discordant findings.

Table 36. Summary of Discordant Results for Bone Marrow

No. of Potential Discordant Results	Type of Discordant Result	No. of Discordant Results	%
195	Technical	4	2.1
195	Interpretative	10	5.1
Total		14	7.2



FLOW CYTOMETRY

TESTING MODEL

Two wet surveys were conducted in 2003, each consisting of samples of whole blood for HIV investigation and samples accompanied by blood films for the investigation of neoplastic hematologic disorders. Samples for

CD34+ progenitor cell enumeration were also distributed. Testing material is sent by overnight courier to allow participating laboratories to conduct their analyses within three days of distribution. Results are submitted on the computer-compatible reporting form that also allows limited textual comment. The reporting form for the hematologic neoplasm investigation allows correlation of blood film morphology with analytical results for diagnostic interpretation. Laboratories are also required to submit sample preparation data, all light scatter and fluorescence histograms and laboratory-generated reports. In November 2003, a CD-ROM dry challenge for hematological malignancies was conducted. This allowed participants to review listmode data using their own computer analysis programs and also to review a case history and digital slides from the case. Results from the dry challenge were posted on the QMP-LS Web site, and significantly more information was made available to enhance the educational aspects of the survey.

LABORATORY PERFORMANCE

Lymphocyte Immunophenotyping for HIV

Samples from HIV positive donors were distributed to 21 participants, 17 Ontario and 4 out of province. All laboratories utilized CD45 as gating agent. A number of laboratories reported correcting the lymphocyte percentage for purity while using CD45 as gating agent. Correcting for lymphocyte purity along with CD45 gating may result in falsely elevated results. The majority of laboratories used dual platform analysis, but the number of laboratories that used single platform analysis has gradually increased from two in March 1999 to eight in the September 2003 survey. All laboratories now use 3- or 4-colour combinations. The majority used 4-colour combinations. The number of laboratories that used 4-colour combinations has risen from two in 1995 to 18 in 2003. Surveys for HIV testing have been conducted since 1995 and the performance is summarized in Table 37. There were no significant errors in 2003 but one lesser error was assessed in the September survey. The low error rate observed for the last two years highlights the consistency with which this test is now performed. Absolute CD4 counts are key in therapeutic decision making for patients with HIV and the reliability of the results from this quality assurance activity is encouraging.

Table 37. Performance on 1995-2003 Surveys, Lymphocyte Phenotyping for HIV Investigation

Survey Vial	Reference Result	Lesser Errors	Significant Errors	Error Rate %*
H-9509-FC	Normal	0	0	0
H-9603-FC-A	Normal	3	1	22.2
H-9603-FC-B	HIV	8	2	27.8
H-9703-FC-A	HIV	1	2	15.0
H-9803-FC-A	HIV	1	0	14.3
H-9808-FC-A	HIV	0	0	0
H-9903-FC-A	Normal	0	0	0
H-9908-FC-A	HIV	1	0	5.3
H-0003-FC-A	HIV	2	0	11.1
H-0008-FC-A	HIV	2	0	11.1
H-0103-FC-A	Normal	5	0	26.3
H-0108-FC-A	HIV	1	0	4.8
FLOW-0203-HV	HIV	0	0	0
FLOW-0208-HV	Normal	0	0	0
FLOW-0303-HV	HIV	0	0	0
FLOW-0309-HV	HIV	1	0	4.8

* Error Rate % = Number of errors × 100/Number of Laboratories

Leukocyte Phenotyping for Neoplastic Hematological Disorders

Two clinical cases were distributed (March and September) to 26 participants (14 Ontario and 12 out of province). Participants were expected to include the following in their submissions:

- Blood film morphology
- Flow cytometry analysis results and histograms
- Interpretation of results
- Laboratory-generated reports showing interpretation of results.

The first sample was from a patient with hairy cell leukemia (HCL) and large granular lymphocyte (LGL) disorder. Due to the complexity of the case the committee designated the survey as an educational challenge and no errors were assessed. Important information was gathered from this study. Just over two thirds of the participants

identified the monoclonal B cell population characterizing HCL. This highlights the need for increased awareness of approaches to identifying small populations of malignant cells. Further studies will attempt to address similar types of cases or those with minimal residual disease following therapy for acute leukemia.

The second sample was acute lymphoblastic leukemia (ALL), CALLA positive B lineage. All participants performed well on this survey. One lesser error was assessed for failure to submit the required blood film morphology. Correspondence was sent to the laboratories that failed to submit the internally generated laboratory reports recording their results, the requested histograms as well as the required blood film morphology.

CD-ROM Dry Challenge

This was a case of follicular cell lymphoma. Ninety-four per cent of laboratories correctly identified the case as either a follicular lymphoma or other lymphoproliferative disorder, not specified. There was one discordant finding for reporting the case as mantle cell lymphoma. Confirmatory results were made available to participants through the QMP-LS Web site. Several participants had difficulty accessing the files, even with the explicit instructions provided. QMP-LS will look into providing better access to the data for subsequent surveys. Use of electronic data (as compared to fresh samples) allows greater opportunity to expose participants to rare and unusual cases. The subsequent feedback from a reference laboratory analyzing the same set of listmode files adds value to the educational aspect of the survey,

CD34 Analysis

Two surveys were conducted in 2003, each consisting of commercial fixed whole blood and diluted apheresis samples. There were fourteen participants for both surveys, half were out of province. Over two-thirds of laboratories are performing single platform analysis and almost all are using the ISHAGE gating strategy. The average of the coefficient of variation (CV) was approximately 20%, not unexpected for this rare event analysis. Errors were assessed for calculation errors, where the laboratory failed to include the dilution factor in their calculations for the apheresis samples. Correspondence was sent to laboratories that misgated the samples, one by setting the forward angle light scatter threshold too high, excluding dim CD45+ cells, and the other by excluding CD34+ cells with low forward angle light scatter from the analysis gate. A focus of the 2004 survey year will be to monitor the incorporation of a viability dye into the analysis, a requirement of OLA guidelines for products that are not tested immediately.

COAGULATION

TESTING MODEL

Two coagulation challenge surveys and a patterns-of-practice survey were conducted in 2003. Testing materials were chosen to represent a variable, but clinically meaningful, range of results. Prothrombin time/International Normalized Ratio (PT/INR) testing was monitored using lyophilized coumadinized plasmas supplied by Thrombosis Reference Centre, Manchester, UK. The activated partial thromboplastin time (APTT) lyophilized survey material consisted of normal control plasma and heparinized control plasma supplied by bioMerieux Canada, Inc., Saint-Laurent, Quebec. Affinity Biologicals Inc., Hamilton, Ontario provided lyophilized plasma for APTT testing that was spiked with unfractionated heparin giving an anti-Xa activity of 0.30 U/mL. In addition, Affinity Biologicals Inc. supplied QMP-LS with lyophilized immuno-depleted factor VIII and IX samples for factor assay testing. In June, a patterns-of-practice survey concerning the investigation of platelet function and thrombophilia disorders was distributed. One aim of this survey was to determine current practices regarding thrombophilia testing in the province. This information was used to identify participants performing hypercoagulable screening tests. In September, these participants received two frozen plasma samples for thrombophilia investigation. One of these samples was from a triply heterozygous patient (heterozygous for factor V Leiden, the prothrombin gene mutation, and the thermolabile MTHFR mutation). Hamilton Regional Laboratory Medical Program provided these samples.

Flagging rules, utilized to bring laboratory results to the attention of the committee for review, are noted in Table 38.

LABORATORY PERFORMANCE

PT/INR

Routine surveys were distributed in February (COAG-0302) and September (COAG-0309). In the final survey, it was noted that the previously identified survey material matrix effect reported by participants using IL Test PT/Fibrinogen recombinant reagent and an ACL coagulation instrument had resurfaced after a brief disappearance, necessitating users of this reagent/instrumentation combination to be evaluated against their reagent group peers, rather than the all-methods' mean.

Laboratories that performed PT/INR testing using lyophilized coumadinized plasmas (Table 39) were assessed three significant errors on the two surveys. The committee is pleased with the laboratory performance with respect to INR testing in 2003 as the number of errors continues to be low.

Progress continues towards the committee's goal of having all laboratories establish and validate their normal reference interval for INR testing. Since the INR system was designed to compensate for variability in the PT, the committee is no longer analyzing, flagging or assessing errors based on PT results. Rather, the committee will only examine PT results in cases where the INR is clearly incorrect. In 2004, the committee will continue to monitor INR testing by reviewing and requesting clarification in instances where normal or therapeutic INR reference intervals are suspect; errors may be assessed if the normal ranges appear grossly inappropriate and cannot be justified. Also, the committee will continue to request that laboratories determine the effect new reagent lot numbers, reagent suppliers or new instrumentation will have on their INR reference intervals.

Table 38. Coagulation Flagging Limits Used in 2003

Tests	Deviation Allowed From Mean (%)
INR	20% of all-methods' mean*
APTT	20% of reagent mean
Factor VIII and IX Assays	20% of all-methods' mean

* Until further notice, participants using IL Test PT/Fibrinogen Recombinant reagent and an ACL coagulation instrument will be evaluated against their peers

Table 39. INR Target Values, All-Methods' Mean and Minimum and Maximum Results

Vial	Material	Target INR	All-Methods' Mean	Min. and Max. Result
Survey COAG-0302				
A	Coumadinized plasma	3.5	3.3	2.4-4.5
B	Coumadinized plasma	3.5	3.3	2.4-4.6
Survey COAG-0309				
A	Coumadinized plasma	2.7	2.7	2.1-4.7
B	INR calibrated plasma	0.99	1.1	0.9-1.3

APTT

APTT testing was included in the February (COAG-0302) and September (COAG-0309) surveys. A total of one significant and 14 lesser errors were assessed on the two surveys. Three vials, in two surveys, used heparinized lyophilized samples to assess the quality of heparin monitoring in the province. APTT testing remains good, and the committee has no specific comments concerning routine APTT monitoring except the continued recommendation that laboratories (a) review their reference intervals, (b) ensure that their reference intervals have been validated, and (c) re-confirm their reference intervals when instrumentation or reagents are changed.

Factor VIII and IX

In the February survey (COAG-0302-FA) coagulation factor analysis was carried out on immuno-depleted factor VIII and IX samples. Four significant errors were assessed. A total of 21 laboratories are licensed to perform factor assays. Coagulation factor assays were routinely well performed and the committee does not have any concerns with

coagulation factor testing in the province. Proficiency with coagulation factor assays will be assessed with similar assays in 2004. Since the laboratories performing this testing appear to be very proficient at detecting severe and moderate coagulation factor deficiencies, we will begin to test for wider ranges of coagulation factor results in 2004.

D-dimer

D-dimer testing remains problematic due to difficulties in procuring suitable EQA survey material. In 2004, we will undertake a pilot challenge survey using pooled human samples prepared by the United Kingdom National External Quality Assessment Service (UK NEQAS) for Blood Coagulation. This should overcome some of the limitations identified with the use of pure D-dimer spiked into plasma used in our previous 2002 pilot survey.

Thrombophilia

The September (COAG-0309-TH) survey included two samples for thrombophilia testing. Samples were sent to laboratories performing one or more of the following tests: antithrombin, protein C, protein S, activated protein C resistance, and DNA analysis for factor V Leiden and prothrombin gene mutation. One of the samples distributed was obtained from a triply compound heterozygous patient.

Thrombophilia testing in Ontario was uniformly performed perhaps due to the fact this type of testing is confined to referral laboratories.

Heparin Assay

In February 2004 the routine coagulation survey will include a sample for heparin assay testing.

DISCORDANT FINDINGS

Figure 31 shows the contributing causes for discordant findings for coagulation surveys. Table 40 contains information relating to the number of potential discordant results. It does not indicate the actual number of assigned errors or the noted discordant findings.

MORPHOLOGY

TESTING MODEL

In 2003, four routine surveys (February, April, August and November) and one educational survey were conducted. The August morphology survey included an educational blood film that was distributed to enhance the laboratories' hematology blood film collection. To reflect current practice, the referral of survey blood films for the purpose of examination and/or confirmation, interpretation and reporting was allowed if a patient's blood film of similar complexity would normally be referred out. The Hematology Committee evaluates laboratory performance by comparing the participant's results to reference results and scoring rules as defined by

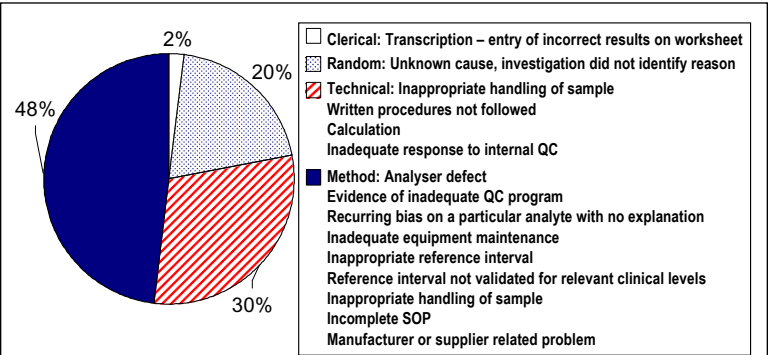


Figure 31. Contributing causes for coagulation discordant findings (n=50)

Table 40. Summary of Discordant Results for Coagulation

No. of Potential Discordant Results	Type of Discordant Result	No. of Discordant Results	%
1637	Clerical	1	0.1
1637	Technical	15	0.9
1637	Method	24	1.5
1637	Random	10	0.6
Total		50	3.1

designated referees. The reference results and the final scoring rules on a survey reflect the majority or consensus (>80%) of participant's results. Each flagged result is classified as no error, lesser descriptive error, significant descriptive error or a discordant finding. Discordant findings are noted if the clinical relevance statement reported would have the potential to lead to clinical decisions that may be harmful to the patient.

LABORATORY PERFORMANCE

Survey MORP-0302

This blood film was obtained from a 47-year-old male presenting with jaundice and splenomegaly diagnosed with hereditary spherocytosis (HS). The blood film showed numerous spherocytes and increased polychromasia. The possibility of immune hemolysis could not be excluded and both or either diagnosis was considered an acceptable clinical relevance statement. The ancillary data indicated a pre-incubated mean cell osmotic fragility of 0.52 g/dL (normal 0.43). The results were excellent with 100% of laboratories correctly identifying the presence of diagnostic morphological features and all participants reporting hereditary spherocytosis and/or immune hemolysis as possible diagnoses.

Survey MORP-0305

This blood film was from a patient with hemoglobin H (HbH) disease. The main feature in this case was the presence of microcytosis, hypochromia and target cells. The results were excellent with 100% of laboratories correctly identifying the presence of these features. The ancillary data included Hb A₂ of 0.019 and the presence of numerous Hb H bodies. The hemoglobin gene sequencing report indicated a compound heterozygous for the Southeast Asian α -thalassemia 1 deletion and the rightward single α -gene deletion, consistent with Hb H disease.

Survey MORP-0308

The blood film distributed to participants was typical of Hb S disease and an excellent example of sickling conditions with the main feature in this case being the presence of sickle cells, nucleated erythrocytes and target cells. All participants described the salient feature of sickle cells and all but one laboratory indicated a "Hemoglobin S condition" as the clinical relevance statement.

Survey MORP-0308-E

This was an interesting case of *Babesia* blood parasite and was included as an educational slide to illustrate a rare parasitic infection.

Survey MORP-0311

This case was obtained from a 2-year-old male with acute leukemia and/or peripheralizing lymphoma. The clinical data indicated the child presented with a three-week history of fatigue, weakness and sore throat. Further investigative reports, not distributed to participants, noted that the flow cytometry report indicated that approximately 97% of total leukocyte count expressed a dim CD45, CD19/CD10, CD34, dim CD13, cCD79a positive.

The blood film demonstrated the presence of pancytopenia (anemia with neutropenia and thrombocytopenia) and greater than 20% blasts. Ninety-seven per cent of laboratories correctly identified the presence of blasts or lymphoma cells.

Over-reporting

The committee continues to be concerned with over-reporting of descriptive and clinical relevance statements. On one survey a laboratory described no less than 12 erythrocyte descriptive statements and another laboratory included 10 clinical relevance statements. Even though the expected results were included in these reports, the over-reporting of descriptive morphology and clinical relevance statements can be clinically misleading and detract

from emphasis on more likely clinical considerations. The committee will continue to work on improving the morphology Analysis Worksheet to try and reduce the over-reporting phenomena.

DISCORDANT FINDINGS

Figure 32 shows the contributing causes for discordant findings for morphology surveys. Table 41 contains information relating to the number of potential discordant results. It does not indicate the actual number of assigned errors or noted discordant findings.

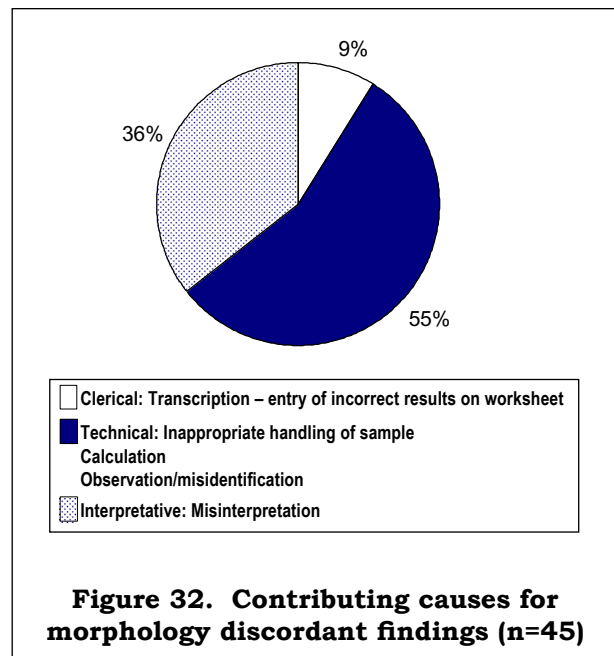


Table 41. Summary of Discordant Results for Morphology

No. of Potential Discordant Results	Type of Discordant Result	No. of Discordant Results	%
1666	Clerical	4	0.2
833	Technical	25	3.0
833	Interpretative	16	1.9
Total		45	5.1

TRANSFUSION MEDICINE

TESTING MODEL

Four wet surveys were conducted in 2003 (Table 42). As in previous years, challenges were based on the laboratory licence, using two sets of material from different sources:

- Set A is procured mostly from a U.S. supplier and is distributed to laboratories with licences that include antibody identification. The number of participants in this category ranged from 92–94.
- Set B is procured from a Canadian supplier and is distributed to laboratories with licences that include antibody detection, but not identification. The number of participants in this category ranged from 82–83.

This tiered approach continues to provide an appropriate level of challenge to all laboratories, while permitting cost containment.

Routine assessment of all participants includes ABO and Rh grouping, antibody detection, direct antiglobulin testing and crossmatching.

Set A participants were challenged with:

- A variety of ABO and Rh groups for typing and interpretation.
- ABO and Rh grouping anomalies/mixed-field interpretation.
- Detection and identification of multiple antibodies and performance of crossmatch.
- Samples consistent with a delayed hemolytic transfusion reaction.
- Samples for maternal antibody and umbilical cord testing.

Set A participants completed three questionnaires:

- Policies for investigation and management of delayed hemolytic transfusion reactions.
- Policies for testing of maternal/fetal blood samples.
- Policies for antibody identification.

Set B participants were challenged with:

- A variety of ABO and Rh groups for typing and interpretation.
- ABO and Rh grouping anomalies/mixed-field interpretation.

Table 42. Samples Distributed in 2003

Set A		Set B	
TMED-0303-1	60% O Rh Negative, 40% O Rh Positive	TMED-0303-7	75% A Rh Positive, 25% O Rh Positive
TMED-0303-2	50% Ab Rh Positive, 50% B Rh Positive	TMED-0303-8	B Rh Positive, weak anti-A
TMED-0303-3	B Rh Positive, weak anti-A	TMED-0303-9	50% Ab Rh Positive, 50% B Rh Positive
TMED-0303-4	75% A Rh Positive, 25% O Rh Positive	TMED-0303-10	60% O Rh Negative, 40% O Rh Positive
TMED-0305-1	O Rh Positive, DAT Positive, anti-Jka	TMED-0305-7	A Rh Positive
TMED-0305-2	O Rh Positive, Jk(a-)	TMED-0305-8	O Rh Positive, antibody present
TMED-0305-3	O Rh Positive, Jk(a-) donor unit	TMED-0305-9	A Rh Negative, antibody present
TMED-0305-4	O Rh Positive, Jk(a+) donor unit	TMED-0305-10	O Rh Positive, donor unit
TMED-0308-1	O Rh Negative, anti-K	TMED-0308-7	B Rh Negative, antibody present
TMED-0308-2	O Rh Positive, K-	TMED-0308-8	AB Rh Positive
TMED-0308-3	O Rh Positive, weak D	TMED-0308-9	O Rh Positive
TMED-0308-4	A Rh Positive, DAT positive	TMED-0308-10	A Rh Positive, DAT Positive
TMED-0311-1	O Rh Positive	TMED-0311-7	O Rh Positive, antibody present
TMED-0311-2	O Rh Positive, anti-K and anti-Fya	TMED-0311-8	B Rh Positive
TMED-0311-3	O Rh Negative, K- Fy(a-), donor unit	TMED-0311-9	A Rh Positive, antibody present
TMED-0311-4	O Rh Positive, K- Fy(a+), donor unit	TMED-0311-10	O Rh Negative

- Detection of multiple antibodies and performance of crossmatch.
- Performance of direct antiglobulin test (DAT).
- Samples for maternal antibody and umbilical cord testing.

Set B participants completed one questionnaire:

- Policies for testing of maternal/fetal blood samples.

ASSESSMENT OF RESULTS

Scenarios were representative of those commonly encountered in transfusion medicine laboratories, but were designed to be challenging. Clinical information and testing directions were provided for each survey.

The committee's assessment of errors for 2003 is displayed in Tables 43 and 44, and the five-year review of errors is displayed in Table 45. The total number of significant errors is much lower than last year (25 in 2002 compared to 9 in 2003). Significant errors for 2003 decreased for both Set A (11 in 2002 to 5 in 2003) and Set B participants (15 in 2002 to 4 in 2003). However, there was a marked increase in lesser errors for both Set A and Set B (100 for Set A and 140 for Set B in 2003, for a total of 240 lesser errors for both sets in 2003 compared to 66 in 2002). This is almost

Table 43. Committee Assessment of Errors for 2003 Surveys, Set A Only

Error Type	TMED-0303		TMED-0305		TMED-0308		TMED-0311		Total 2003	
	Significant	Lesser	Significant	Lesser	Significant	Lesser	Significant	Lesser	Significant	Lesser
ABO	0	35	0	0	1	0	0	1	1	36
Rh	0	30	0	12	0	8	0	1	0	51
DAT	0	1	0	0	0	1	0	1	0	3
Ab Detection	0	0	0	0	0	0	0	0	0	0
Ab Identification	0	0	0	0	0	0	2	0	2	0
Phenotype	0	0	0	5	0	1	0	0	0	6
Crossmatch	0	0	1	3	0	0	1	1	2	4
Total	0	66	1	20	1	10	3	4	5	100

Table 44. Committee Assessment of Errors for 2003 Surveys, Set B Only

Error Type	TMED-0303		TMED-0305		TMED-0308		TMED-0311		Total 2003	
	Significant	Lesser	Significant	Lesser	Significant	Lesser	Significant	Lesser	Significant	Lesser
ABO	0	85	0	0	1	0	0	0	1	85
Rh	2	39	0	3	0	0	0	0	2	42
DAT	1	4	0	0	0	3	0	4	1	11
Ab Detection	0	0	0	1	0	0	0	0	0	1
Phenotype	0	0	0	0	0	0	0	0	0	0
Crossmatch	0	0	0	1	0	0	0	0	0	1
Total	3	128	0	5	1	3	0	4	4	140

Table 45. Committee Assessment of Errors, 1999–2003

Error Type	1999		2000		2001		2002		2003	
	Significant	Lesser	Significant	Lesser	Significant	Lesser	Significant	Lesser	Significant	Lesser
ABO	0	6	3	45	1	43	7	14	2	121
Rh	1	4	2	66	0	57	2	18	2	93
DAT	0	8	0	6	4	11	0	6	1	14
Ab Detection	5	5	3	13	4	21	6	13	0	1
Ab Identification	13	1	5	3	1	3	1	2	2	0
Phenotype	0	11	0	0	0	17	0	12	0	6
Crossmatch	2	1	8	0	4	2	9	1	2	5
Total	21	36	21	133	14	154	25	66	9	240

entirely due to the inclusion of a mixed-field survey in 2003; none was provided in 2002 and this type of survey in the past has typically resulted in a large number of lesser errors due to failure to detect a mixed-field reaction.

Table 46 provides a summary of mixed-field detection since 1997 to 2003 on ABO samples with a 50/50 mix. Committee Comments have emphasized the importance of detecting mixed-field reactions in several previous surveys and provided suggestions for testing for and interpreting these reactions. While there appeared to be an improvement in performance for all laboratories after the initial mixed-field survey in 1997, and this was maintained for Set A participants (87% detection rate for 2003), the committee was concerned with 59% detection rate for Set B participants in 2003. Again, suggestions for performance improvement were provided.

ABO and Rh

The marked increase in lesser errors in ABO grouping (121 in 2003, compared to 14 in 2002 for Set A) and Rh typing (93 in 2003, compared to 18 in 2002 for Set B) is mainly due to poor performance in detection of mixed-field reactions, as discussed previously. There were, however, only four significant errors in ABO and Rh grouping in 2003. Laboratory assessment of the contributing causes of errors in the detection of mixed-field reactions is summarized in Figure 33.

Direct Antiglobulin Testing

One significant and 14 lesser errors were assigned for DAT performance in 2003 compared to no significant and six lesser errors in 2002. Our expectations for complete differential DAT testing (anti-IgG and anti-C3) have increased and lesser errors will be assigned more consistently for failure to comply.

Antibody Detection and Identification

There were no significant errors in antibody detection and 2 in antibody identification in 2003 compared to 6 antibody detection and 1 antibody identification errors in 2002. One lesser error in antibody detection in 2003 compared favourably with 13 in 2002, and there were no lesser errors in antibody identification in 2003 compared to two in 2002. The committee was supportive of this improvement in performance.

Phenotyping

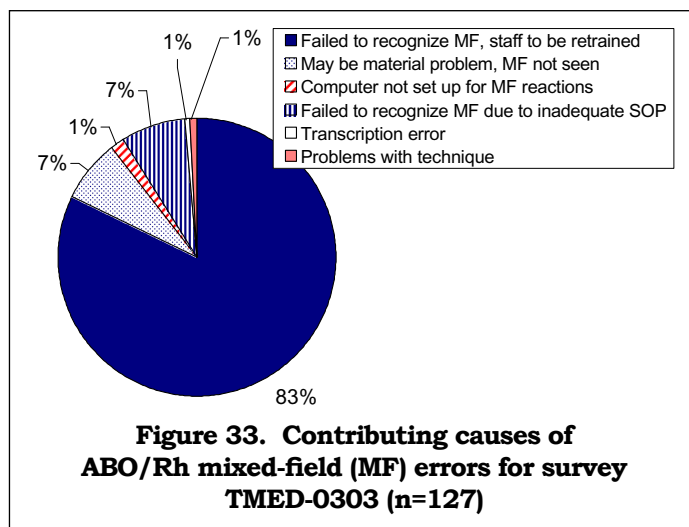
There were no significant errors in either 2003 or 2002 in phenotyping performance and six lesser errors in 2003 compared to 12 in 2002.

Crossmatching

Two significant and 5 lesser crossmatch errors were assessed in 2003 compared to 9 significant and 1 lesser error in 2002.

Table 46. Participants Detecting Mixed-Field Reactions in Survey I-9703-2, I-0008, I-0109 and TMED-0303

Vial		ABO (MF)	50/50 Mix
		No. Detected Mixed Field	Total No. of Laboratories
I-9703-2	69	79	114
I-0008-3	96	94	98
I-0109-2	81	77	95
TMED-0303-2 Set A	87	82	94
TMED-0303-9 Set B	59	48	82



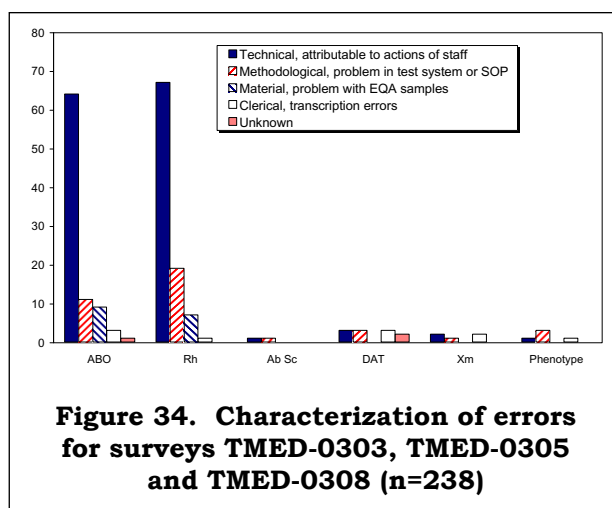
CHARACTERIZATION OF ERRORS

The contributing causes of errors in transfusion medicine testing, as assessed by the laboratories, are characterized and shown in Figure 34.

CORRECTIVE ACTIONS

Extensive analysis and discussion appeared in Committee Comments during 2003 for the following:

- Recognition, interpretation and significance of mixed-field reactions on ABO and Rh testing.
- Investigation of a delayed hemolytic transfusion reaction.
- Requirements for perinatal maternal/umbilical cord blood testing.
- Requirements for differential testing of positive DAT.
- Need for clear procedures for exclusion and confirmation of suspected antibodies and clarification of crossmatch techniques.



FUTURE ACTIVITIES

- BROADSHEETS on ABO and Rh testing are being finalized and will be distributed in 2004.
- An automation pilot study was successfully completed in 2003 and will permit routine assessment of automated laboratories in the future.
- A more formal scoring system will be developed for assessing transfusion medicine surveys in the future.

Testing Material Suppliers

Hematology-Routine

Hamilton Regional Laboratory Medicine Program,
Hamilton, Ontario
R&D Systems, Inc., Minneapolis, Minnesota

Hematology-Red Cell Disorders

Hamilton Regional Laboratory Medicine Program,
Hamilton, Ontario

Hematology-Flow Cytometry

Hamilton Regional Laboratory Medicine Program,
Hamilton, Ontario
London Health Sciences Centre, London, Ontario
R&D Systems, Inc., Minneapolis, Minnesota

Coagulation

Affinity Biochemicals Inc., Ancaster, Ontario
Hamilton Regional Laboratory Medicine Program,
Hamilton, Ontario
bioMerieux Canada, Inc., Saint-Laurent, Quebec
Thrombosis Reference Centre, Manchester, UK
Morphology and Hematology-Bone Marrow
Various laboratories throughout the province

Transfusion Medicine

Gamma Biologicals, Inc., Houston, Texas
London Health Sciences Centre, University Campus/
Canadian Blood Services, London, Ontario

Reference Laboratories

Hamilton Regional Laboratory Medicine Program,
Hamilton, Ontario

The Credit Valley Hospital, Mississauga, Ontario
Sunnybrook and Women's College Health Sciences
Centre, Toronto, Ontario
London Health Sciences Centre, London, Ontario
Alberta Inter-provincial Quality Assessment

The Credit Valley Hospital, Mississauga, Ontario
Royal Victoria Hospital, Barrie, Ontario
Sunnybrook and Women's College Health Sciences
Centre, Toronto, Ontario

MICROBIOLOGY DISCIPLINES

BACTERIOLOGY

TESTING MODEL

Table 47 shows an overview of the 2003 testing model. Fifteen samples were distributed for isolation and identification of clinically significant microorganisms. Antimicrobial susceptibility testing was appropriate for ten of the organisms in these specimens. Eleven cultures were lyophilized and four were simulated “fresh” specimens.

Table 47. 2003 Bacteriology Surveys

BACT-0303	4 lyophilized cultures
BACT-0303-GM	1 smear for Gram staining
BACT-0303-AF	1 smear for acid-fast bacilli (AFB) staining
BACT-0306	2 lyophilized cultures
	2 “fresh” simulated blood culture specimens
BACT-0306-GM	1 smear for Gram staining
BACT-0309	3 lyophilized cultures
	1 “fresh” simulated blood culture specimen
BACT-0309-GM	1 smear for Gram staining
BACT-0309-AF	1 smear for acid-fast bacilli (AFB) staining
BACT-0311	2 lyophilized cultures
	1 “fresh” simulated faecal specimen

Three of the challenges contained a mixture of organisms:

- post-C-section wound swab, with *Streptococcus pyogenes* and small numbers of *Staphylococcus warneri* (BACT-0303-4);
- “fresh” simulated faecal specimen with non-sorbitol fermenting *Escherichia coli*, serotype O75:H55, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Candida albicans* and *Enterococcus faecalis* (BACT-0311-2);
- liver abscess aspirate with *Bacteroides fragilis*, *Clostridium novyi* and *Enterococcus faecium* (BACT-0311-3).

Three unstained smears for Gram staining and interpretation were distributed to laboratories licensed for either bacteriology or Gram stain and two unstained smears for detection of acid-fast bacilli (AFB) were sent to those laboratories licensed to perform this testing.

SURVEY ASSESSMENT

Participants’ results for identification, antimicrobial susceptibility testing, Gram stain interpretation and AFB detection were assessed against the consensus results determined by eight reference laboratories. Results were flagged when they did not agree with the reference results or when an antimicrobial agent was reported that was not appropriate for the specific organism or putative site in the clinical data provided, and starting in 2003, for not reporting the antibiotic of choice. Errors were assessed according to the potential impact a similar error would have on patient care, with a significant error assigned for results that were considered potentially clinically misleading.

LABORATORY PERFORMANCE

Isolation and Identification

Performance in isolation and identification is shown in Table 48. Excellent performance was achieved by a significant proportion of laboratories for all but the following challenges:

- *Staphylococcus aureus* CMRSA-5 (Canadian epidemic methicillin-resistant *S. aureus* Type 5 strain [BACT-0303-1]). Only 85% (81/95) of laboratories identified this isolate as *S. aureus*, in contrast to 100% for BACT-0311-1.

Bacteriology

No. of Participants (Dec. 2003).....	114 *
No. of Participants (Dec. 2002)	118 *
No. of Surveys Conducted in 2003	9

Mycology

No. of Participants (Dec. 2003).....	23
No. of Participants (Dec. 2002).....	24
No. of Surveys Conducted in 2003	2

* Includes laboratories licensed for Gram stain only

Parasitology

No. of Participants (Dec. 2003).....	25
No. of Participants (Dec. 2002).....	26
No. of Surveys Conducted in 2003	2

Virology

No. of Participants (Dec. 2003).....	74
No. of Participants (Dec. 2002).....	75
No. of Surveys Conducted in 2003	13

This organism was difficult to identify because the tube coagulase test, which has been considered the “gold standard” for identification of *S. aureus*, gave variable results with 38% of laboratories that performed this test reporting a negative result. The standard tube coagulase is no longer reliable for the identification of certain strains of MRSA, including CMRSA-5. Commercial agglutination tests gave more consistent positive results for this particular strain. Laboratories were advised to undertake further investigations if there was a discrepancy in results between the commercial slide agglutination test and the tube coagulase test.

- *Cryptococcus neoformans* (BACT-0303-2). Approximately one-half (47/95) of laboratories identified this organism to species level and 64% to genus level. Performance with this organism has declined significantly since 1994 when 69% of laboratories were able to identify *C. neoformans* to species level and 80% to genus level.
- *Propionibacterium acnes* (BACT-0306-2). Only 44% (42/95) of laboratories identified this isolate to species level and 49% to genus level. Considering that *P. acnes* is a common contaminant in blood cultures and other fluids obtained through the skin, most laboratories should be able to identify this organism to species level by observing typical Gram stain and colonial morphology and performing basic biochemical tests (indole, catalase, nitrate).
- *Actinobacillus actinomycetemcomitans* (BACT0309-1). Although only 49% (46/94) of laboratories identified this organism to genus level, this performance was considered very good since this was the first time that *A. actinomycetemcomitans* has been used as a challenge in a QMP-LS survey and it is infrequently encountered in clinical specimens.
- *Ralstonia pickettii* (BACT-0309-3). The 56% (55/99) of laboratories that correctly identified this infrequently encountered non-fermenting Gram-negative bacillus used a commercial identification system, which generally performed well. However, laboratories were cautioned about the limitation of commercial identification systems when identifying isolates from the respiratory tract of cystic fibrosis patients, as it is not uncommon for a member of the *Burkholderia cepacia* complex to be misidentified as *R. pickettii*. In this setting, it was recommended that isolates, identified as *R. pickettii*, be referred to a reference laboratory for confirmation.

Table 48. Organisms Distributed in 2003 and Performance in Identification

Survey	No. of Laboratories Reporting	Organism	% Correct* Identification (Excellent)	% Partial† Identification (Acceptable)	% Incorrect‡ Identification (Unacceptable)
BACT-0303-1	95	<i>Staphylococcus aureus</i>	85.3	7.4	7.4
BACT-0303-2	95	<i>Cryptococcus neoformans</i>	49.5	50.5	0.0
BACT-0303-3	95	<i>Proteus mirabilis</i>	100.0	0.0	0.0
BACT-0303-4§	95	<i>Streptococcus pyogenes</i>	100.0	0.0	0.0
BACT-0306-1	95	<i>Pseudomonas aeruginosa</i>	100.0	0.0	0.0
BACT-0306-2	95	<i>Propionibacterium acnes</i>	44.2	52.6	3.2
BACT-0306-3	100	<i>Salmonella typhimurium</i>	1.0	97.0	2.0
BACT-0306-4	100	No microorganisms present	99.0	1.0	0.0
BACT-0309-1	94	<i>Actinobacillus actinomycetemcomitans</i>	46.8	50.0	3.2
BACT-0309-2	94	<i>Escherichia coli</i>	98.9	0.0	1.1
BACT-0309-3	99	<i>Ralstonia pickettii</i>	55.6	37.3	7.1
BACT-0309-4	94	<i>Staphylococcus haemolyticus</i>	41.5	58.5	0.0
BACT-0311-1	93	<i>Staphylococcus aureus</i>	100.0	0.0	0.0
BACT-0311-2	102	No <i>Salmonella</i> , <i>Shigella</i> , <i>Campylobacter</i> , <i>Yersinia enterocolitica</i> or <i>E. coli</i> O157:H7	82.4	15.7	1.9
BACT-0311-3A#	93	<i>Bacteroides fragilis</i>	41.9	53.8	4.3
BACT-0311-3B#	93	<i>Clostridium novyi</i>	5.4	74.2	20.4
BACT-0311-3C#	93	<i>Enterococcus faecium</i>	73.1	21.5	5.4

* Identified correctly to species level

† Identified to genus level (without naming a species) or to correct Gram stain characteristics (e.g. Gram positive bacillus)

‡ Identified incorrectly

§ Mixed with small numbers of *Staphylococcus warneri* (wound swab, post-C-section)

|| “Fresh” simulated blood culture specimen

¶ “Fresh” simulated faecal specimen with normal faecal flora (non-sorbitol fermenting *E. coli*, serotype O75:H55, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Candida albicans*, *Enterococcus faecalis*)

Mixed culture (aspirate, liver abscess)

- *Bacteroides fragilis* (BACT-0311-3A). Forty-two per cent (39/93) of laboratories identified *B. fragilis* to species level and 29% reported “*Bacteroides fragilis* group.” Performance with this organism was significantly better than that in 1999, but has declined since 1986 when approximately 92% of participants were able to identify it to genus level.
- *Clostridium novyi* (BACT-0311-3B). Only five laboratories identified *C. novyi* to species level. This is similar to performance in 2002. However, there was significant improvement in isolating this fastidious anaerobe—13 laboratories failed to grow this organism compared to 34 in 2002. Nevertheless, it is of concern that so many laboratories still failed to report this organism. The fact that this vial contained a mixture of three organisms was a significant factor affecting performance, since several laboratories that did not initially report *C. novyi* were able to isolate it from the original vial after the survey results were made known. The Committee Comments for the 2002 survey stressed the importance of using a selective medium such as phenylethyl alcohol (PEA) agar for Gram-positive anaerobes when mixed infections are to be expected (e.g. liver aspirate). This was reiterated for this survey.
- *Enterococcus faecium* (BACT-0311-3C). Approximately three-quarters (68/93) of laboratories identified *E. faecium* to species level. This performance is very similar to that achieved in 1997. A significantly higher proportion of laboratories (89/98; 90.8%) identified *Enterococcus faecalis* to species level in 2001, which was likely due to the fact that the strain was vancomycin resistant—a situation where it is necessary for laboratories to differentiate among species enterococci for infection control purposes. The strain of *E. faecium* used in BACT-0311 was not vancomycin-resistant.

Antimicrobial Susceptibility Testing

A reference result was available for 2899 antimicrobial susceptibility results reported by laboratories and 136 (4.7%) results were flagged (Table 49). This flagging rate is substantially lower compared with 2002 when 183/2156 (8.5%) results were flagged. Noteworthy observations concerning antimicrobial susceptibility testing performance in 2003 include:

- 100% (85/85) of laboratories that reported an oxacillin result for *Staphylococcus aureus* CMRSA-5 (BACT-0303-1) correctly reported oxacillin-resistant; this was the third consecutive challenge with an MRSA, for which all laboratories successfully detected this resistance.
- All but one of 94 laboratories (99%) correctly indicated they either confirmed or suspected the *Escherichia coli* strain in BACT-0309-2 to be an ESBL-producer. This continues the trend in improved detection of ESBL-production in *E. coli*. In 1997, only 32% of participants recognized or suspected this, improving to 94% in 1999, and 95% in 2000.
- 88% (75/85) of laboratories reporting vancomycin correctly reported a non-susceptible result for *Staphylococcus haemolyticus* (BACT-0309-4). This was excellent performance since it was the first time an isolate of staphylococcus with reduced susceptibility to vancomycin has been used as a QMP-LS challenge. The disk diffusion method was the least reliable method for detecting this reduced susceptibility, which was not surprising since failure of the disk diffusion method to detect vancomycin-intermediate strains of staphylococci has been well-documented.
- The majority of very major interpretive error flags were for clindamycin (35/195; 18%):
 - 10 were for BACT-0303-1 (*S. aureus*). This isolate was resistant to erythromycin and susceptible to clindamycin by *in vitro* testing but due to the presence of the *erm* gene should have been reported as clindamycin-resistant (MLS_B-inducible resistance). Although ten laboratories reported clindamycin-susceptible, four indicated they would either report the isolate as resistant or that resistance may develop during therapy with this agent. Since 1998, QMP-LS has recommended that laboratories report erythromycin-intermediate or resistant strains of *S. aureus* as clindamycin-resistant, although inducible clindamycin resistance was not addressed by NCCLS until its most recent susceptibility testing standard published in January 2004. While laboratories in Ontario are for the most part assessed on the basis of NCCLS susceptibility testing performance standards, there are occasions when QMP-LS makes recommendations that deviate from, or are not addressed by NCCLS, particularly when patient care is

potentially compromised. MLS_B-inducible resistance is illustrative of such a situation. Reporting clindamycin as resistant based on erythromycin resistance in *S. aureus* has improved dramatically since 1998 when 86/99 (87%) laboratories reported clindamycin as susceptible for an erythromycin-resistant *S. aureus*.

- 5 were for *Staphylococcus haemolyticus* (BACT-0309-4). Similar to the *S. aureus* discussed above, this erythromycin-resistant isolate should have been reported resistant to clindamycin due to MLS_B-inducible resistance. A few laboratories that did not over-ride the clindamycin-susceptible result were not aware that this recommendation applied to all species of staphylococci, not only to *S. aureus*.
- 20 were for *Streptococcus pyogenes* (BACT-0303-4). This strain of *S. pyogenes* also possessed the *erm* gene and demonstrated that inducible-MLS_B resistance may also be present in organisms other than staphylococci. However, in Canada, macrolide resistance in *S. pyogenes* is primarily due to an efflux mechanism mediated by the *mef* gene, which does not affect clindamycin. Until molecular testing of Canadian strains indicates an increase in *erm*-mediated resistance, susceptible results for clindamycin by *in vitro* testing will usually be valid for *S. pyogenes*. This is in contrast to *Streptococcus agalactiae* (see 2002 Review). No errors were assessed for reporting a clindamycin-susceptible result for this isolate.

Table 49. Antimicrobial Susceptibility Testing Interpretive Error Flags for 2003

Antimicrobial Agent	Gram Negative Organisms Interpretive Error Flags						Gram Positive Organisms Interpretive Error Flags					
	No. of Tests Reported	Very Major*	Major†	Minor‡	Total Flags	(%)	No. of Tests Reported	Very Major*	Major†	Minor‡	Total Flags	(%)
Amikacin	50	0	3 §	13 §	16	(32.0)	0	...	...	...	...	...
Amoxicillin/ clavulanate	2	0	0	0	0	(0.0)	0	...	...	...	...	...
Ampicillin	266	1	0	0	1	(0.4)	70	1	0	0	1	(1.4)
Azithromycin	0	...	...	...	...	...	1	0	0	0	0	(0.0)
Cefazolin	120	0	0	1	1	(0.8)	45	0	0	0	0	(0.0)
Cefotaxime	49	0	0	0	0	(0.0)	13	0	0	0	0	(0.0)
Cefoxitin	1	0	0	0	0	(0.0)	0	...	...	...	...	...
Cefotetan	2	0	0	0	0	(0.0)	0	...	...	...	...	...
Ceftazidime	101	5 §	0	11 §	16	(15.8)	0	...	...	...	...	...
Ceftizoxime	4	0	0	0	0	(0.0)	0	...	...	...	...	...
Ceftriaxone	71	0	0	1	1	(1.4)	8	0	0	0	0	(0.0)
Cephalothin	31	0	0	0	0	(0.0)	4	0	0	0	0	(0.0)
Chloramphenicol	36	0	0	0	0	(0.0)	2	0	0	0	0	(0.0)
Ciprofloxacin	334	1	0	0	1	(0.3)	27	0	0	1	1	(3.7)
Clindamycin	0	...	...	...	...	...	195	35	0	6	41	(21.0)
Erythromycin	0	...	...	...	...	...	229	0	0	8	8	(3.5)
Gatifloxacin	2	0	0	0	0	(0.0)	1	0	0	0	0	(0.0)
Gentamicin	274	0	0	0	0	(0.0)	25	2	0	0	2	(8.0)
Gentamicin (high-level)	0	...	...	...	...	...	34	0	0	0	0	(0.0)
Imipenem	42	0	0	0	0	(0.0)	0	...	...	...	...	...
Levofloxacin	15	0	0	0	0	(0.0)	21	0	0	0	0	(0.0)
Linezolid	0	...	...	...	...	...	11	0	0	0	0	(0.0)
Meropenem	23	0	0	0	0	(0.0)	0	...	...	...	...	...
Nitrofurantoin	150	0	0	0	0	(0.0)	0	...	...	...	...	...
Norfloxacin	68	0	0	0	0	(0.0)	0	...	...	...	...	...
Ofloxacin	1	0	0	0	0	(0.0)	5	0	0	0	0	(0.0)
Oxacillin	0	...	...	...	...	...	270	0	0	0	0	(0.0)
Penicillin	0	...	...	...	...	...	232	1	0	0	1	(0.4)
Piperacillin	81	0	3	0	3	(3.7)	0	...	...	...	...	...
Piperacillin/ tazobactam	3	0	0	0	0	(0.0)	0	...	...	...	...	...
Quinupristin-dalfopristin	0	...	...	...	...	...	1	0	0	0	0	(0.0)
Streptomycin (high-level)	0	...	...	...	...	...	20	0	0	0	0	(0.0)
Sulfonamides	2	0	0	0	0	(0.0)	0	...	...	...	...	...
Tetracycline	6	0	0	0	0	(0.0)	13	1	0	0	1	(7.7)
Ticarcillin	4	0	0	0	0	(0.0)	0	...	...	...	...	...
TMP/SMX	277	12	0	0	12	(4.3)	211	2	0	0	2	(0.9)
Trimethoprim	4	0	0	0	0	(0.0)	0	...	...	...	...	...
Tobramycin	69	0	0	0	0	(0.0)	0	...	...	...	...	...
Vancomycin	0	...	...	...	...	...	380	0	0	25 #	25	(6.6)
β-lactamase	73	3	0	0	3	(4.1)	120	0	0	0	0	(0.0)
Total	961	22	6	26	54	(5.6)	1938	42	0	40	82	(4.2)

* Reporting an antimicrobial result as susceptible (S) when the reference result is resistant (R) (i.e. falsely susceptible).

† Reporting an antimicrobial result as R when the reference result is S (i.e. falsely resistant).

‡ Reporting an antimicrobial result as S or R when the reference result is intermediate (I) or reporting an I when the reference result is S or R.

§ All for *Pseudomonas aeruginosa* (BACT-0306-1)

|| 10 for *Staphylococcus aureus* (BACT-0303-1; 20 for *Streptococcus pyogenes* [BACT-0303-4]; 5 for *Staphylococcus haemolyticus* [BACT-0309-4])

¶ All for *Salmonella typhimurium* (BACT-0306-3)

All for *Staphylococcus haemolyticus* (BACT-0309-4)

- 12/88 (13.6%) laboratories reporting trimethoprim-sulfamethoxazole results for *Salmonella typhimurium* (BACT-0306-3) reported a false susceptible result. All used the Vitek® system, although 27 other laboratories that used Vitek® correctly reported a resistant result. The manufacturer of Vitek® (bioMérieux) tested the QMP-LS isolate from this survey that was submitted to them by a number of laboratories and reported that the susceptible result was confirmed using Vitek® but a resistant result was generated by Vitek 2® and by the microbroth dilution reference method. This was an unexpected result. The purpose of selecting this challenge was to illustrate emerging fluoroquinolone resistance in *Salmonella* species and to highlight the recommendation by NCCLS—new in 2003—that testing of extraintestinal *Salmonella* isolates for nalidixic acid resistance be considered. Testing ciprofloxacin or other fluoroquinolone-susceptible isolates for nalidixic acid resistance is recommended since clinically it has been observed that *Salmonella* strains causing bacteremia that are resistant to nalidixic acid *in vitro* respond much less favorably to fluoroquinolone therapy. It was recommended that nalidixic acid-resistant strains be reported resistant to all fluoroquinolones regardless of *in vitro* results.

Gram Stain Smear Interpretation

Performance on staining and interpretation of Gram smears is shown in Tables 50 and 51. Due to complaints by participating laboratories about the quality of the smears for BACT-0306-GM and BACT-0309-GM, no errors were assessed for these smears. Performance on BACT-0303-GM for the microorganism component was satisfactory.

AFB Smear Interpretation

Performance on the two prepared smears of concentrated sputa for acid-fast stain and interpretation was excellent (Table 52).

Table 50. Performance in Microscopic Identification of Microorganisms for Gram Stain Smears Distributed in 2003

Survey	No. of Laboratories Reporting	Microorganism Component	% Correct Identification* (Excellent)	% Incorrect Identification† (Unacceptable)
BACT-0303-GM ‡	116	Gram-positive bacilli	87.0	12.9
BACT-0306-GM §	115	No microorganisms present	78.3	21.7
BACT-0309-GM	114	Gram-negative bacilli/coccobacilli	63.2	36.8

* Correct morphology and Gram reaction of microorganism component

† Failure to report microorganism morphotype(s) present or reporting microorganism or morphotype(s) not present in the smear

‡ Simulated smear of lacrimal duct swab for Gram staining (moderate to many *Actinomyces israelii*)

§ Simulated smear of cerebrospinal fluid (CSF) for Gram staining (No microorganisms present)

|| Simulated smear of sputum for Gram staining (moderate to many *Haemophilus influenzae* with rare to few Gram-positive cocci)

Table 51. Performance in Microscopic Identification of Cells for Gram Stain Smears Distributed in 2003

Survey	No. of Laboratories Reporting	Microorganism Component	% Correct Identification* (Excellent)	% Incorrect Identification† (Unacceptable)
BACT-0303-GM ‡	116	Pus/white blood cells	98.3	1.7
BACT-0306-GM §	115	Pus/white blood cells	96.5	3.5
BACT-0309-GM	114	Pus/white blood cells & epithelial cells	72.8	27.2

* Correct identification of cellular component of smear

† Failure to report cellular morphotype(s) present or reporting cellular morphotype(s) not present in the smear

‡ Simulated smear of lacrimal duct swab for Gram staining (many pus/white blood cells)

§ Simulated smear of cerebrospinal fluid (CSF) for Gram staining (many pus/white blood cells)

|| Simulated smear of sputum for Gram staining (many pus/white blood cells, rare/few epithelial cells)

Table 52. Performance in Microscopic Identification of AFB for Smears Distributed in 2003

Survey	No. of Laboratories Reporting	Quantity of Acid-Fast Bacilli	%Correct Identification* (Excellent)	%Partial† Identification* (Acceptable)	% Incorrect Identification‡ (Unacceptable)
BACT-0303-AF	40	No acid-fast bacilli present	97.5	2.5	0.0
BACT-0309-AF	39	Moderate AFB present	79.5	20.5	0.0

* Correct quantity of AFB reported

† Presence or absence of AFB correctly identified but quantity reported differed from expected quantity

‡ Presence or absence of AFB incorrectly identified

ERROR RATES

Errors assessed for isolation/identification, incorrect antimicrobial susceptibility testing results and inappropriate antimicrobial agents/failure to report antibiotic of choice are detailed in Tables 53, 54 and 55, respectively. The error rate for isolation and identification (3.4%) was lower than in 2002 (7.3%). Many of the significant errors (13/38) were for failing to report *C. novyi* in BACT-0311, as discussed earlier. The error rate for incorrect antimicrobial susceptibility testing results (1.5%) was also lower than in 2002 (4.4%). One-third (12/38) of significant errors were for trimethoprim-sulfamethoxazole for BACT-0306 as noted above. The number of errors for inappropriate antimicrobial reports or failure to report the antibiotic of choice for organism/site (35) was significantly higher than in 2002 when 14 errors were assessed. These errors accounted for over one-third (35/95) of errors assessed for antimicrobial susceptibility testing and are completely avoidable if laboratories follow NCCLS guidelines.

Errors for Gram stain interpretation were only assessed for BACT-0303-GM (Tables 56–58). The 11 significant errors assessed for this smear were for reporting *Actinomyces israelii* as Gram-negative due to over-decolorization of the smear and failing to take the morphology into account. Only one error was assessed for AFB interpretation (Table 59).

Table 53. Errors Assessed for Organism Isolation and Identification

Survey	No. of Laboratories	Opportunities for Error*	No. of Significant Errors (%)	No. of Lesser Errors (%)	No. of Total Errors (%)
BACT-0303	95	380	7 (1.8)	1 (0.3)	8 (2.1)
BACT-0306	100	390	4 (1.0)	3 (0.8)	7 (1.8)
BACT-0309	99	381	6 (1.6)	5 (1.3)	11 (2.9)
BACT-0311	102	474	21 (4.4)	9 (1.9)	30 (3.4)
Total	...	1625	38 (2.3)	18 (1.1)	56 (3.4)

* Number of participating laboratories × number of organisms for isolation/identification

Table 54. Errors Assessed for Incorrect Antimicrobial Susceptibility Results

Survey	No of Laboratories	Opportunities for Error*	No. of Significant Errors (%)	No. of Lesser Errors (%)	No. of Total Errors (%)
BACT-0303	95	1373	8 (0.6)	8 (0.6)	16 (1.2)
BACT-0306	95	888	19 (2.1)	3 (0.3)	22 (2.5)
BACT-0309	94	1134	6 (0.5)	11 (1.0)	17 (1.5)
BACT-0311	93	666	5 (0.8)	0 (0.0)	5 (0.8)
Total	...	4061	38 (0.9)	22 (0.5)	60 (1.5)

* Number of participating laboratories × number of antibiotic results reported (with reference result available)—includes β-lactamase errors

Table 55. Errors Assessed for Reporting Inappropriate Antimicrobial Agents (for Organism and/or Site) or Failure to Report Antibiotic of Choice

Antimicrobial Agent	No. of Organism	No. of Significant Errors	Lesser Errors
Azithromycin	<i>Pseudomonas aeruginosa</i> *	0	1
Cefazolin	<i>Salmonella typhimurium</i> †	2	0
Cefotetan	<i>Pseudomonas aeruginosa</i> ‡	0	1
Cephalothin	<i>Staphylococcus aureus</i> #	1	0
Ciprofloxacin	<i>Staphylococcus aureus</i> #	2	0
Erythromycin	<i>Enterococcus faecium</i> §	0	2
	<i>Staphylococcus aureus</i> #	1	0
	<i>Enterococcus faecium</i> **	0	1
Gentamicin	<i>Salmonella typhimurium</i> †	3	0
Gatifloxacin	<i>Salmonella typhimurium</i> §	0	1
Nitrofurantoin	<i>Pseudomonas aeruginosa</i> ‡	0	2
Oxacillin	<i>Staphylococcus aureus</i>	0	4
Trimethoprim	<i>Pseudomonas aeruginosa</i> *	0	1
	<i>Salmonella typhimurium</i> *	0	1
	<i>Staphylococcus haemolyticus</i> *	0	1
Sulfonamides	<i>Salmonella typhimurium</i> *	0	1
β-lactamase	<i>Pseudomonas aeruginosa</i>	0	1
	<i>Salmonella typhimurium</i>	0	1
Quinolone	<i>Salmonella typhimurium</i>	0	4
Not applicable	<i>Ralstonia pickettii</i> ¶	1	0
Vancomycin	<i>Staphylococcus haemolyticus</i> (oxacillin-resistant)	0	3
Total		10	25

* Antibiotic code transcription error

† *In vitro* testing of these agents may produce falsely susceptible results for this organism

‡ No NCCLS interpretive criteria for this antibiotic/organism combination

§ Interpretive criteria are for urine isolates only

|| Failure to report antibiotic of choice

¶ No NCCLS disk diffusion interpretive criteria for this organism

Inappropriate for isolates from CSF

** May be tested for VRE only

Table 56. Errors Assessed for Incorrect Gram Stain Interpretation—Microorganism Component

Survey	No. of Laboratories	Opportunities for Error*	No. of Significant Errors (%)	No. of Lesser Errors (%)	Total No. of Errors (%)
BACT-0303-GM	116	116	11 (9.5)	1 (0.9)	12 (10.3)
BACT-0306-GM	115	0 †	...	...	...
BACT-0309-GM	114	0 †	...	...	...
Total	...	116	11 (9.5)	1 (0.9)	12 (10.3)

* Number of participating laboratories × number of microorganism morphotypes present

† No errors assessed—unsatisfactory testing material

Table 57. Errors Assessed for Incorrect Gram Stain Interpretation—Cellular Component

Survey	No. of Laboratories	Opportunities for Error*	No. of Significant Errors (%)	No. of Lesser Errors (%)	Total No. of Errors (%)
BACT-0303-GM	116	116	0 (0.0)	1 (0.9)	1 (0.9)
BACT-0306-GM	115	0 †	...	...	...
BACT-0309-GM	114	0 †	...	...	...
Total	...	116	0 (0.0)	1 (0.9)	1 (0.9)

* Number of participating laboratories × number of microorganism morphotypes present

† No errors assessed—unsatisfactory testing material

Table 58. Errors Assessed for Incorrect Gram Stain Interpretation—Physician Reports

Survey	No. of Laboratories	Opportunities for Error*	No. of Significant Errors (%)	No. of Lesser Errors (%)	Total No. of Errors (%)
BACT-0303-GM	116	116	1 (0.9)	0 (0.0)	1 (0.9)
BACT-0306-GM	115	0 †	...	...	...
BACT-0309-GM	114	0 †	...	...	...
Total	...	116	1 (0.9)	0 (0.0)	1 (0.9)

* Number of participating laboratories × number of microorganism morphotypes present

† No errors assessed—unsatisfactory testing material

Table 59. Errors Assessed for Incorrect AFB Interpretation

Survey	No. of Laboratories	Opportunities for Error*	No. of Significant Errors (%)	No. of Lesser Errors (%)	Total No. of Errors (%)
BACT-0303-AF	40	40	0 (0.0)	0 (0.0)	0 (0.0)
BACT-0309-AF	39	39	1 (2.6)	0 (0.0)	1 (2.6)
Total	...	79	1 (1.3)	0 (0.0)	1 (1.3)

* Number of participating laboratories × number of slides

CAUSE ANALYSIS

In 2003, an investigation form was introduced that accompanied correspondence to laboratories concerning discordant results reported on QMP-LS surveys. The purpose of this form was to assist laboratories in performing cause analyses for their discordant results. Information provided by laboratories for bacteriology surveys was assessed by QMP-LS to determine the factors that contributed to reporting of discordant results.

Antibiotic Susceptibility Testing

The three categories of antibiotic discordance were incorrect antibiotic results (including β -lactamase testing), reporting inappropriate antibiotics for the organism and/or site and failure to report the antibiotic of choice. The relative proportion of discordant results in 2003 for these categories is shown in Figure 35. Contributing causes were determined to be in one of four categories—clerical error, technical problem, method/equipment problem or problem with EQA material. More than half of discordant antibiotic results for all categories of antibiotic discordance were due to method-related problems,

followed by clerical errors for inappropriate antibiotics and failure to report the antibiotic of choice, and then by technical problems for incorrect antibiotic results (Figure 36).

The majority of clerical errors were antibiotic code transcription errors, which are not likely to occur with patient samples and are attributable to the complexity of completing the Analysis Worksheet (Figure 37). Although errors are assessed for code transcription, they only become a concern when they occur repeatedly as it signals a lack of attention to detail that may affect the quality of a laboratory's operations. Transcription of antibiotic results, which accounted for 40% of clerical errors, are more significant since these errors are more likely to occur with patient samples, although occasionally these were due to the fact that EQA samples were not reported directly from the Laboratory Information System (LIS), which is programmed to override certain antimicrobial results (e.g. a clindamycin-susceptible result for and erythromycin-resistant *S. aureus*).

Most method-related errors were due to an inaccurate method or inadequate Standard Operating Procedures (SOPs) (Figure 38). Discordant results caused by an inaccurate method included a falsely susceptible trimethoprim-sulfamethoxazole result produced by Vitek® for *S. typhimurium* and failure of the disk diffusion method to detect decreased susceptibility to vancomycin for *S. haemolyticus*. Examples of inadequate SOPs were: an oversight in antibiotic reporting protocols (e.g. for *S. aureus* isolated from CSF), not following NCCLS guidelines or not acting on technical bulletins.

The most common causes of technical errors were failure to follow SOPs, failure to act on QC results and incorrect operation of the LIS (Figure 39). Instances of deviation from SOPs were in not over-riding the clindamycin-susceptible result for erythromycin-resistant *S. aureus*, although this was part of the documented antibiotic reporting protocol and not following documented incubation time or inoculum preparation for susceptibility tests. The best example of failure to act on QC results was not investigating the source of obvious bias on QC graphs for the disk diffusion method. An example of the incorrect operation of the LIS was selecting the wrong antibiotic to report during programming of the system.

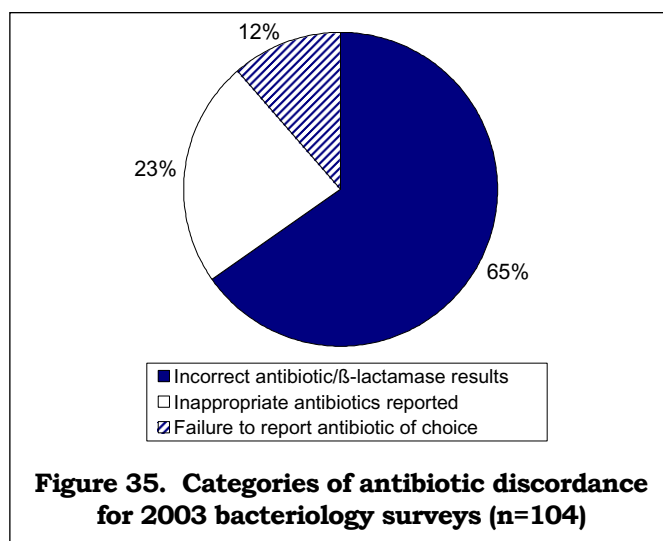


Figure 35. Categories of antibiotic discordance for 2003 bacteriology surveys (n=104)

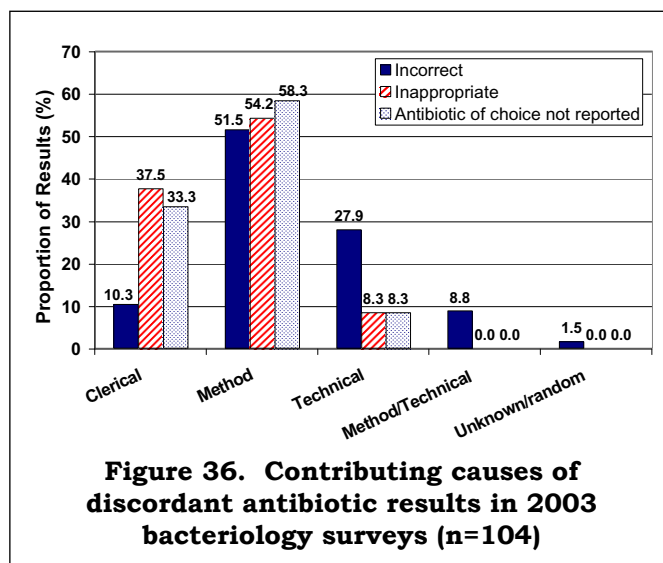


Figure 36. Contributing causes of discordant antibiotic results in 2003 bacteriology surveys (n=104)

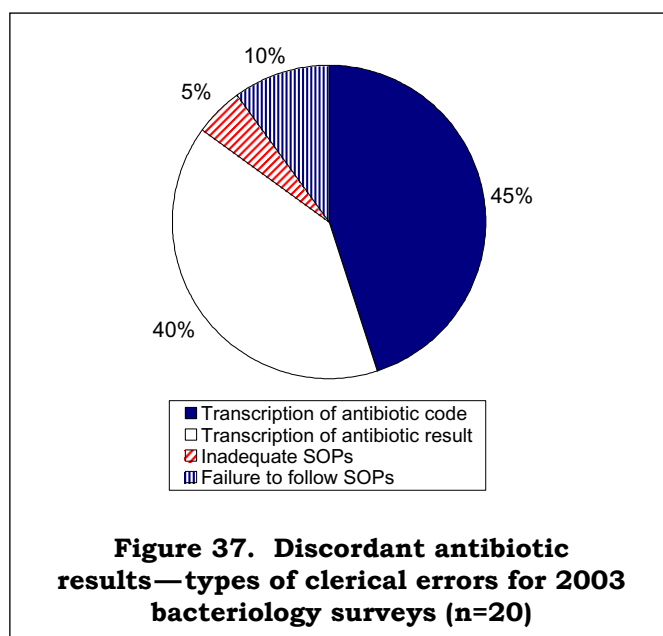
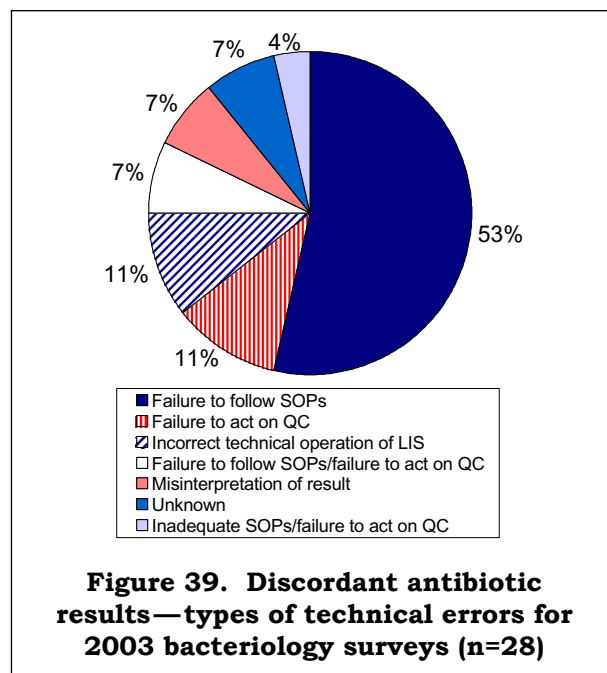
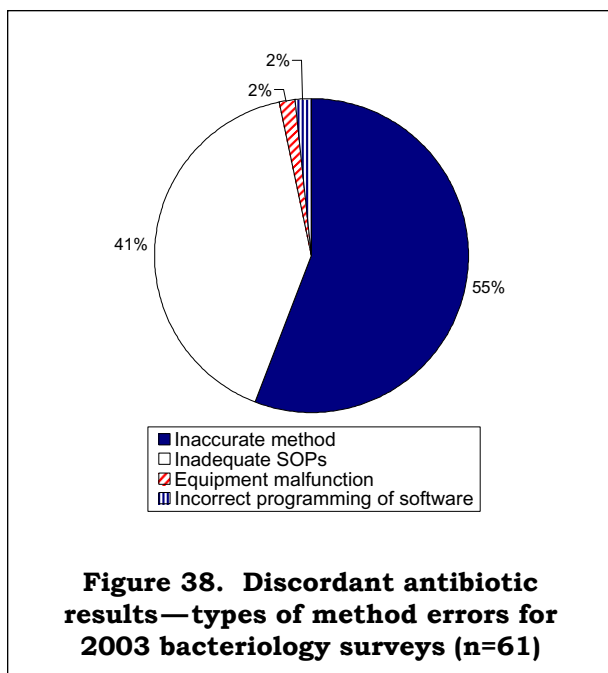


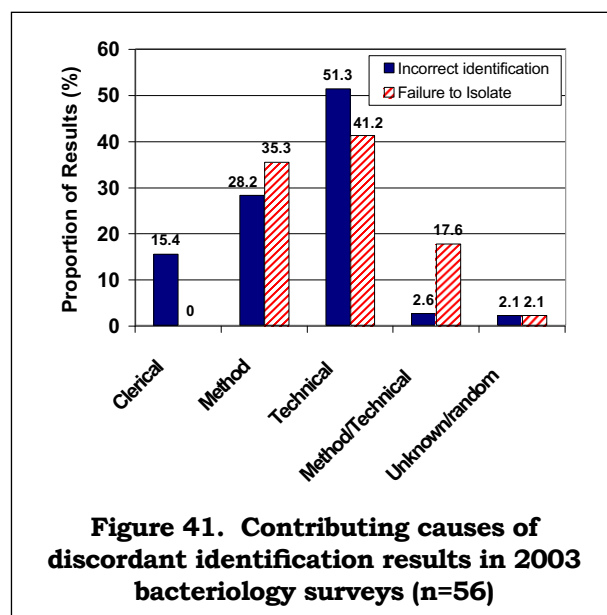
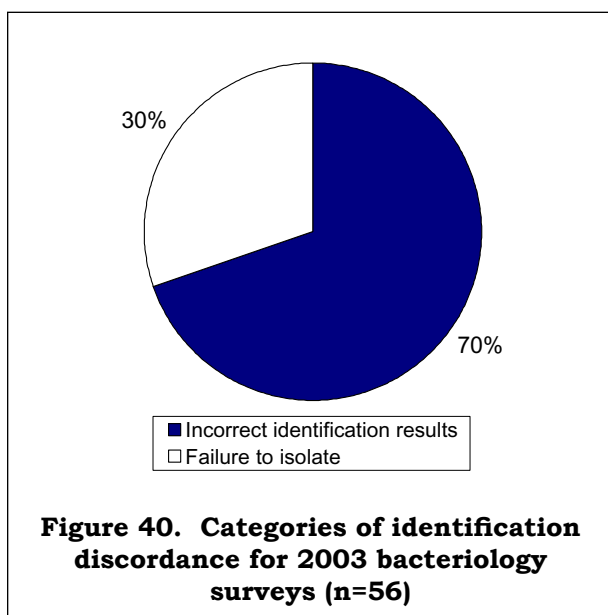
Figure 37. Discordant antibiotic results—types of clerical errors for 2003 bacteriology surveys (n=20)

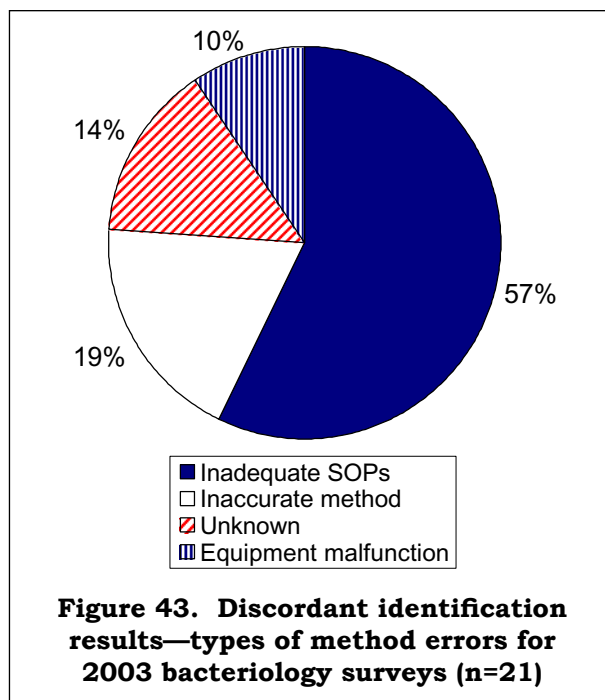
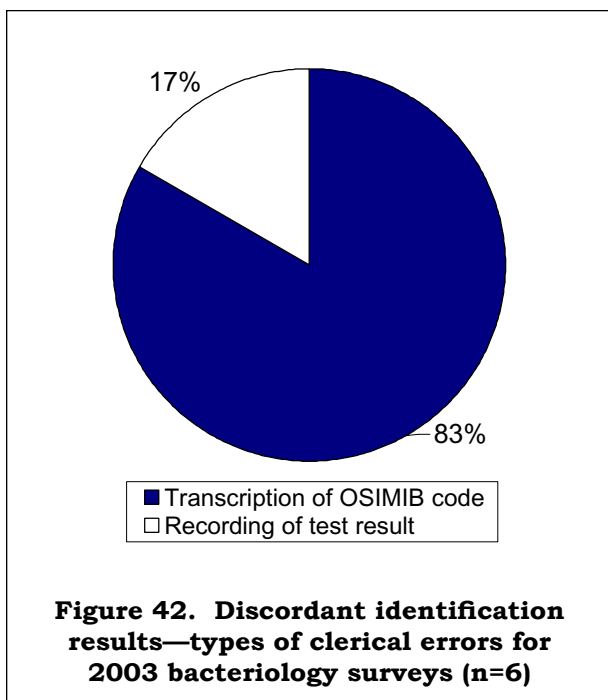


Isolation and Identification

There were two categories of identification discordance—incorrect identification and failure to isolate the organism (Figure 40). In contrast to antibiotic discordances, which were mainly method-related, technical problems were the major contributing factors to discordant identification results, followed by method problems (Figure 41). Clerical errors, which accounted for 15% of incorrect identification results, were almost entirely due to transcription of the Ontario System for Identification of Medically Important Bacteria and Fungi (OSIMIB) code, an idiosyncrasy of the reporting format (Figure 42).

Inadequate SOPs, such as not including appropriate selective media for culture of specimens for anaerobes or not documenting how to resolve discrepancies between tube coagulase and slide agglutination tests for *S. aureus* were the primary source of method-related errors in identification (Figure 43). Inaccurate methods—most commonly commercial identification systems/kits—also contributed significantly to poor performance in identification.





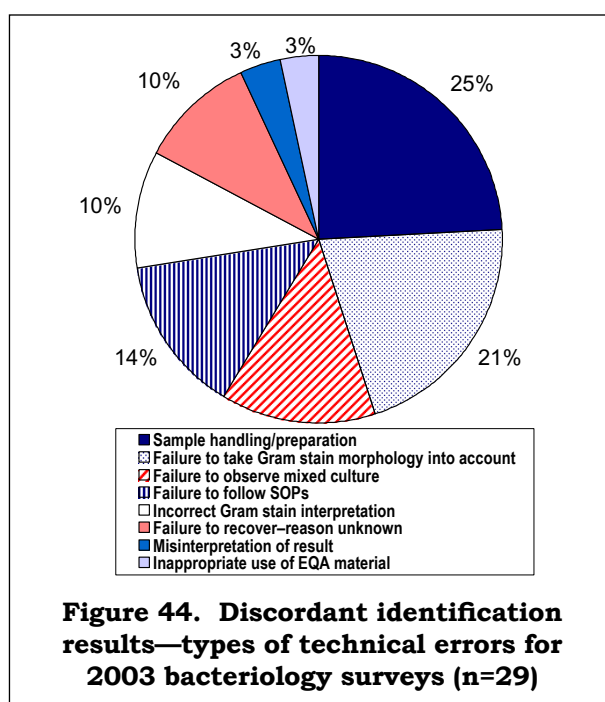
The leading technical-related problem in identification was sample handling/preparation (Figure 44). The artificial nature of lyophilized cultures contributes significantly to this problem and is the reason that QMP-LS is moving towards providing more realistic specimens that closely resemble patient samples for bacteriology. Failure to take the Gram stain morphology into account as part of organism identification was a frequent source of technical error, as was failure to observe an organism in a mixed culture.

Root Causes

While contributing causes to discordant results on bacteriology surveys are relatively easy to identify, root causes are more difficult to discern. Most laboratories did not actually determine the root cause of errors, i.e. why were SOPs inadequate? Why were inaccurate methods used? Or why were SOPs not followed? In bacteriology, which is a discipline that is continuously evolving and is fundamentally knowledge-based (as opposed to technology-based), it is likely that the root cause of discordant EQA results (and therefore potentially patient results) is predominantly lack of training, knowledge or experience.

NUMBER OF PROVIDERS

The number of laboratories that provide a comprehensive testing menu in bacteriology decreased by four in 2003 (Figure 45). Two laboratories licensed for Gram stain only and two licensed for AFB smear examination have dropped this testing since 2002 (Figure 46).



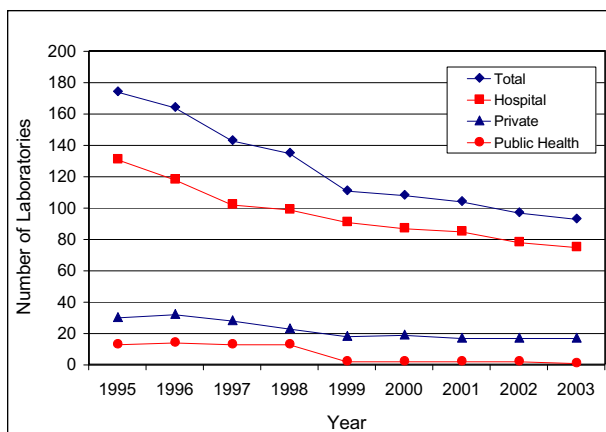


Figure 45. Number of bacteriology laboratories in Ontario by facility type

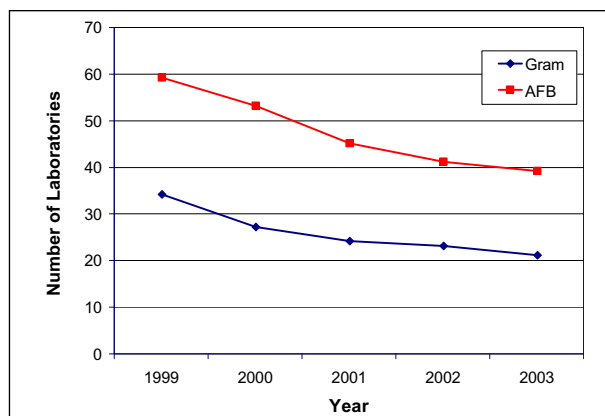


Figure 46. Number of laboratories performing Gram stain and AFB smear examination

MYCOLOGY

TESTING MODEL

Two surveys were conducted in 2003, consisting of eight challenge samples. As in previous surveys, the challenges were selected from the three groups of medically significant fungi—dermatophytes, yeasts and moulds. Testing material was distributed to laboratories as live cultures on agar slants. The type of specimen, microscopic information and a limited clinical history was provided to participants on the Analysis Worksheets. Laboratories were required to process the cultures as if they were patient specimens. Since the licence for mycology includes culture for yeasts, dermatophytes and systemic fungi, many laboratories may only culture one or two of these groups. Therefore, participants' assessment is based on their level of practice (Table 60). All challenge samples are sent to all laboratories, but performance assessment of submitted results is based on each laboratory's stated level of practice.

Although the reported identification of organisms according to the OSIMIB code is the only component of the survey that is scored, all information provided by participants on the Analysis Worksheets in terms of isolation media used, macroscopic and microscopic findings as well as other identification features are reviewed for appropriateness. In addition to the requirement to report the identity of the organism, according to OSIMIB, to their stated level of competence, participants are encouraged to comment on how each organism would be reported to the physician. Hypothetical direct microscopy results for each sample are now provided on the Analysis Worksheet to facilitate participant interpretation of the potential clinical significance of each organism. Errors are classified as lesser or significant, depending on their potential impact on patient care.

Comprehensive Committee Comments for each organism include a review of the identification of the organism and its clinical significance as well as a review of participant performance.

LABORATORY PARTICIPATION

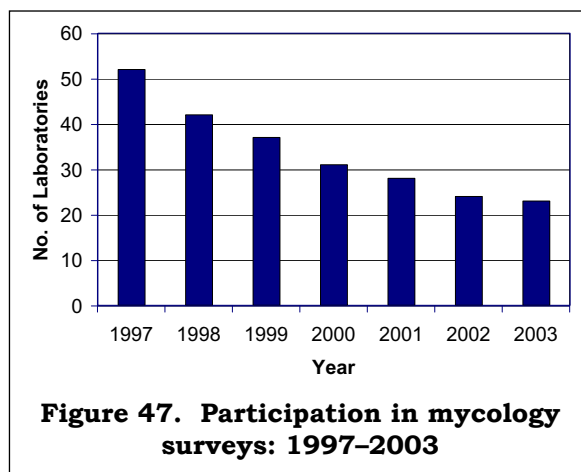
There has been a reduction in the number of laboratories licensed to perform mycology since the program started in 1997, when 52 laboratories participated in the initial pilot survey. By the end of 2003, there were 23 laboratories performing mycology (Figure 47) in Ontario.

Although the number of participants has dropped, the level of practice has not changed significantly. Most laboratories (65%) identify yeasts as part of their routine microbiology practice. However, some of these may not attempt to isolate yeasts associated with systemic infection and choose to refer out such specimens.

Table 60. Level of Practice by Laboratories Licensed for Mycology in 2003 (n=23)*

	No. of Labs
Yeast	
Identify most yeast to species level	15
Culture and refer all isolates	1
Refer all yeast specimens	3
Practice with yeast not specified	4
Dermatophytes	
Culture for dermatophytes and identify most isolates	16
Culture for dermatophytes and refer all isolates	2
Refer all dermatological mycology specimens	2
Practice with dermatophytes not specified	3
Systemic Fungi	
Culture systemic specimens and identify most isolates	17
Culture systemic specimens and refer all isolates	3
Refer all systemic specimens for mycology	3

* No laboratories participating at end of year. Does not include two out-of-province laboratories that participate in the mycology program as reference laboratories — Wadsworth Centre for Laboratories and Research, Albany, New York, and Laboratoire de santé publique du Québec.



In 2003, 70% of laboratories handled dermatophyte fungi from superficial skin specimens, while all licensed laboratories cultured fungi from systemic specimens. Specimen referral patterns for identification of organisms varied with the nature of the agent isolated and ranged from a low of 11% for relatively common dermatophytes to 64% for rare yeast species.

OVERALL PERFORMANCE

Challenge Surveys

Overall, performance on survey MYCO-0303 was good, with most laboratories performing satisfactorily to their stated level of practice (Table 61) on three of the four challenge samples.

Table 61. 2003 Organism Distribution and Survey Performance

Survey	No. of Labs Reporting	Organism	% Correct * Identification (Excellent)	% Partial † Identification (Acceptable)	% Incorrect ‡ Identification (Unacceptable)
MYCO-0303-1	23	<i>Microsporum gypseum</i>	65.2	30.5	4.3
MYCO-0303-2	23	<i>Trichophyton violaceum</i>	65.2	34.9	0.0
MYCO-0303-3	23	<i>Candida kefyr</i>	65.2	34.9	0.0
MYCO-0303-4	23	<i>Penicillium marneffeii</i>	30.4	52.2	17.4
MYCO-0307-1	23	<i>Microsporum audouinii</i>	47.8	52.1	4.3
MYCO-0307-2	23	<i>Alternaria</i> NOS	69.5	31.5	0.0
MYCO-0307-3§	23	<i>Sporobolomyces salmonicolor</i>	30.4	43.5	26.1
MYCO-0307-4	23	<i>Cryptococcus albidus</i>	82.6	17.4	0.0
MYCO-0307-5§	23	<i>Stachybotrys</i> NOS	82.6	8.6	8.6

* Identified correctly to species level (or to genus level when appropriate).

† Identified genus level (without naming a species) or correct to general classification (e.g., yeast, mould, filamentous fungi, dermatophyte).

‡ Identified incorrectly.

§ Educational challenge

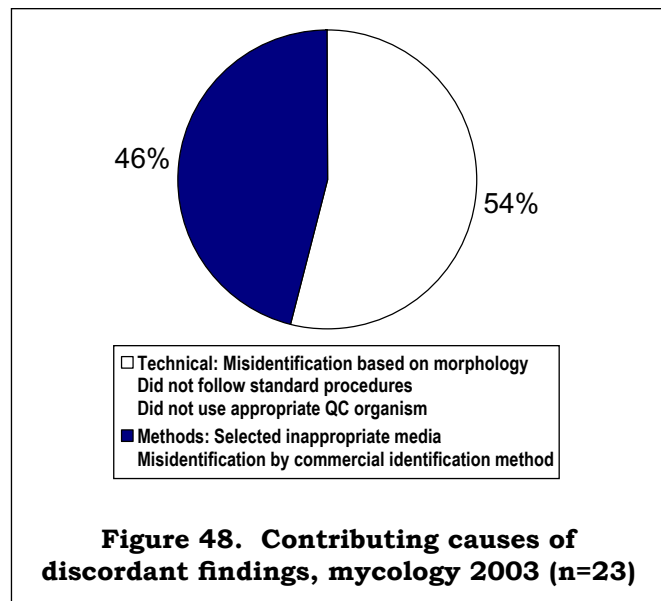
However, there were five significant errors associated with the culture and identification of *Penicillium marneffeii*. Four of the five laboratories mistakenly identified the organism as *Paecilomyces* NOS and reported a filamentous fungus suggestive of an actinomycete (such as *Streptomyces*). *P. marneffeii* is the only dimorphic member of the genus *Penicillium* and typically converts to a yeast form at 37°C. However, as the characteristic is somewhat strain-dependent, several laboratories noted that this did not occur. It also typically produces a red diffusible (reverse) pigment and has typically tapered phialides.

Performance on survey MYCO-0307 also varied by the nature of the challenge sample. Laboratories performed well in the identification of *Microsporum audouinii* (one error), *Alternaria* NOS (no errors), and *Cryptococcus albidus* (no errors). *Stachybotrys* was an educational sample and 84% of laboratories identified it correctly with only one laboratory incorrectly identifying this environmental mould as *Wangiella* NOS.

Performance on the challenge material containing *Sporobolomyces salmonicolor* was unsatisfactory and was judged as an educational challenge only. *S. salmonicolor* is a basidiomycetous yeast—an environmental fungus commonly found in areas of decaying vegetation and also in still pooled water such as toilets and drain traps as well as water chiller components of mechanical ventilation systems. It has rarely been associated with human illness. Seven laboratories incorrectly identified the organism as *Rhodotorula* NOS or *Rhodotorula glutinis*. This was in part due to some similarity with *Rhodotorula* spp., but primarily due to automated identification systems that produced incorrect identification profiles.

Discordant Findings

In 2003, laboratories with significant or lesser errors were asked to complete the Discordant Findings Form developed by QMP-LS. Results of the responses received were analyzed according to root cause of the error (Figure 48). Factors contributing to errors in mycology results included primarily technical and methodological errors. Technical errors ranged from not following standard procedures, or failure to set-up an appropriate quality control organism to misidentification of an organism based on morphological findings (inability to discriminate specific features). The most common methodological problem was related to incorrect identification resulting from commercial identification systems or kits. This was common for rare organisms such as *S. salmonicolor*.



PARASITOLOGY

TESTING MODEL

Two challenge surveys were conducted in 2003, each consisting of three vials of SAF-preserved faecal suspension for concentration and preparation of stained smears by laboratories. The testing material was unpooled specimens from patients in Ontario and was generously provided by the Regional Parasitology Laboratory, Hamilton Regional Laboratory Medicine Program—St. Joseph's site, Hamilton, Ontario. Material was distributed by London Health Sciences Centre, London, Ontario.

SURVEY ASSESSMENT

Performance was assessed by comparing participants' results to the consensus results of ten referee laboratories, selected from their peers. The ten laboratories with the highest average score over the preceding four surveys were designated as the referee group (representing more than one-third of participating laboratories) for the survey being evaluated. The collated results of these laboratories were used to determine the scoring scheme and flagging criteria. A result was scored if more than 50% of the referee laboratories reported it. Full marks (3) were awarded for each correct stage and quantity of parasite species reported. Partial marks (2) were awarded if the quantity reported fell outside the expected range. Marks were deducted for reports of parasite species not present in the sample. Errors were assigned only when a parasite was not reported in both the concentrate and stained smear or if a parasite not actually present in the specimen was reported in either the concentrate or stained smear. Errors were not assessed for failing to report a parasite unless there was at least 90% agreement among the referee laboratories.

LABORATORY PERFORMANCE

An overview of performance on the two surveys is shown in Table 62. Participant and referee agreement on the identity and stage of parasites listed was similar on all specimens. Table 63 shows the errors assessed. The overall error rate

Table 62. Overall Performance of Referee and Participating Laboratories in 2003

Survey	Expected Parasite	Quantity	Referee Agreement (%)	Participant Agreement (%)*
PARA-0304-1C (Concentrate)	No parasites seen OR	...	30	46 †
	<i>Blastocystis hominis</i>	D	70	65 †
PARA-0304-1S (Stained slide)	<i>Dientamoeba fragilis</i> trophozoites	D	100	100
PARA-0304-2C (Concentrate)	<i>Entamoeba histolytica/dispar</i> cysts	A	100	96
	<i>Giardia lamblia</i> cysts	B/C	100	100
PARA-0304-2S (Stained slide)	<i>Entamoeba histolytica/dispar</i> cysts	A/B	100	100
	<i>Entamoeba histolytica/dispar</i> trophozoites	D	100	100
	<i>Giardia lamblia</i> cysts	C	100	100
	<i>Giardia lamblia</i> trophozoites	A	100	96
PARA-0304-3C (Concentrate)	<i>Strongyloides stercoralis</i> larvae	A	100	100
PARA-0304-3S (Stained slide)	<i>Strongyloides stercoralis</i> larvae	A	100	96
PARA-0310-1C (Concentrate)	No parasites seen	...	100	100
PARA-0310-1S (Stained slide)	No parasites seen	...	100	100
PARA-0310-2C (Concentrate)	<i>Entamoeba histolytica/dispar</i> cysts	B	100	96
PARA-0310-2S (Stained slide)	<i>Chilomastix mesnili</i> trophozoites	A	70	52 ‡
	<i>Endolimax nana</i> trophozoites	A	70	40 ‡
	<i>Entamoeba histolytica/dispar</i> cysts	B	100	96
	<i>Entamoeba histolytica/dispar</i> trophozoites	C	100	100
PARA-0310-3C (Concentrate)	No parasites seen OR	...	80	60 §
	<i>Endolimax nana</i> cysts	A	20	28 §
PARA-0310-3S (Stained slide)	<i>Endolimax nana</i> trophozoites	C	100	100
	<i>Entamoeba hartmanni</i> trophozoites	A	60	48 ‡

Helminths: A-occasional, 1–4 per coverslip; B-few, 5–20 per coverslip; C-moderate, 11–20 per coverslip; D-many, 1 per low power field; E-numerous, 1 or more per high power field

Protozoa: A-occasional, 1–5 per coverslip; B-few, 6–25 per coverslip; C-moderate, 1 per low power field; D-many, 1 per high power field; E-numerous, 1 or more per oil immersion field

* All laboratories including referee laboratories

† Either report considered acceptable

‡ No errors assessed due to low referee agreement

§ Either report considered acceptable

Table 63. Errors Assessed in Parasitology in 2003

Survey	No. of Laboratories	Opportunities for Error*	No. of Significant Errors (%)	No. of Lesser Errors (%)	No. of Total Errors (%)
PARA-0304	26	104	1 (1.0)	11 (10.6)	12 (11.6)
PARA-0310	25	125	0 (0.0)	1 (0.8)	1 (0.8)
Total	...	229	1 (0.4)	12 (5.2)	13 (5.7)

* Number of participating laboratories × number of parasites present

(5.7%) in 2003, was down from 2002 (8.1%). All errors were due to over-reporting parasites that were not present in the specimen. These included misidentifying *Entamoeba histolytica/dispar* as *Entamoeba hartmanni* (3), *Dientamoeba fragilis* as *Endolimax nana* (3), *Trichomonas hominis* (1), *Enteromonas hominis* (1) or small flagellate trophozoites (1), small *Blastocystis hominis* forms as *Enteromonas hominis* (1) and *Chilomastix mesnili* as *E. hartmanni* (1). It should be noted that in all cases of misidentification, the correct parasite species was also reported.

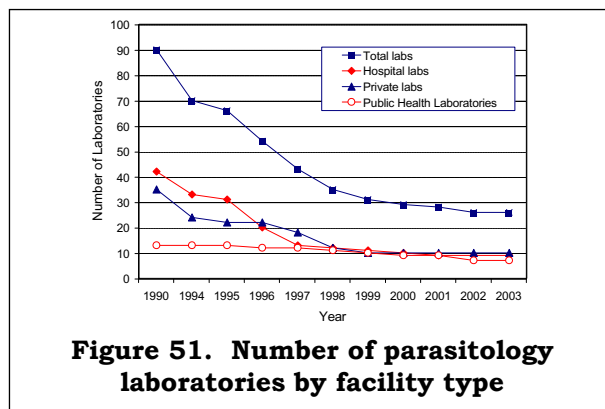
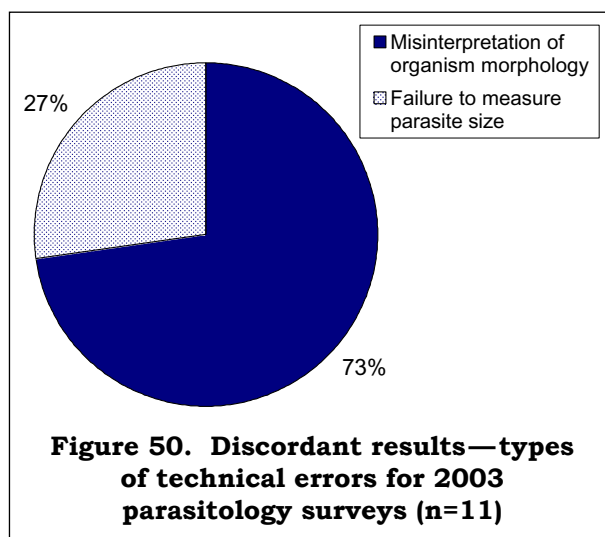
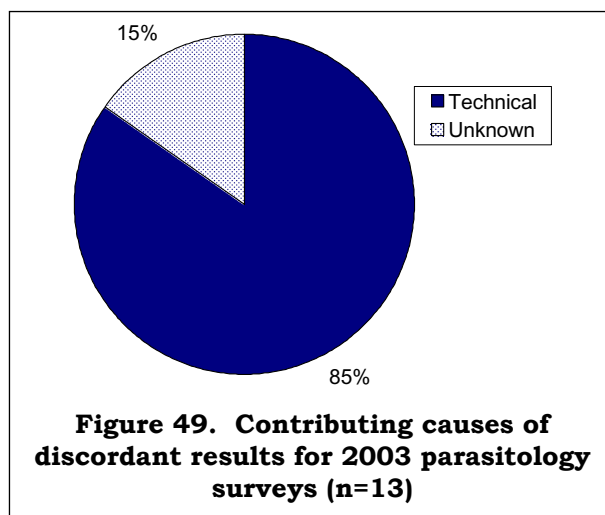
CAUSE ANALYSIS

In 2003, an investigation form was introduced that accompanied correspondence to laboratories concerning discordant results reported on QMP-LS surveys. The purpose of this form was to assist laboratories in performing cause analyses for their discordant results. Information provided by laboratories for parasitology surveys was assessed by QMP-LS to determine the factors that contributed to reporting of discordant results.

Contributing causes were determined to be in one of four categories—clerical error, technical problem, method/equipment problem or problem with EQA material. Almost all discordant parasitology results (85%) were due to technical problems and for the remaining results, the contributing cause could not be determined (Figure 49). Types of technical problems identified included misinterpretation of organism morphology and failure to accurately measure the parasite size (Figure 50). Only one laboratory identified the root cause of their discordant results, acknowledging that the technologists performing parasitology were not seeing enough positive specimens to maintain proficiency.

NUMBER OF PROVIDERS

The number of parasitology laboratories in Ontario decreased by one since 2002, leaving a total of 25 testing facilities (Figure 51).



VIROLOGY

TESTING MODEL

Twelve challenge surveys were conducted during 2003 of which two represented “pilot” surveys for viruses. Table 64 shows the number of samples in each survey and the number of laboratories participating.

Table 64. Number of Ontario Laboratories Participating in Viral or Chlamydial Surveys During 2003

Survey	Samples per Survey	Hepatitis A , B, C	HIV	Rubella/CMV/VZV	<i>C. trachomatis</i>	Respiratory
V-0302	11	...	4/19	...	4/18	3/50
V-0304	12	4/43	4/19	4/33	...	...
V-0308	12	4/44	4/20	4/32	...	...
V-0311	11	...	...	4/31	4/17	3/50

Number of samples/number of participants reporting results. The numbers include out-of-province laboratories (1 chlamydia, 1 rubella/VZV/CMV, 3 hepatitis A/B/C)

The testing material used for hepatitis A virus (HAV), hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV) and rubella/varicella-zoster virus (VZV)/cytomegalovirus (CMV) surveys was either serum or plasma. The plasma used for hepatitis and HIV testing was kindly provided by the Canadian Blood Services. As in previous years, testing material for serological markers is not heat- or otherwise inactivated. The surveys for HAV, HBV and HCV were consolidated into a single panel for 2003.

Serum for rubella, VZV and CMV testing was obtained from volunteers, selected on the basis of their immune status. In addition, since it is becoming increasingly difficult to find donors who test negative for rubella antibody or positive for rubella IgM antibody, material for rubella was purchased from commercial sources. When material from a potential commercial source is identified, a sample is obtained and pre-tested before purchase to ensure that it meets the required testing specifications and demands for quality. Material for the first chlamydia challenge was prepared at the Virology Laboratory of the Hamilton Regional Laboratory Medicine Program where strains of *Chlamydia trachomatis* are grown in tissue culture, harvested and then adjusted in strength to simulate clinical specimens containing defined numbers of elementary bodies. Material for the second chlamydial challenge was obtained from a commercial source. Participants are instructed to place the chlamydia samples into collection tubes of their respective testing systems immediately upon receipt. Material for RSV, influenza A and B for 2003 was purchased from a commercial source.

Packaging and shipping of all samples complies with federal regulations for transportation of dangerous goods. Participants are instructed to process the samples as they would handle routine clinical specimens and that they are not inactivated. In addition, participants are reminded that serum and plasma samples have been previously frozen and that they should observe manufacturer's instructions for processing frozen material.

In addition to the Ontario laboratories participating in the surveys, three out-of-province laboratories also participate in the virology surveys.

SURVEY ASSESSMENT

Participants' results were compared to those obtained from reference laboratories using similar methodology and manufacturers' assays, and where applicable, with peer groups (participants using identical methodology). The amount of the analyte present in the specimen was also taken into consideration when assays of different sensitivity were assessed. Results were flagged when they did not agree with the reference results. Errors were assessed as being either significant or lesser errors (Table 65), depending on the potential impact of the results on patient outcomes or the potential risk for disease transmission. Errors were further classified as analytical or interpretive.

Precision of testing is also being considered in the review of results and has been discussed in the Committee Comments; however, currently errors are not being assessed.

OVERALL PERFORMANCE

Chlamydia trachomatis

Although the number of participating Ontario laboratories has steadily decreased from 26 in 2001 to only 16 in 2003, the performance for chlamydia improved in 2003 as the overall error rate declined from 1.22% to 0.71%. There were some concerns regarding the stability of the material used for chlamydia challenges, which have been resolved with a new supplier.

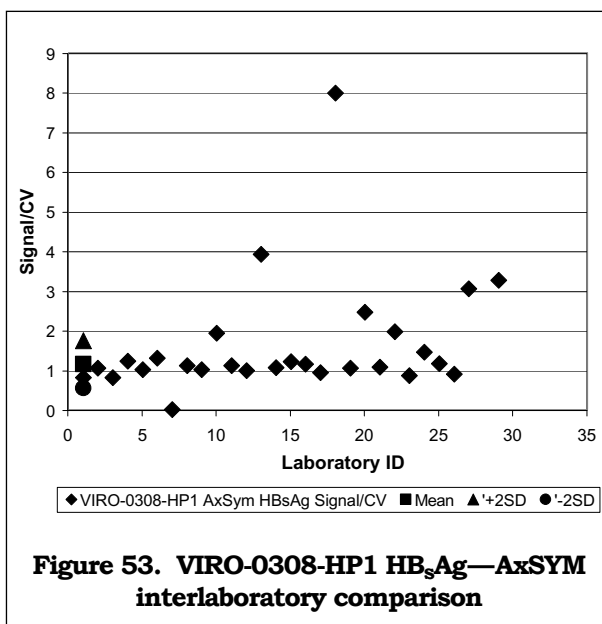
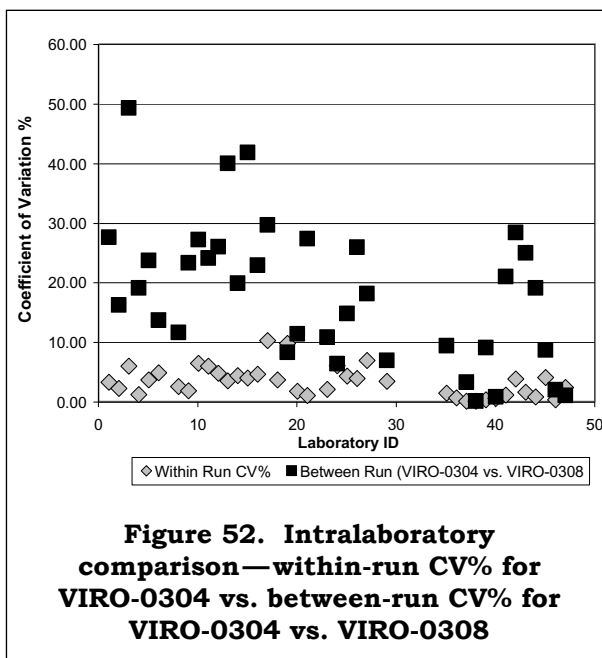
Hepatitis A, B and C

The performance of hepatitis testing remained stable this year, with 0.78% for hepatitis A and B, and 0.76% for hepatitis C in 2003. This error rate represents a combination of significant and lesser errors for a number of markers including HBsAg, anti-HBs, anti-HBc and anti-HCV antibody. One laboratory mixed-up all four specimens in one challenge and was assigned four lesser errors. Five false positive HBsAg results on AxSYM and IMx instruments on survey VIRO-0308 indicated changes in instruments or test kits resulting in decreased specificity. Most laboratories are confirming HBsAg positives in-house or by sending out to the Public Health Laboratory for confirmation. QMP-LS informed laboratories to be aware of specificity issues and encouraged them to perform in-house confirmatory testing for HBsAg.

Precision of HBsAg was assessed by analyzing results obtained for one specimen that was included three times in two surveys (VIRO-0304-HP1 and VIRO-0308-HP2 and -HP4). There was good precision for HBsAg in VIRO-0308 for HP2 and HP4 (<10% coefficient of variation [CV] in most laboratories) but poor CVs (up to 50%) within the same laboratory over time (Figure 52). The interlaboratory comparison for VIRO-0304-HP1 produced about 20% CV compared to 10% for VIRO-0308-HP1 (Figure 53). These results suggest an improvement over time but it is unclear if the improvement is related to product or due to proper maintenance and calibration of equipment. QMP-LS reminded laboratories to use adequate internal and external quality control testing to be able to track trends in test performance over time.

Table 65. Error Assessment for Ontario Laboratories for 2003

Analyte	Significant Errors	Lesser Errors	Opportunities for Error	% Error
Chlamydia	1	0	140	0.71
Hepatitis A,B,C	6	8	1804	0.78
HIV	1	0	152	0.66
Rubella/CMV/VZV	7	0	664	1.05
Respiratory Panel	9	0	516	1.74
Total	24	8	3276	0.98



Lack of standardization in the assessment of hepatitis B antibody and immune status, which has been apparent in the past surveys, has been discussed in Committee Comments and in previous *Reviews*. The internationally accepted definition of immunity is 10 mIU/mL of anti-HBs. However, antibody can be present at levels lower than 10 mIU/mL. In 2002, QMP-LS reminded participating laboratories that specimens with anti-HBs levels ≥ 10 IU/L should be reported as immune, whereas specimens with anti-HBs levels < 10 IU/L should be reported as non-immune. In 2003, participants were reminded that anti-HBs levels between 2–10 IU/L should not be considered positive as these low levels of antibodies have no bearing on the management of individual patients, and subsequently the reporting improved. It is noteworthy that one of the major manufacturers of anti-HBs test kits provided information to their customers regarding the potential lack of specificity of anti-HBs in a series of kit lots with results between 10–20 mIU/mL. Such false positive results have been documented by QMP-LS over the past two years.

Errors for HCV testing have been assessed for the past three years. The error rate for anti-HCV antibody has continued to decline (0.76%) in 2003 indicating that the quality of HCV testing in Ontario is improving.

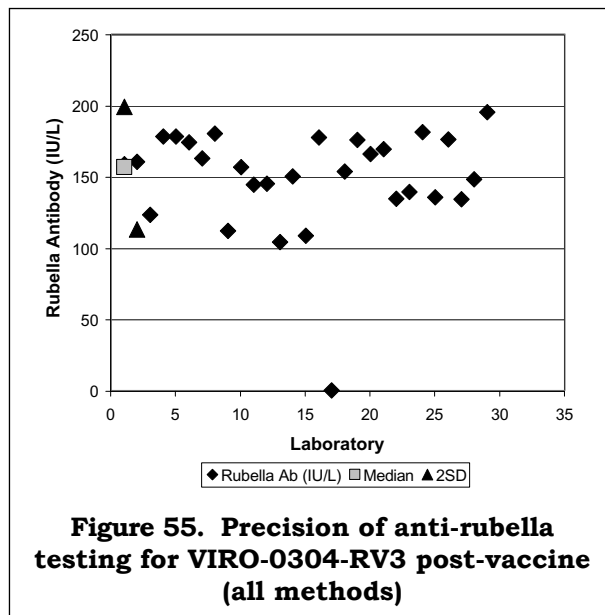
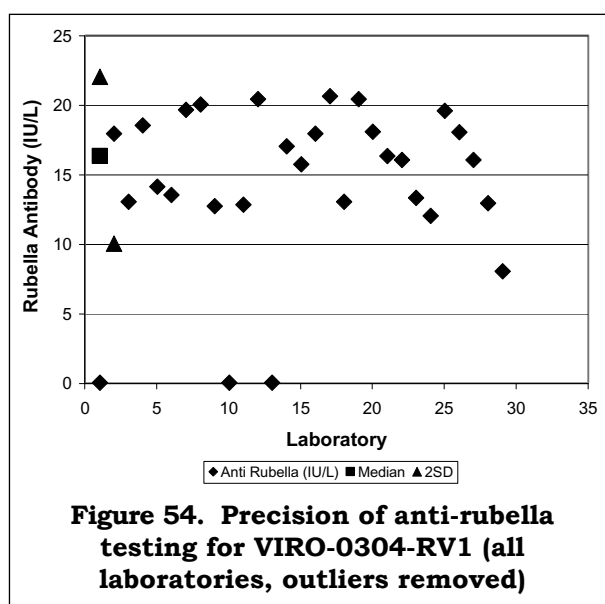
HIV Antibody Detection

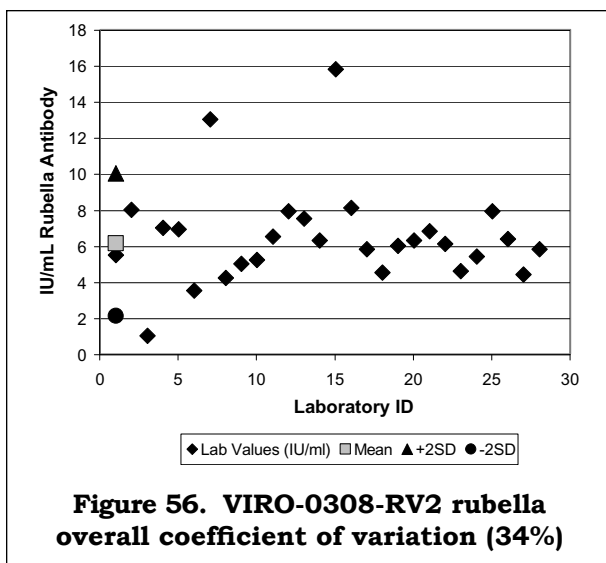
The HIV error rate has remained stable at 0.66% in 2003. One laboratory reported a false-positive screening test result for one specimen but a correct negative result on repeat testing in duplicate. QMP-LS reminded laboratories to follow the manufacturers' protocol for HIV testing that requires repeat testing of all initial positive screen test results. The quality of HIV testing in Ontario continues to improve.

Rubella Antibody Detection

The error rate for rubella increased marginally from 1.01% in 2002 to 1.39% in 2003. Three laboratories were assigned significant errors for false-positive rubella results since a false-positive rubella result on a pregnant woman could result in the failure to vaccinate, increasing the chance for a congenital rubella baby if the woman was exposed to rubella virus. Rubella precision was assessed using VIRO-0304-RV1 (low positive). Figure 54 shows the precision for all laboratories including the three outliers as zero (removed for statistical analyses). The median for this sample was 16 IU/mL with SD of 3 IU/L. Three laboratories were outside the 2 SD limits. For comparison, Figure 55 shows the precision for VIRO-0304 RV3, which was a strong positive specimen. The median for this sample was 156 IU/L with SD of 21.3 IU/L. Two laboratories were outside the 2 SD limits. These results indicate that the precision was better for strong positive specimens than low positive specimens.

Precision was also assessed with VIRO-0308-RV2. As shown in Figure 56, the overall interlaboratory CV (34%) for this specimen was poor. A specimen such as RV2 should have a CV of no more than 20%.





VZV Antibody Detection

A combined rubella/VZV/CMV antibody challenge, piloted in 2002, was again assessed in 2003. Twelve laboratories tested for VZV. No errors were assessed for either varicella antibody testing. Surveys again demonstrated that different tests varied in sensitivity. Latex agglutination (LA) and fluorescent assays were more sensitive than some enzyme immunoassays (EIA). This was seen with results for RV2 and RV3, pre- and post- vaccination sera, where seroconversion was detected by eight of 12 laboratories. Some methods did not detect post-immunization VZV antibody. This phenomenon of the lack of sensitivity to post-immunization VZV antibody was documented during the vaccine trials for VZV. It is now encouraging to note

that laboratories are switching to test kits that do detect post-immunization antibody. QMP-LS notified participating laboratories that not all VZV antibody tests (EIA or LA) will detect antibody produced following VZV immunization.

CMV Antibody Detection

Ten laboratories tested for CMV antibody. All participating laboratories reported correct results for all specimens.

Respiratory Antigen Detection

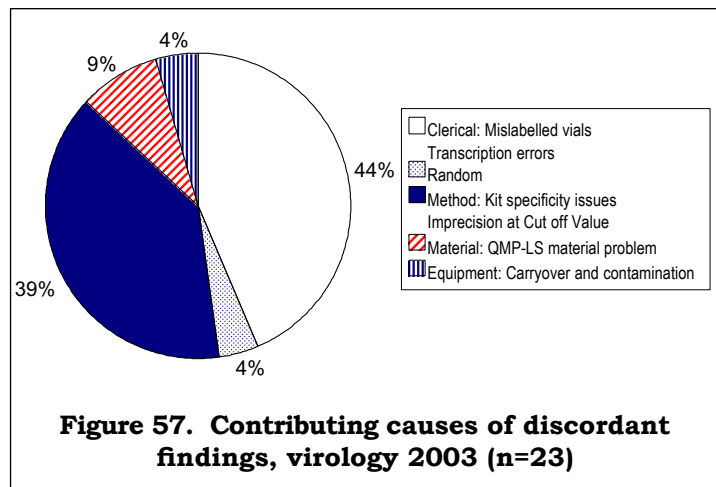
Following a pilot RSV antigen survey in 2001, and a second RSV survey in 2002 using commercial material, the respiratory virus antigen survey was expanded in 2003 to include RSV, influenza A and B. No errors were assessed for this pilot. The overall error rate for the two respiratory virus antigen challenges was 1.74%. For the first survey, one influenza A specimen and one RSV-positive specimen were included in the survey. Five laboratories achieved a false positive RSV result for VIRO-0302 RS2. This specimen was positive for influenza A. The five laboratories used the same rapid RSV test kit (RSV Directogen). QMP-LS reminded laboratories that the apparent cross-reactivity between influenza A and the RSV Directogen assay has been previously documented by the QA material manufacturer and that laboratories doing RSV testing should choose appropriate reagents and/or assays.

The second survey (VIRO-0311), contained one each of RSV, influenza A and influenza B positive specimens. All 30 laboratories correctly identified the influenza A specimen, 24 of 25 laboratories correctly identified the influenza B specimen, and 49 of 50 laboratories correctly detected the RSV positive specimen. The RSV positive specimen produced positive results in two of four laboratories testing for parainfluenza 3 indicating a cross-reactivity between the parainfluenza 3 antibody and RSV. QMP-LS informed laboratories of the potential cross-reactivity between respiratory virus antibodies and the need to evaluate the specificity of assays prior to use. The respiratory panel challenge will continue to be important as Ontario health care institutions face the ongoing possibility of Sudden Acute Respiratory Syndrome (SARS).

CORRECTIVE ACTIONS

All errors assessed to a laboratory result in correspondence from QMP-LS. Laboratories are required to respond and provide specific information regarding the error and their own assessment of the situation and demonstrate that internal corrective action has been taken. If the committee is not satisfied with the response, further correspondence is undertaken with additional responses until the committee is satisfied that the laboratory understands the nature and cause of the error and has undertaken appropriate corrective action. In addition,

laboratories are asked to complete the QMP-LS Discordant Findings Form. Results are shown in Figure 57. In 2003, 43% of errors were clerical, occurring either pre- or post-analytical, 39% were related to the method selected for the test, 8% were due to problems with QMP-LS material, 4% were technical errors and 4% were random errors. Of note: for errors related to the method selected for testing, product specificity leading to false positive results was the dominant issue. Appropriate method validation and quality control monitoring will reduce product performance problems.



For the benefit of all laboratories, Committee Comments address general issues that arise as a result of each survey. In 2003:

- Committee Comments re-addressed the issue of confirmatory testing for HBsAg and immune status for hepatitis B. It requested all laboratories to report anti-HBs results using International Units and interpretive results as immune or not immune according to guidelines for immune status using the 10 IU/L cut-off.
- Issues regarding the determination of immune status for rubella highlighting the difference between test cut-off values and immunity levels established by international standards were discussed in Committee Comments. Laboratories have been requested to report results in International Units of antibody.
- The committee indicated that various technologies have differing sensitivities for detecting post-immunization VZV antibodies.
- The need for confirmation of screen test positive results for HCV antibody testing was reiterated in Committee Comments.
- The need to carry out methods validation prior to implementing laboratory procedures was discussed in Committee Comments related to the cross-sensitivity and effect on specificity for detecting respiratory viruses.

NUMBER OF LABORATORY PARTICIPANTS

Table 66 shows the number of laboratories participating in respective surveys by constituent. The number of laboratories testing for virology constituents/markers in 2003 was similar to that of 2002. There was an increase in the number of laboratories performing HCV supplemental or confirmatory antibody screening tests from six to 19. There was a significant decrease (38%) in the number of laboratories performing chlamydia testing from a high of 26 in 2001 to a low of 16 as of the end of 2003.

Table 66. Number of Ontario Participants Testing Virology by Constituent and/or Marker

Constituent/Marker	2000	2001	2002	2003
Hepatitis				
HBsAg	50	44	42	41
anti-HBs	43	39	35	35
Anti-HBc	32	31	31	30
Anti-HBc IgM	13	13	13	12
HbeAg	11	11	11	11
Anti-Hbe	10	10	10	11
Anti-HAV	20	20	20	20
Anti-HAV IgM	23	22	22	21
Hepatitis C				
HCV Screening Tests	26	24	31	32
HCV Supplementary Tests	4	6	...	17
Rubella				
Rubella Ab	29	29	28	27
Rubella IgM	4	4	4	3
VZV				
VZV Ab	13	13	10	12
CMV				
CMV Ab	...	...	...	10
HIV				
HIV Ab	21	19	15	20
Chlamydia				
<i>C. trachomatis</i> Ag or NA	26	26	20	16
Respiratory Panel				
Influenza A	...	...	...	30
Influenza B	...	...	...	25
RSV	...	48	50	50
Other viral antigens	...	...	...	5

Note: The last survey in each year was used for comparison for each of the constituents. The numbers relate to Ontario participants only and do not include markers tested by the out-of-province laboratories

Testing Material Suppliers

Bacteriology

London Health Sciences Centre, London, Ontario

Gram Smears

Clinical Microbiology Proficiency Testing Program (CMPT), Vancouver, British Columbia

AFB Smears

Central Public Health Laboratory, Toronto, Ontario

Mycology

Central Public Health Laboratory, Toronto, Ontario

Parasitology

Hamilton Regional Laboratory Medicine Program—
St. Joseph's Site, Hamilton, Ontario

Virology

The Canadian Blood Services and selected volunteer donors
Hamilton Regional Laboratory Medicine Program, Hamilton, Ontario
London Health Sciences Centre, London, Ontario
Meridian Bioscience Inc, Cincinnati, Ohio

Reference Laboratories

Central Public Health Laboratory, Toronto, Ontario
London Health Sciences Centre, London, Ontario
Lakeridge Health, Oshawa, Ontario
Mount Sinai Hospital, Toronto, Ontario
Kingston General Hospital, Kingston, Ontario
The Credit Valley Hospital, Mississauga, Ontario
The Ottawa Hospital, Ottawa, Ontario
Hamilton Health Sciences Corporation, Hamilton, Ontario

Central Public Health Laboratory, Toronto, Ontario
Wadsworth Centre for Laboratories and Research, Albany, New York
Laboratoire de santé publique du Québec, Ste-Anne-de-Bellevue, Quebec

Canadian Blood Services, National Testing Laboratory, Ottawa, Ontario
Central Public Health Laboratory, Toronto, Ontario
Health Canada–Federal Laboratories, Winnipeg, Manitoba
Hamilton Health Sciences Corporation, Hamilton, Ontario
Hospital for Sick Children, Toronto, Ontario
Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario
Toronto Medical Laboratories, Toronto, Ontario

ANATOMIC PATHOLOGY

TESTING MODEL

A patterns-of-practice survey PATH-0302-PP on colorectal cancer reporting was distributed. This survey focused on laboratory demographics, laboratory operations and the use of synoptic formats for the reporting of colorectal cancer resection specimens. This type of survey provided participants with an opportunity to compare their practice in these areas to those of their peers.

One histotechnology staining external quality assessment (EQA) survey PATH-0306 was distributed. Each participating laboratory received sequential unstained paraffin sections from a single specimen of liver, to be stained by a panel of stains including a routine oversight, trichrome, reticulin and hemosiderin stains.

The immunohistochemistry survey, scheduled for the fall, had to be postponed due to a material problem.

PERFORMANCE ASSESSMENT

The submitted slides were independently assessed by four committee members using the criteria and scoring system previously published as Committee Comments. The hemosiderin-stained slides were circulated with draft criteria to be used for assessment and the hematoxylin-phloxin-saffron (HPS) oversight stain had new criteria developed for assessment. Each participating laboratory received an individual report for each stain performed. These reports provide an overall final score, as well as the score achieved, the peer average score and the maximum achievable score for each criterion. The emphasis is placed on providing an opportunity for participants to improve their histochemical staining results, in a criterion-referenced way, if such improvement seems necessary.

PATH-0306 was the first regular histotechnology EQA survey to be circulated. Both previous histotechnology surveys were pilot surveys.

The survey was mailed to 79 laboratories licensed to perform surgical pathology (L720).

Four of these laboratories did not perform histological techniques on-site.

The results of this survey were published as Committee Comments in February 2004, together with a review of the scoring scheme and the definition and assessment of error.

The average score for those laboratories performing the hematoxylin-eosin (H&E) oversight stain reflects a good overall standard of performance.

The average score for those laboratories performing the HPS oversight stain was slightly lower and reflects an acceptable standard of performance. Differentiation with the yellow counterstain was a common problem resulting in slightly lower scores for this oversight stain.

The average score for laboratories performing a hemosiderin stain was exceptionally good and reflects a high overall standard of performance.

Anatomic Pathology

No. of Participants (Dec. 2003)	79
No. of Participants (Dec. 2002)	79
No. of Surveys Conducted in 2003	3

The average score for laboratories performing a trichrome stain was less than that achieved in the pilot survey, reflecting a lowered and only adequate overall standard of performance. Loss of the red staining component was a common problem resulting in the lowered scores. Five laboratories were assessed a significant discordance in result.

The average score for laboratories performing a reticulin stain was also less than that achieved in the pilot survey, again reflecting a lowered and only adequate standard of performance. Failure to fully impregnate the reticulin fibers was a very common problem resulting in the lowered scores. Six laboratories were assessed significant discordances and seven laboratories were assessed lesser discordances in result.

PATTERNS-OF-PRACTICE SURVEY

The survey was mailed to 79 laboratories licensed (L720) to perform surgical pathology.

The results of this survey were published as Committee Comments in February 2004.

In summary, the majority (71%) of colorectal cancer reporting institutions are community hospitals. There was a high awareness of the synoptic style of reporting with 81% of laboratories using a form of synoptic report. Seventy per cent (70%) of these were regarded as complete in that they included all important diagnostic parameters.

It is exemplary that 98.4% of laboratories send reports to Cancer Care Ontario. This is essential for optimal patient care, including follow-up and for epidemiological purposes.

SUMMARY OF OTHER ACTIVITIES

Two tutorials about the assessment model pilot surveys PATH-0206 and PATH-0210 were presented at the Ontario Society of Medical Technologists annual conference in London, Ontario in September 2003. Additional presentations have been given to the Histology supervisors group and to the Immunohistochemistry users group in Toronto.

2004 PLANS

The immunohistochemistry survey that was postponed in 2003 is rescheduled for February 2004.

A histochemical staining survey is scheduled for September 2004.

The assessment tutorial has been developed into a full one-day staining workshop to be presented at various locations around the province during 2004. The Ontario Society of Medical Technologists and the College of Medical Laboratory Technologists of Ontario are in partnership with QMP-LS in making the workshop available to all regions of the province.

Testing Material Suppliers

Anatomic Pathology

Various participating laboratories

CYTOLOGY

TESTING MODEL

The sixth cytology patterns-of-practice survey CYTO-0302-PP was distributed in 2003. This survey focused on personnel and laboratory demographics, laboratory operations, screening and reporting practices, and included a modified section on quality assurance procedures. This type of survey provided participants with an opportunity to compare their practice to those of their peers, as well as to compare data with the previous years.

One combined gynecologic and non-gynecologic cytology external quality assessment (EQA) survey CYTO-0307 was distributed. The survey maintained a similar format to previous years. Each participating laboratory again received a total of 20 slides, including 10 gynecologic and 10 non-gynecologic challenges. The refined scoring system introduced in 2002, which placed increased emphasis on majority peer agreement, was again used.

An additional educational pilot survey CYTO-0308 was also distributed. Each participating laboratory received six liquid-based gynecologic preparations, together with a revised Analysis Worksheet. Both SurePath™ and ThinPrep® preparations were included. All participants were encouraged to complete this survey even if they do not utilize liquid-based preparations as part of their normal practice.

PERFORMANCE ASSESSMENT

Scoring of the slide survey, as modified in 2002, was again used to improve reproducibility and fairness. Committee consensus diagnoses continue to be based on an independent review of the slides with agreement of at least two committee members. As in 2002, lesser discordances and slides with more than 20% significant discordances were not used for performance assessment. As well, discordances between low-grade squamous intraepithelial lesion (LSIL) and high-grade intraepithelial lesion (HSIL) were considered minor discordances reflecting the frequent lack of agreement in this area.

Due to the number of participants requesting changes in the survey schedule, an additional circulation had to be introduced. This resulted in CYTO-0307 not being completed until the end of January 2004. Similar delays occurred with the liquid-based pilot survey. It is anticipated that these will be reported in April 2004.

PATTERNS-OF-PRACTICE SURVEY

The cytology patterns-of-practice survey CYTO-0302-PP allowed for comparison with the previous surveys CYTO-0203-PP, Y-0103, Y-0003, Y-9904 and Y-9806. The purpose of this survey was to assess general trends in distribution of cases, screening, reporting and quality assurance of gynecologic and non-gynecologic cytology. Another intent was to monitor the implementation of the Ontario Quality Assurance Program in Gynecologic Cytology. Fifty-five (55) hospital and 31 community laboratories completed the survey. The results were published as Committee Comments and are summarized below:

- Gynecologic cytology represents 61% of the total cytology workload in hospital laboratories and 96% in private laboratories.
- The number of cytology cases has increased by 9.2%.

Cytology

No. of Participants (Dec. 2003)	88
No. of Participants (Dec. 2002)	90
No. of Surveys Conducted in 2003	3

- In 2002 liquid-based cytology represented 52.2% of all GYN cytology in Ontario (2.1% in 2001) and 59.9% of all gynecologic cytology in private laboratories.
- All responding licensed laboratories indicated the use of the Bethesda system as the primary system for reporting gynecologic cytology. In addition to the Bethesda system, 28.2% of laboratories used the CIN terminology and 34.6% used dysplasia terminology.

SUMMARY OF OTHER ACTIVITIES

Two slide surveys were conducted and reviewed for the Alberta Laboratory Quality Enhancement Program (formerly LPTP) of the College of Physicians and Surgeons of Alberta in 2003.

PLANNED INITIATIVES FOR 2004

- To further revise the Analysis Worksheets, scoring system and the current Ontario Laboratory Accreditation and Standards of Practice Guidelines to incorporate the modified Ontario Bethesda System terminology.
- To continue to monitor and support the implementation of the Ontario Quality Assurance Program in Gynecologic Cytology.
- Expand the external quality assessment survey to include liquid-based gynecologic samples.
- Establishment of guidelines for quality assurance practices for automated screening devices.
- Address issues pertaining to quality assurance practices for testing for human papilloma virus in cervical cancer screening.

Testing Material Suppliers

Cytology

Various participating laboratories

GENETICS

CYTOGENETICS

The Genetics Committee membership has representation from both cytogenetics and molecular genetics.

TESTING MODEL

The cytogenetics external quality assessment model (EQA) remains essentially unchanged. Four clinical challenge surveys were scheduled. Only three of the four challenge surveys were conducted in 2003. One survey was cancelled due to a material problem (GENE-0308-CG). A participating laboratory provides the testing material for each survey. The ongoing involvement of participating laboratories in survey development is an important feature of the program. This involvement enabled the test challenge to be a bona fide clinical specimen of human whole blood or tissue culture obtained from a single donor. Participants are required to culture, process, karyotype and provide an interpretive report on the case provided. Laboratories submitted their results using the same format to report patient results to physicians. Participants who do not perform long-term culturing received fixed culture survey material.

All results, karyotypes, and photographs submitted by each laboratory were reviewed and evaluated. Each laboratory has been routinely assessed on the technical procedure and interpretive report. Due to issues surrounding the assessment of the interpretive component, the scoring system was changed since survey GENE-0202-CG and only the technical component was assessed. Until the assessment of interpretation has been resolved, only educational comments will be provided.

Committee Comments were published for each survey detailing the clinical case report provided by the supplying laboratory, the committee's expectations and minimum requirements for assessment—karyotypes submitted and a model report.

LABORATORY PERFORMANCE

The Ontario cytogenetic laboratories continue to perform well and the results were within acceptable limits.

MOLECULAR DIAGNOSTICS OF INHERITED HUMAN DISEASES

The development continued on a testing model for molecular diagnostics of inherited human diseases.

OTHER ACTIVITIES

QMP-LS continues to provide EQA services to 12 out-of-province cytogenetics laboratories. One laboratory participates in the oncology challenges only. Interest has been expressed by out-of-province molecular genetic colleagues to participate in the surveys for molecular diagnostics of inherited human diseases. This will be explored further as the survey model is developed.

Genetics

No. of Participants (Dec. 2003)	10
(plus 13 out-of-province laboratories)	
No. of Participants (Dec. 2002)	11
(plus 12 out-of-province laboratories)	
No. of Surveys Conducted in 2003	3

QMP-LS participated on the Predictive Cancer Genetics Implementation Steering Committee for breast, ovarian and colon cancer programs and the respective sub-committees (laboratory and data).

QMP-LS in collaboration with Health Canada, Centre for Chronic Disease Prevention and Control developed the Canadian Genetic Quality Network (CGQN). The network of genetic service providers (clinical and laboratory) will collect and share information through a Web site. The aim of the project is to promote networking and sharing of resources to obtain accurate and timely information regarding genetic services in Canada.

Discussions were ongoing with the Ministry of Health and Long-Term Care regarding the potential utility of Ontario genetic services information on the OnGene Web site.

Testing Material Suppliers

Genetics

Various participating laboratories

ONTARIO LABORATORY ACCREDITATION

PURPOSE

The purpose of this report is to provide an update on the activities of Ontario Laboratory Accreditation (OLA) and the Test Review Committee in 2003.

EXECUTIVE SUMMARY

The year 2003 was a watershed year for OLA. After 2½ years of consultative development, plans were put in motion to phase in a mandatory accreditation of Ontario's licensed medical laboratories over a five-year period commencing in 2003. Other laboratories may subscribe voluntarily. OLA's peer review accreditation program requirements are based on the international standard ISO 15189:2003 *Medical Laboratories—Particular Requirements for Quality and Competence*. The Test Review Committee utilized electronic means of communication during 2003 to undertake a quality review of 17 candidate tests for the Ministry of Health and Long-Term Care (MOHLTC).

January–March

In the first quarter, pilot peer accreditation assessments were conducted in six volunteer laboratories along with an impact analysis, which was conducted by an independent consulting firm. The external impact analysis was designed to determine what is required for a laboratory to prepare for accreditation. The pilots yielded sufficient data to conclude that:

- most accreditation requirements are reasonable and achievable for Ontario laboratories;
- tools for the assessment process are useful with some modification;
- the proposed accreditation process is workable with minor modification; and
- there are common issues and enablers that may help other laboratories prepare for accreditation.

Pilot assessments validated the concept of peer assessments and provided the opportunity to improve proposed requirements and conformance assessment processes to reflect lessons learned.

In the meantime, OLA staff and advisors continued to assist laboratories to prepare for accreditation by conducting 16 *Am I Ready?* seminars (Appendix I) throughout the province, and three presentations were made at conferences. Sixty-seven individuals completed assessor training.

April–June

In the second quarter, revised requirements for accreditation were released (Version 2, May 2003) to all licensed laboratories and identified stakeholders. These 551 requirements and 61 good practice recommendations reflect improvements that were identified during the pilot peer assessment visits, in order to ensure that requirements are reasonable and achievable by Ontario laboratories. During this time, processes for peer and self-assessments were refined and improvements made to reflect pilot findings. Staff and advisors made three presentations at regional, national and international meetings.

July–September

In the third quarter, QMP–LS began notifying laboratories of self-assessments. OLA staff presented at a multi-disciplinary seminar. An OLA symposium was held on September 13, 2003, for personnel from Ontario laboratories, identified stakeholder organizations, MOHLTC and interested vendors. The 612 attendees heard first-hand OLA's implementation plans, pilot assessment experiences and impact analysis findings, expectations for peer and self-assessments and changes to program requirements.

October–December

In the fourth quarter, 14 laboratories were notified of pending peer assessment visits. Thirty-eight additional laboratories submitted self-assessment exception reports, which were reviewed at OLA. An implementation update and an extensive list of frequently asked questions about OLA and the program requirements were posted on the QMP–LS Web site.

ADVANCING IMPLEMENTATION OF ACCREDITATION

One of the objectives met in 2003 was to advance the implementation of accreditation with pilot assessments and an impact analysis. The OLA program is the first medical laboratory accreditation program in North America to utilize ISO 15189:2003 *Medical Laboratories—Particular Requirements for Quality and Competence* as the applicable standard. This standard was adopted internationally in February and as a Canadian national standard shortly thereafter. OLA is mandatory for all licensed medical laboratories in Ontario.

Pilot Accreditation Assessments

During January and February 2003, pilot assessments were conducted in six volunteer laboratories. Pilot laboratories were selected from a number of volunteers and all pilot sites agreed to the terms of reference in advance. The six laboratories selected were from different areas of Ontario, they represented both the public and private sector, their scope of testing differed and the population served varied: urban hospital (3), rural hospital (2) and one community broad-scope-specialty laboratory. This was a fair representation of the mix of laboratories across Ontario. The scope of testing in these laboratories covered all disciplines and a vast majority of requirements. Only some specialized testing and a few requirements were not formally assessed during these pilots (e.g. molecular diagnostics and radiation safety). Assessors were selected from the pool of previously-certified assessors. In total, 20 assessors and three OLA staff were involved. The personnel from pilot laboratories and the volunteer assessors (Appendix B) contributed a great deal to the success of accreditation.

The pilot assessment provided data to evaluate the proposed accreditation process and the requirements, guidance information and assessment tools. A by-product was the opportunity to evaluate the process in a multi-site laboratory. The objectives of the pilot process were to determine whether:

- requirements are reasonable and achievable;
- tools for assessment process are useful;
- proposed process is appropriate;
- opportunities for improvement could be identified.

Each aspect of the accreditation process was evaluated (initial notification, team selection, confirmation and performance, pre-visit questionnaire, date coordination and confirmation, information packages, quality manual review, visit and travel arrangements, conformance assessment, visit opening and summation meetings). Pilot site personnel, assessors and OLA staff completed the evaluation forms. Site personnel reported that activities leading up to assessment (including team selection, composition and assignment) were appropriate and the visit agendas realistic, but some useful information was lacking on the pre-visit questionnaire. The effectiveness of the summation meeting was questioned by two sites. Other comments included that teams were well-prepared, thorough, professional and the assessors helpful.

Assessors suggested some improvements to their information packages. All reported the assessment to be a positive experience and that they would readily participate in future assessments. Not enough time, however, was allocated for team meetings to collate findings during the visit and assessors put in long days. The large volume of work precluded the ability of teams to leave complete written summaries in the laboratory. Assessors and staff thought that electronic tools might be useful. The role of the team leader and staff coordinator during visits was pivotal to the success of the visit.

OLA staff questioned the usefulness of OLA evaluating the quality manual in advance of the visit. The need for some clarification on assessment of major/minor non-conformances was indicated, as was guidance regarding what constitutes full accreditation. Multi-site assessments are possible and cost-effective, but assessment tools need modification to make multi-site visits more efficient.

QMP-LS submitted a complete report on the pilot accreditation assessments to the Laboratories Branch, MOHLTC, in March.

Impact Analysis

The independent impact analysis was conducted by BearingPoint (formerly KPMG Consulting) to determine what it takes for a laboratory to prepare for accreditation:

- To determine what it takes for pilot sites to meet accreditation requirements, and to use that information to identify any changes that might be necessary to successfully implement accreditation.
- To collate information from all pilot sites, in order to identify common issues and enablers.
- To learn what activities pilot sites conducted that were most effective and efficient, and to utilize that information to implement accreditation.

Specifically, the impact analysis project's objectives were:

- To determine structures and processes that pilot sites instituted to implement accreditation requirements.
- To identify what gaps pilot sites filled to meet requirements.
- To determine the activities that were necessary for the design and implementation of a quality management system in the pilot sites.
- To collate the above information in order to gain knowledge about what worked best for the pilot sites.

QMP-LS coordinated a project start-up teleconference with the participation of the pilot laboratories to review the project approach, methodology, work plan and schedule; responsibilities of BearingPoint and pilot laboratories; the data collection and reporting process; site visit schedule; and any other issues and concerns. The information regarding impact was gathered through a series of guided interviews. Guided interviews were held three times with each site—two interviews over the telephone, and the third in person. A guided interview format was used with consistent questioning:

- How did you prepare for accreditation assessment?
- Why were the activities conducted?
- What structures and processes did you put into place to implement accreditation?

The pilot laboratories used the OLA requirements to monitor their progress in filling each of the gaps identified in the initial gap analysis. The BearingPoint consultant had regular telephone contact with the sites to monitor the activities, resources, structures and processes utilized to achieve conformance with the OLA requirements. The BearingPoint consultant conducted a final on-site interview. At each time of contact, the list of requirements was reviewed in detail. Activities, resources, structures and processes used to carry out the work of achieving conformance were tracked. Throughout the project, there was consistency month to month with what each pilot laboratory reported as their accomplishments and highlighted as their challenges. At the on-site interview, the external consultants spent time with a variety of staff, reviewing aspects of the gap analysis and the reported activities, resources, structures and processes. This helped clarify the preparatory activities and their impact on the laboratories. BearingPoint submitted its final report to QMP-LS in March.

BearingPoint reported that, initially, the majority of pilot sites identified 77 requirements or good practice recommendations they did not meet, and issues with about half of the requirements or good practice recommendations were observed in at least one laboratory. At the time of pilot visits, there were no requirements

that all sites did not feel prepared for. Initially, non-conformance was reported for 56 of point-of-care testing (POCT) requirements or good practice recommendations relating to quality management system, training, document control, inventory management, ordering protocols and quality assurance. At the time of the accreditation visit, the number of POCT requirements or good practice recommendations of concern to pilot laboratories was reduced to 45. Pilot sites reported that the staff resources required to prepare for peer assessments were substantial, with 6%–36% of staff involved one to five months prior to the assessment visit, ranging from one or two staff full-time to a couple of hours per week. All sites involved managers or supervisors (who contributed their time by extending the work day or putting off other projects). Only one site reported a new hire during the preparatory stage. No specific overtime costs were declared.

Pilot laboratories reported that the bulk of preparation was conducted within four months of the assessment date. Sites reported that the sheer volume of requirements was a challenge. Key enablers were to involve all laboratory staff and staff from other departments. Senior management support was critical to success. Timelines were established with tools to monitor them. Project teams championed the process. Staff were assigned specific projects, regular meetings were held and updates were provided. It was valuable to have employees who were certified assessors. Information technology was also of help. Staff from other departments were involved where necessary, and the value of sharing resources was emphasized. In all cases, it was deemed important to involve, educate and communicate with staff.

Advancing Implementation with Lessons Learned from Pilots: Peer Assessment Visits and Self-assessments

Implementation of OLA continued mid-2003 following a complete evaluation of the pilot process. Laboratories will receive peer accreditation assessment visits at least once every five years, and will perform self-assessments mid-way between visits. Peer assessment visits are required in order to formally assess conformance to requirements and issue certificates of accreditation. Self-assessments aid laboratories in determining their preparedness, and OLA in identifying requirements that all laboratories find difficult to meet. Laboratory notifications of self-assessments began in July and notifications of pending peer assessment visits in October. Laboratories receive four months' notice of pending peer assessment visits and self-assessments. An implementation schedule was devised in consultation with the Laboratories Branch, MOHLTC. The following considerations influenced the initial schedule: Laboratory Licensing and Inspection Service (LLIS) inspection schedule, request for early visits, laboratory corporations with multiple sites, geographical representation across Ontario in any one year, controlled travel costs and referral patterns.

According to the approved implementation schedule, all licensed laboratories will receive peer assessment visits by August 2008. Prior to March 31, 2004, 14 laboratories will receive peer assessment visits and approximately 54 laboratories will be visited annually thereafter. All laboratories not visited prior to March 31, 2004 are expected to complete self-assessments and submit exception reports to QMP-LS before November 2004. Thereafter, all licensed laboratories will be asked to perform self-assessments about halfway between the initial peer assessment visit and the five-year accreditation expiry date.

Prior to December 31st, 119 laboratories were notified of self-assessments and 14 of pending peer assessment visits.

Self-assessments are intended to assist laboratories in determining the degree to which they meet accreditation requirements. Self-assessments ensure that:

- laboratories continue to monitor their own conformance to accreditation requirements;
- QMP-LS can identify the degree to which laboratories meet requirements;
- QMP-LS can determine requirements that may be difficult to achieve.

The initial self-assessments will enable laboratories to identify which accreditation requirements they do not meet, what needs to be done to meet requirements, and what priorities must come first. These and subsequent self-

assessments will aid laboratories in preparing for peer assessment visits. Self-assessments help laboratories to ensure they “stay on track” to comply with accreditation requirements. A series of teleconferences were convened in order to help laboratories get ready for their first self-assessments with the aid of laboratories. Led by OLA staff, eight teleconferences occurred in 2003 and 38 laboratories submitted their self-assessment exception reports to OLA for review. OLA reviews submitted self-assessment exception reports to:

- Confirm that the laboratory has actually performed a self-assessment
- Observe the laboratory’s progress in implementing requirements
- Identify “problem” requirements across laboratories
- Identify any specific issues of concern for QMP–LS in an individual laboratory
- Provide the laboratory with direct feedback in the form of a statistical performance summary and reiteration of the laboratory’s non-conformances (within 30 days).

The peer assessment process is outlined in Appendix J. Key improvements to the accreditation process that were implemented after the pilot process are:

- The pre-assessment questionnaire (which is designed to assist OLA staff in planning the assessment visit agenda and compiling the assessment team) now includes information on POCT programs and laboratory information systems, in addition to information on the laboratory’s organizational structure, personnel, physical layout, specimen sources and molecular diagnostics technology.
- OLA will not assess the quality manuals in advance of peer assessments, but instead laboratories will be provided a form on which to submit their own assessments along with their quality manuals.
- During peer assessment visits, conformance to requirements will be assessed, but conformance to good practice recommendations will not. Laboratories are encouraged, however, to determine their conformance with good practice recommendations during self-assessments.
- During assessments, non-conformances will be categorized as major or minor (see Table 67).
- Laboratories will receive verbal conformance reports at the conclusion of assessment visits and written reports within 30 days.
- Laboratories will have 90 days after peer assessment visits to satisfactorily address all major non-conformances and submit an acceptable action plan to correct all minor non-conformances.
- Five-year certificates of accreditation will be issued to all laboratories that resolve all major non-conformances and submit acceptable action plans for minor non-conformances within 90 days (see Table 68).
- Two-year certificates of accreditation will be issued to all laboratories that submit acceptable action plans for addressing all major and minor non-conformances but have not yet resolved all major non-conformances in 90 days (see Table 68).
- If peer assessment findings adversely affect patient care and/or if laboratories fail to submit acceptable action plans for all major and minor non-conformances and/or if there is conclusive evidence that the generally accepted standard cannot be met, QMP–LS will recommend that no certificates of accreditation be issued. These recommendations will be made to the Conjoint Committee (see Table 68).

Table 67. OLA Non-conformances Classification

Minor Non-conformance

- Non-fulfillment of any requirement to a minor degree.
- An isolated incident of non-conformance.
- Adherence to procedures is inconsistent (usually followed but sometimes not).
- If own protocols followed, requirement would be met.
- An isolated incident of non-conformance observed in a laboratory, when all other areas meet the requirement.

Major Non-conformance

- Non-fulfillment of any requirement to major degree.
- Requirement not addressed by laboratory’s quality manual or operating procedures.
- Consistent/persistent incidence of non-conformance.
- Procedures are consistently NOT followed.
- Many minor non-conformances in the same area, or amongst sections of the laboratory.
- If existing protocols are followed, requirement still would not be met.

Table 68. Issuing OLA Certificates

Scenario	QMP-LS Action	Follow-up
Laboratory resolves all major non-conformances and submits an acceptable action plan for minor non-conformances within 90 days of assessment.	Issue five-year accreditation certificate	Regularly scheduled self-assessment and peer assessment visit occur.
Laboratory does not resolve all major non-conformances within 90 days of assessment but submits an acceptable action plan for all major and minor non-conformances.	Issue two-year accreditation certificate	Within the two years, a laboratory may apply to have a two-year certificate replaced with a five-year certificate, provided evidence is submitted substantiating all major non-conformances have been resolved. In some cases, a repeat peer assessment visit at the laboratory's expense may be necessary.
Assessment findings adversely affect patient care and/or laboratory does not resolve all major non-conformances and does not submit an acceptable action plan for all major and minor non-conformances and/or there is conclusive evidence that the generally accepted standard cannot be met.	Recommend intent to not issue certificate or to withdraw accreditation	File referred to Management and Conjoint Committees.

Ontario Laboratory Accreditation Requirements, Version 2, May 2003

OLA's peer review accreditation program standards are based on the international standard ISO 15189:2003 *Medical Laboratories—Particular Requirements for Quality and Competence*. Participating laboratory personnel and assessors in the pilot process aided in the refining of accreditation requirements. One of the purposes of pilots was to validate that accreditation requirements are reasonable and achievable for Ontario laboratories.

Pilot laboratories conducted gap analyses to determine their preparedness for pilot assessments. Initially, they identified their greatest number of non-conformances against quality management system requirements and good practice recommendations. Half of the pilot sites did not feel prepared for 18 requirements related to personnel policies (staff training, job descriptions, performance assessment, competence and record keeping), document control, referral services, physical facilities and environmental conditions, verbal requests for testing, computer calculation verifications, and safety (record keeping, contractors, safety training, personal safety issues related to hair, jewellery and loose clothing and a chemical hygiene plan). However, as the time of the pilot assessments came closer, the majority only considered themselves non-conforming with requirements and good practice recommendations pertaining to referral services and safety. Nearer to the pilot assessment visits, there were no requirements that all sites felt they did not meet.

Following the pilot peer assessments, conformance indicated that the majority of requirements piloted were reasonable and achievable. Assessors in at least one of the pilot laboratories observed issues with approximately half of the requirements and good practice recommendations. However, no requirements or good practice recommendations were observed as problematic in all six laboratories and only five similar observations were raised in five of the six assessments. Table 69 displays the requirements cited in five of six assessments and the resulting changes to these requirements. Interestingly, the five requirements of concern to most laboratories prior to assessments did not correspond to issues of non-conformance observed during assessments. Meeting the POCT requirements, where applicable, was an issue.

While the pilot assessments validated that requirements are reasonable and achievable, many suggestions for improvement were made during the pilots (avoiding duplication, removing redundancy, clarifying intent, transforming requirements into good practice recommendations or guidance information and eliminating unnecessary prescriptive discipline-specific directives). In addition, many references required updating. These suggestions came from pilot laboratory personnel, volunteer assessors and OLA staff. The OLA Advisory Panel vetted all suggestions and approved the deletion of 79 requirements and addition of 12 requirements resulting from combining previous requirements. Fourteen good practice recommendations were deleted and seven new good practice recommendations were added. Significant changes were made to guidance information. Summaries of changes included in the May 2003 release of requirements and guidance information (Version 2) are shown in Tables 70 and 71. Figure 58 provides a synopsis of how OLA requirements are organized. It is important to note that requirements are applicable to all laboratories regardless of the scope and volume of testing performed, and discipline-specific direction is provided within the guidance information but not the requirements themselves.

Requirements are maintained in a customized database that facilitates the monitoring of conformance and production of assessment reports.

Table 69. OLA Pilot Assessments—Requirements not Met by Five of Six Laboratories

Requirement	Resulting Changes (Version 2, May 2003)
Invalid or obsolete documents shall be promptly removed from all points of use, or otherwise assured against inadvertent use.	Combined with another requirement to read "Document control processes shall ensure that obsolete documents are removed and only currently authorized versions of appropriate documents are available for active use at relevant locations."
All laboratory examinations shall be based on methods cited in published peer-reviewed texts or journals, or be recommended by international, national, or regional guidelines. If in-house developed processes are used, they shall be validated for their intended use and fully documented.	Unchanged
For quantitative methods where the need to determine a reference interval is indicated and transference from another laboratory is inappropriate, a minimum of 120 reference values for each reference population or subclass is recommended.	Good practice recommendation now reads: for quarantine methods where the need to determine a reference interval is indicated and transference from another laboratory is inappropriate, a minimum of 120 reference values for each reference population or subclass is recommended.
Transference of reference intervals may be accomplished within a laboratory if the analytical systems in question are comparable. If both the analytical systems and the test subject population are comparable, transference may occur from one laboratory to another. Transference may only be deemed acceptable if the test subject population, and the entire methodology, from preparation of the test individual to the analytical measurement, are the same or appropriately comparable. Laboratories shall validate transference as per NCCLS Approved Guideline C28-A2 (How to Define and Determine Reference Intervals in the Clinical Laboratory).	Good practice recommendation now reads: for quarantine methods where the need to determine a reference interval is indicated and transference from another laboratory is inappropriate, a minimum of 120 reference values for each reference population or subclass is recommended.
There shall be a written policy for the resolution of discrepant results.	Now good practice recommendation.

Table 70. Number of OLA Requirements and Good Practice Recommendations, January 2002 vs. May 2003

Category	Number January 2002	Deleted	Added	Number May 2003
Requirements	618	79	12	551
Good Practice Recommendations	68	14	7	61

Table 71. Changes to the OLA Program Requirements and Guidance Information, Reflected in May 2003 Version 2

Type of Change	Rationale	Impact
Removed duplications and redundancies	Instances of duplication and redundancy were removed.	51 requirements, 2 good practice removed
Combined some requirements	There were instances where two requirements could be combined into one.	13 requirements, 5 good practice removed
Deleted requirements	A few requirements were deemed to be unnecessary, or represented excessive detail not in keeping with the process approach to assessment.	9 requirements and 1 good practice were removed
Added new requirements	Some former discipline-specific information was rewritten as requirements, some overly long requirements were split up.	12 new requirements
Clarification of intent	The pilots and other feedback yielded many constructive suggestions for changes.	105 requirements and/or the accompanying guidance information were revised
Essential⇒Good Practice	There were a few requirements that could not be met by 5 of the 6 pilot sites, some of these were removed, others were "down-graded" from requirements to good practice recommendations.	6 requirements were "down-graded" to good practice
Good Practice⇒Essential	A few good practice recommendations were deemed to be essential.	3 good practice were "upgraded" to requirements
Removed discipline-specific detail	Many of the discipline specific-points were removed because they were: - too detailed for a process-based assessment - redundant - not accompanied by a suitable reference - more suitable as examples to a requirement.	133 discipline-specific points were removed
Renumbered	A detailed correlation table is provided in "Revisions to Program Requirements and Guidance Information, May 2003"	Requirements were renumbered to avoid large gaps. Numbering will remain fixed in future versions
Updated references	OLA staff reviewed entire reference list to determine if they were still applicable, if a new version was released, or if new references were available.	Appropriate changes to the references were made. Reference report was split into two documents: - References to Program Requirements - References to Guidance Information

- I. Organizational Structure, Personnel Policies and Training, and Laboratory Management**
The laboratory's organizational structure, personnel policies and management shall provide the framework to meet the needs of patients and all personnel responsible for patient care. Laboratory management shall consist of those person(s) who manage the activities of the laboratory, headed by the laboratory director, and who are ultimately accountable to the owner/operator. The laboratory's organizational structure and position job descriptions shall identify the members of the laboratory management team. Laboratory management shall ensure that medical laboratory services are designed to meet the needs of patients and all personnel responsible for patient care.
- II. Quality Management System**
A laboratory shall operate efficiently and effectively if it meets regulatory requirements and is managed with the interests of patients and patient-care personnel in mind, while continually striving to improve its performance by means of a quality management system. It is important to identify (audit), measure, analyze and improve those instances where practice does not comply with the quality management system and/or documented operational policies, processes and procedures (problem identification). Documents and records shall be controlled, and referral services managed.
- III. Physical Facilities**
The laboratory's physical facilities shall support its activities. The laboratory space shall be allocated so that its workload can be performed without compromising the quality of work, safety of personnel, and patient care services. Laboratory design shall optimize the comfort of its occupants.
- IV. Equipment, Reagents and Supplies**
Processes for selection (purchasing) and use (inventory control) of purchased external services, equipment, and consumable supplies shall be defined as they affect the quality of the service.
- V. Pre-analytical Process**
The laboratory shall identify and document pre-analytical processes.
- VI. Analytical Process**
Analytical processes shall be defined to meet the needs of users and shall be documented.
- VII. Quality Assurance**
Quality assurance (internal quality control, interlaboratory comparisons and external quality assessment) shall provide adequate confidence that laboratory examinations fulfill the requirements for quality.
- VIII. Post-analytical Process (Reporting)**
Reporting processes shall be defined in accordance with patient care needs and regulations.
- IX. Laboratory Information System**
The laboratory information system (LIS) shall facilitate laboratory services and its processes shall be identified and documented.
- X. Safety**
The employer shall ensure that the safety and health of employees, patients and visitors are protected. Laboratory management shall implement a safe working environment in compliance with regulation and good practice. Laboratory management shall be familiar with applicable safety laws and consult reference documents for additional guidance.
- XI. Point-of-Care Testing**
The laboratory shall define and direct point-of-care testing that occurs within a facility, but outside the physical space of the laboratory (excluding legally qualified medical practitioners who perform laboratory examinations for the exclusive purpose of diagnosing or treating patients in their own offices and patient self-testing outside of a health care facility).

Figure 58. Sections of the Ontario Laboratory Accreditation Requirements Version 2, May 2003

ASSISTING LABORATORIES TO PREPARE FOR ACCREDITATION

Early in 2003, a five-pronged approach to help laboratory personnel prepare for accreditation was developed. This approach consisted of conducting assessor training, presenting seminars, publishing frequent newsletter articles, posting educational material on the QMP-LS Web site, and offering a symposium. Early in 2003, staff completed 16 *Am I Ready for Accreditation?* seminars designed to assist laboratories to prepare for accreditation. Linda Crawford attended NORONT in March and gave an interactive *Are We Ready?* session. Eight newsletter articles appeared throughout the year in *QMP-LS News*, in order to provide an update on OLA's progress and to offer tips to achieving accreditation. In May, Version 2 of OLA's *Guidance for Laboratory Quality Manuals* was released on the QMP-LS Web site. In December, a new section was introduced on the Web site titled *Frequently Asked Questions* and this section is devoted to clarifying the intent of OLA requirements.

ASSESSOR TRAINING

OLA assessors receive advance training and certification. Prior to 2003, 126 individuals who volunteered to serve as Ontario assessors received training and certification. Initial training of volunteers continued in the early months of 2003. Four training sessions were held during January, February and March, and an additional 60 individuals were certified as assessors. The current total number of available assessors is 184.

In order to conduct OLA peer assessments, assessors must meet screening criteria and complete formal training. Applicants accepted must:

- Possess professional credentials, (at the time of application) as required by the OLA program, in one or more of laboratory management, quality practices, and the various technical disciplines.
- Have worked in a laboratory or laboratory-related environment
- Possess good organizational, communication and inter-personal skills
- Be able to conduct at least one (1) OLA assessment per year
- Be able to attend the Assessor Training Program
- Be able to attend refresher courses, as required
- Agree to the OLA Conflict-of-Interest and Confidentiality Agreements prior to each assessment visit.

OLA's training course is comprehensive and meets international standards. The course consists of two segments. The first segment is individual self-directed Internet-based study including the following topics: expectations of assessors, introduction to OLA, the assessment process, quality management system rationale, goals and benefits, and how to conduct an assessment. The second segment is formal classroom training consisting of lectures, group discussions and role-playing over 2½ days, followed by a written examination. Practical topics covered during the classroom training are key concepts of assessing, how to perform assessments, behaviours that may be encountered and how to complete the assessment. Training is offered free of charge to those applicants selected for training.

OLA's goals in offering initial training to applicants were two-fold. While striving to certify a pool of assessors whose numbers and expertise are adequate to conduct the required number of assessments annually, another goal was to aid employers in preparing for self-assessments by having certified assessors on staff. With these goals in mind, additional applicants will be offered training in 2004 and refresher materials will be developed for the benefit of all certified assessors.

Assessor records are maintained in a database developed to facilitate selection of assessment teams based on assessor's expertise and preferences, as well as maintain training records and records of assessment activities.

ONTARIO LABORATORY ACCREDITATION SYMPOSIUM

On September 13th, a symposium on OLA was held in Toronto. Six hundred twelve participants from diverse backgrounds attended this largest symposium ever held by QMP-LS. Representatives from licensed Ontario laboratories, equipment and reagent vendors, the MOHLTC, identified stakeholder organizations and other interested individuals attended. The objectives of this symposium were to share:

- OLA's implementation plans
- Pilot impact analysis
- Pilot assessment experiences
- Expectations for self-assessments
- Expectations for peer assessments
- Changes to program requirements

Dr. Harold Richardson, Managing Director, QMP-LS, Dr. Gregory Flynn, Chairman of the Board of Directors, OMA, Mrs. Sheila Woodcock, Chair, OLA Advisory Panel and Ms. Dawn Ogram, Director, Laboratories Branch, MOHLTC, welcomed attendees. Linda Crawford provided an implementation update. Ms. Maide Yazar, Manager, Public Services, BearingPoint, provided results of the pilot impact analysis. Representatives from each of the pilot sites (Drs. Michel Bonin, Sheila Boss and Brian Rudrick and Mr. Maurice Goulet) presented their experiences. Three sessions were held concurrently in the afternoon: *Self-assessments: A How to Guide*, *Peer Assessments: What to Expect* and *The OLA Requirements: A Closer Look*.

Following the symposium, all slide presentations were posted on the QMP-LS Web site and remain available today. Evaluations from attendees indicated that objectives were met in the time allotted. In response to requests for more guidance on interpretation of OLA requirements, a new section of the QMP-LS Web site was devoted to the most frequently asked questions along with OLA's response.

ONTARIO LABORATORY ACCREDITATION ADVISORY PANEL

The members of the Ontario Laboratory Accreditation Advisory Panel (Appendix A) continued to provide valuable advice and assistance throughout 2003. The panel met in March and conducted two teleconference meetings in October. Web-based communication tools facilitated additional information-sharing and consultation throughout the year. Business concluded by the panel included the approval of the revised requirements for accreditation (Version 2, May 2003), approval of processes for conducting assessments, conformance assessment and issuing of accreditation certificates and approval of the implementation schedule. The panel approved the issuing of accreditation certificates to the six laboratories that participated in the pilot process.

Restructuring of laboratory services in Ontario necessitates the consideration of combining the peer assessment visits to laboratories with formal relationships, and approximately 150 licensed Ontario laboratories may be partnered in some fashion. The panel recommended that multi-site visits be conducted whenever laboratories demonstrate the existence of a single management structure and quality management system. While each licensed laboratory site must receive its own complete assessment, a formal report and an accreditation certificate, plans are underway to conduct multi-site peer assessment visits to qualifying laboratories within a reasonable period of time using a single assessment team.

The panel supports continued staff efforts to establish a partnership with the Standards Council of Canada (SCC) in the delivery of accreditation to Ontario's laboratories. Linda Crawford and Dr. Harold Richardson continued to attend SCC meetings in order to further this initiative.

Members of the panel representing QMP-LS throughout the year made several presentations. In March, Mr. Kurt Davis presented *Implementation of Global Standards Implementing ISO 15189* at the NCCLS Forum. In June, Mrs. Sheila Woodcock (with Linda Crawford) presented *The Design and Implementation of a New Mandatory Peer-review Accreditation Process* at the annual conference of the Clinical Laboratory Management Association in Salt Lake City, Utah.

TEST REVIEW COMMITTEE

The Test Review Committee advised Laboratories Branch, MOHLTC, throughout 2003 on the quality requirements for tests that are not currently listed in the Schedule of Benefits for laboratory services. Membership remains unchanged (Appendix A). Although the committee did not meet in person in 2003, electronic communications proved efficient and effective.

At intervals, the MOHLTC submits a list of tests for consideration by the committee. Additional requests that may require more urgent attention were dealt with expeditiously, e.g. West Nile Virus testing, Maternal Serum Screening tests.

Elements included in the report are:

- Quality requirements
- Patient preparation
- Collection and handling of specimens
- Quality assurance process, quality control procedures and quality indicators
- External quality assessment through interlaboratory comparisons
- Analytical policy and technical procedures
- Practice guidelines
- Clinical utility
- Health cost implications

Quality recommendations were submitted by the Test Review Committee to the Laboratories Branch, MOHLTC, for the tests referred in 2003 (Table 72). For the "well-established" category, preliminary comments with the relevant characteristics of note (clinical utility, external quality assessment, health cost implications, etc.) were provided to the Laboratories Branch and accepted.

Table 72. Tests for Which Quality Recommendations were Submitted to the MOHLTC

Tests under investigation in 2002 and submitted to Laboratories Branch in 2003	Additional referred tests reviewed and completed in 2003	Well-established category tests not requiring full criteria
Cystatin C Anti-Glomerular Basement Membrane Antibody Anti-Scl 70 Anti-Liver-Kidney-Microsomal (LKM) antibodies Anti-Jo-1 Antibody Anti-Centromere Antibody Citrate Lipoprotein (a) Lactose Intolerance—Methane and Hydrogen	Maternal Serum Screening (MSS) tests (Free Beta-Human Chorionic Gonadotropin, Inhibin, Pregnancy Associated Plasma Protein-A) Antiphospholipid Antibody Testing Echis Factor/Echarin Clotting Time Ristocetin Co-factor Assay Chylomicrons Intralipid West Nile Virus (WNV) testing	Rh Rosette Test

The existing processes concerning appeals, unmet quality criteria and tests not requiring quality criteria (as outlined in the 2002 Review) have continued to allow prompt communication between LLIS and the Test Review Committee and as a result, minor modifications have been made to a few reports in response to queries received from laboratories.

The function of the Test Review Committee is greatly enhanced by the services of external advisors (Appendix B) and current or former scientific committee members who have willingly assisted in sharing specific knowledge and expertise in the preparation of expert opinion reports. Their contributions are acknowledged with thanks and appreciation.

COLLABORATIVE EFFORTS

Staff liaised with Mr. Pat Paladino and Mr. Stephen Cross of the Standards Council of Canada, Mrs. Nancy Heddle, Ms. Kate Gagliardi and Ms. Ray Berger from the Transfusion Ontario Program, as well as Drs. Arseneault and Tilak of Hospitals In-Common Laboratory Inc. Linda Crawford presented *Are We Ready for Ontario Laboratory Accreditation?* at NORONT in March and participated in a panel presentation and discussion during the Canadian Society for Medical Laboratory Science (CSMLS) Congress in June on *Transfusion Standards for Accreditation*. Julie Coffey attended the Triple G Users Group Meeting in June and made a presentation titled *OLA Bits and Bytes*. Linda Crawford presented *Rolling Out Ontario Laboratory Accreditation* at a multidiscipline seminar for medical laboratory technologists sponsored by Sanguin Consultation Services in July.

An Accreditation Working Group of the Interprovincial Quality Assurance group (proposed new name is the Canadian Coalition for Quality in Laboratory Medicine) was formed in 2002 chaired by Linda Crawford. In June 2003, this Accreditation Working Group held a meeting in Quebec City where it pledged to identify and work towards commonalities amongst provincial medical laboratory accreditation programs. Specific topics for discussion were identified as assessment means, checklist use, assessment follow-up protocols, human resources required and desirable standards for accreditation. Representatives from six provinces (Alberta, British Columbia, Manitoba, Ontario, Quebec, and Saskatchewan) actively participate. Two additional meetings were convened via teleconference in October and November. It was agreed that regardless of the number of laboratories to be accredited or the frequency of assessments, a minimal number of permanent staff is necessary for the success of an accreditation program. Furthermore, a large number of paid “volunteers” is required and these volunteers are needed to serve as advisors, consultants and assessors. The group also confirmed that ISO 15189 is the preferred standard upon which medical laboratory accreditation should be based, while provincial and locally derived standards as well as NCCLS standards and guidelines are valuable and necessary additions to this international standard.

FUTURE PLANS

OLA implementation will advance in 2004 with peer assessment visits and self-assessments. Additional assessors will be trained and refresher materials developed and distributed. The processes of accreditation will be aligned with the QMP-LS quality system and refined through continual improvement measures. This will be aided by the evaluation of peer assessment visits submitted by assessors and laboratories. The customized accreditation databases will be enhanced with reporting features to maintain records, measure and monitor progress. Program information and updates will be distributed through the QMP-LS Web site.

APPENDICES

Appendix A

2003–2004 QMP–LS Committees

CONJOINT

MOHLTC Representatives:

Ms. Dawn Ogram (to December 2003)

Ms. Marnie Cooper (from January 2004)

Ms. Patricia Anderson

Ms. Leela Prasad

OMA Representatives:

Dr. Harold Richardson

Dr. Gregory J. Flynn

Dr. Michael Thoburn

MANAGEMENT

Dr. Gregory J. Flynn

Dr. C. Mark Cheung

Ms. Marnie Cooper (from January 2004)

Dr. Daniel Klass

Ms. Dawn Ogram (to December 2003)

Dr. Michael Thoburn (ex-officio)*

Dr. Harold Richardson (ex-officio)

Mrs. Kathy Wilkie

ADVISORY COUNCIL

College of Physicians & Surgeons of Ontario

Dr. Daniel Klass

College of Medical Laboratory Technologists of Ontario

Mrs. Kathy Wilkie

Association of Medical Microbiologists of Ontario

Dr. Alicia Sarabia

Ontario Association of Medical Laboratories

Mr. Don Kerr

Ontario Association of Pathologists

Dr. Frank E. Thompson

Ontario Hospital Association

Mr. Glen Dietz

Ontario Medical Association

Section on Laboratory Medicine

Dr. Barry W. Sawka

Ontario Society of Medical Technologists

Mrs. Blanca McArthur

Ontario Society of Clinical Chemists

Dr. Lynn Allen

PROFESSIONAL ADVISORY COMMITTEE

Dr. C. Mark Cheung

Dr. Robert Barr

Dr. Scott Boerner

Dr. Nancy Carson

Mr. Mark Donahoe

Dr. Fran Jamieson

Mrs. Suba Krishnan

Mr. John Lafferty

Dr. James Mahony

Dr. A. Rocke Robertson

Dr. Murray E. Treloar (to June 2003)

ONTARIO LABORATORY ACCREDITATION ADVISORY PANEL

Mrs. Sheila Woodcock

Mrs. Linda Crawford (ex-officio)

Mr. Kurt Davis

Dr. Joel Goodman

Dr. Denis Macdonald

Mr. Gaman Modi

*Ms. Dawn Ogram**

Dr. John Penswick

*Ms. Leela Prasad**

Dr. Harold Richardson (ex-officio)

Dr. Sandip Sengupta

Dr. Brian Sheridan

TEST REVIEW COMMITTEE

Dr. Robert Moore

Dr. Kenneth Arnold (OMA Representative)

Dr. David E. C. Cole

Dr. Gregory J. Flynn

Dr. Harold Richardson (ex-officio)

Dr. Sandip Sengupta

Dr. Frank E. Thompson

Mr. Sam Thomson

*Ms. Leela Prasad**

* Ex-officio member with voting rights

Note: Names in italics identify Chairs

CHEMISTRY-GENERAL & ENZYMES

Dr. C. Mark Cheung
Dr. Vipin Bhayana
Dr. Sheila Boss
Mr. David Carson
Dr. Christine Collier
Dr. Stephen A. Hill
Dr. Ken Newell

Drug Monitoring Advisor:
Dr. Edward Dunn

Point-of-Care Testing, Advisor:
Ms. Cathie McCallum

ENDOCRINOLOGY & IMMUNOLOGY

Mr. Mark Donahoe
Ms. Linda Evelyn (Bossie)
Dr. Peter S. Bunting
Dr. David E.C. Cole
Dr. Mario D'Costa

Endocrinology Advisor:
Dr. Pui-Yuen Wong

MATERNAL SERUM SCREENING

Mrs. Suba Krishnan
Dr. Jo-Ann Johnson
Dr. Natalie Lepage
Mrs. Andrea O'Donnell
Dr. Anne M. Summers
Dr. Pui-Yuen Wong

MSS Database Consultant:
Mr. Chris Meier

HEMATOLOGY

Mr. John Lafferty
Dr. Malcolm Carlson
Dr. Mark Crowther
Mr. Michael Keeney
Dr. Denis Macdonald
Mr. Jeffrey Sumner
 Flow Cytometry Advisor:
Mr. Praniti Soamboonsrup

TRANSFUSION MEDICINE

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Dr. Jeannie Callum
Mrs. Laura J. Harrison
Mrs. Debbie Lauzon
Ms. Wendy Owens

MICROBIOLOGY

Dr. Frances B. Jamieson
Ms. Candy Rutherford
Dr. Alicia Sarabia
Ms. Marilyn Sarina
Dr. Baldwin W. Teye
Dr. Dick E. Zoutman
 Parasitology Advisory:
Dr. Frances Jamieson
Dr. Douglas W. MacPherson
Ms. Rose McQueen
 Mycology Advisory:
Dr. Frances Jamieson
Ms. Ursula Bunn
Dr. Susan E. Richardson
Dr. James Scott

VIROLOGY

Dr. James B. Mahony
Dr. Margaret Fearon
Dr. Tony Mazzulli
Mr. John Nishikawa

ANATOMIC PATHOLOGY

Dr. A. Rocke Robertson
Dr. Geoffrey W. Gardiner
Dr. OLA A. Kassim
Ms. Laurie Mason
Dr. David Murray
Mr. William R. Parks
Ms. Sue Seguin
Dr. Sandip Sengupta
Dr. Frank E. Thompson
Dr. Murray E. Treloar (to June 2003)

CYTOLOGY

Dr. Scott L. Boerner
Dr. Monique Arquint
Dr. Yvan C. Bedard
Mrs. Sue Clipsham
Dr. Linda Kapusta
Mr. Marvin K. Maclean

GENETICS

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Dr. Kathy Chun
Mrs. Viola Freeman
Dr. Karen Harrison
Ms. Dara Kennedy
Dr. Peter Ray
Dr. Ikuko E. Teshima

* Ex-officio member with voting rights
 Note: Names in italics identify Chairs

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Ms. Diane Armstrong	Dr. John Freedman	Dr. Michael J. Raymond
Ms. Linda Borycheski	Ms. Karen Green	Ms. Gwen Rosenfield
Dr. William Brien	Ms. Ilene Guglielmi	Mr. Vito Scalia
Ms. Shirley Brown	Ms. Jennine Kafka	Mr. Glen Small
Ms. Virgincita Bryan	Dr. John Kim	Ms. Carol Swantee
Ms. Jessica Carson	Dr. Robert Lannigan	Ms. Donna Thompson
Ms. Santina Castriciano	Dr. Wendy Lau	Mr. Steve Thompson
Mrs. Patti Cheatley	Mr. Scott MacDonald	Ms. Liese Walchuk
Ms. Pam Chedore	Ms. Theresa Mahony	Ms. Lai Ling Wat
Mr. Ahmed Coovadia	Ms. Laurie Malloch	Ms. Carol Wenzel
Mr. David Core	Dr. Allison McGeer	Ms. Barbara Willey
Ms. Debra Deacon	Mr. Subash Mohan	Ms. Wendi Woods
Dr. Dennis Delaney	Mrs. Connie Pletch	
Mr. Diaram Deokharan	Dr. Russell Price	

ONTARIO LABORATORY ACCREDITATION

Mr. Richard Bedard	Mr. Glen Dietz	Ms. Lisa Merkley
Dr. Michel Bonin	Dr. Michael A. Drebot	Ms. Pauline Monks
Dr. Sheila Boss	Dr. Gregory Flynn	Mr. Jim Moran
Ms. Gini Bourner	Mr. Maurice Goulet	Mr. David More
Dr. William Brien	Ms. Chin Ho	Dr. Karam Ramotar
Dr. Peter Bunting	Ms. Ruth Jaeger	Dr. Jennifer Raymond
Dr. Max Chernesky	Ms. Pam Kirwan	Dr. Michael J. Raymond
Ms. Betty Anne Clark	Dr. Robert Lannigan	Mr. Jack Sinclair
Ms. Rose Costa	Ms. Cathie McCallum	Ms. Linda Turner-Smith

Harold Richardson	Managing Director
Joanne Bishop	Staff Technologist, OLA
Darlene Cameron	Data Officer
Jason Chard	Systems Analyst
Julie Coffey	Staff Technologist, OLA
Linda Crawford	Director, OLA
Ruby Dubash	Managing Editor
Christine Fleming	Consultant Technologist, EQA—Bacteriology, Mycobacteriology, Parasitology
Beverley Glenday	Senior Administrative Assistant, Special Projects
Jane Gun-Munro	Director, EQA and Quality Manager
Bryan Hewlett	Consultant Technologist, EQA—Anatomic Pathology, Cytology
Neela Khatri	Senior Systems Analyst
Maritess Koerner	Communications Assistant
Emily Lee	Receptionist
Alex Lesniara	Senior Systems Analyst
Dan MacFayden	Director, Information Services
Carol Major	Consultant Technologist, EQA—Mycology, Virology
Joanne Miyazaki	Manager, Business Development and Education and Consultant Technologist, EQA—Genetics, Maternal Serum Screening
Matt O'Connor	Corporate Administrative Assistant
Astrid Petersons	Consultant Technologist, EQA—Flow Cytometry, Transfusion Medicine, Point-of-Care Testing
Anne Raby	Consultant Technologist, EQA—Hematology, Coagulation, Morphology, Bone Marrow, Red Cell Disorders
Shelly Rowe	Senior Systems Analyst
Maureen Singh	Senior Administrative Assistant, EQA
Miralla Suares	Senior Administrative Assistant, OLA
Brenda Todd	Senior Administrative Assistant, EQA
Carol Turner	Staff Technologist, OLA
Betty Waltenberry	Data Officer
Sharon Webb	Consultant Technologist, EQA—Chemistry-General, Drug Monitoring, Endocrinology, Immunology, Enzymes, Cardiac Markers and Lipids
Margaret Hall Yousefi	Web site Officer
Manny Zamora	Assistant, Expediting

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Module 1: An Overview of the Laboratory in Modern Health-care

Module 2: Laboratory Management

Module 3: People Management

Module 4: Operational Systems

Module 5: Laboratory Design and Layout

Module 6: Workplace Health and Safety

Module 7: Tips for Decision-makers

Module 8: Self-assessment Exercises

Thompson JS, Thompson DS, Blakaj S, Berisha L, Kurti A, Osmani GM and Richardson H. *Use of Mast Bacteruritest™ test strip as inoculator for qualitative and quantitative quality control of bacteriological culture media*. Canadian Association for Clinical Microbiology and Infectious Diseases (CACMID), Montreal, Quebec. November 2003.

TOPIC/EVENT	DATE	LOCATION	QMP-LS REPRESENTATIVE
<i>Project Management</i> Michener Institute's Fundamental Skills of the Quality Manager 100 Course	January	Toronto, Ontario	Dr. Harold Richardson
<i>Update and Future Directions of QMP-LS</i> Abbott Diagnostics Cell-Dyn 3200 Users Groups (2)	February	Ottawa, Ontario	Mrs. Linda Crawford
<i>Ontario Laboratory Accreditation—Are We Ready?</i> 25 th NORONT Conference	March	Timmins, Ontario	Mrs. Linda Crawford
<i>Implementation of Global Standards</i> <i>Implementing ISO 15189</i> 2003 NCCLS Leadership Conference	March	Washington, D.C.	Mr. Kurt Davis
<i>The Path to Accreditation—Medical Laboratories in Ontario</i> CAREC Meeting Strengthening of Medical Laboratory Services in the Caribbean	April	Port of Spain, Trinidad and Tobago	Dr. Harold Richardson
<i>The Case for Using ISO 15189 Standards in the Caribbean</i> CAREC Meeting Strengthening of Medical Laboratory Services in the Caribbean	April	Port of Spain, Trinidad and Tobago	Dr. Harold Richardson
Provincial Advisory Group Meeting	April	Toronto, Ontario	Dr. Harold Richardson
<i>QMP-LS</i> OMA Section on Laboratory Medicine Council Meeting AGM, OMA Section on Laboratory Medicine	April	Hamilton, Ontario	Dr. Harold Richardson
<i>Quality Systems in Laboratory Medicine</i> Specifically ISO 15189, NCCLS HS1A, and others (Six Sigma and Balanced Scorecard, CCQML—IPQA) Quality Council Retreat	June	Ottawa, Ontario	Dr. Harold Richardson
<i>Ontario Laboratory Accreditation</i> Triple G User's Group Conference	June	Goderich, Ontario	Mrs. Julie Coffey
<i>Transfusion Standards for Accreditation</i> Health Canada Standards in Blood Banking 2003 Joint Congress of the Canadian Society for Medical Laboratory Science (CSMLS) and the Ordre professionnel des technologistes médicaux du Québec (OPTMQ)	June	Quebec City, Quebec	Mrs. Linda Crawford
<i>Design and Implementation of a New Mandatory Peer-review Accreditation Process</i> 2003 Conference of the Clinical Laboratory Management Association (CLMA) and the American Society for Clinical Pathology (ASCP)	June	Salt Lake City, Utah	Mrs. Linda Crawford, Mrs. Sheila Woodcock

TOPIC/EVENT	DATE	LOCATION	QMP-LS REPRESENTATIVE
<i>Rolling out Ontario Laboratory Accreditation</i> Multidiscipline Seminar for Medical Laboratory Technologists, Sanguin Consultation Services	July	Toronto, Ontario	Mrs. Linda Crawford
<i>Quality Assurance</i> Career Canada College	August	Toronto, Ontario	Dr. Harold Richardson
<i>Focus on ISO 15189</i> Clinical Laboratory Management Association (CLMA) CLMA Audio conference	August	Toronto, Ontario	Dr. Harold Richardson
<i>Quality: Reality or Myth?</i> Annual National Medical Laboratory Week (NMLW) Symposium	September	Toronto, Ontario	Dr. Harold Richardson
<i>Anatomic Pathology Pilot Surveys</i> Ontario Society Medical Technologists (OSMT) Convention	September	London, Ontario	Mr. Bryan Hewlett
<i>Are Your Laboratory Results Reliable</i> American Society for Quality (Toronto Chapter)	October	Toronto, Ontario	Ms. Jane Gun-Munro
<i>Chemistry Response Data</i> Ontario Society for Clinical Chemists	November	Hamilton, Ontario	Ms. Jane Gun-Munro

EVENT/TOPIC	DATE	LOCATION	PLANNERS/PRESENTERS MODERATORS
Symposium on Ontario Laboratory Accreditation Welcoming Remarks	September	Toronto Congress Centre Toronto, Ontario	Dr. Harold Richardson Mrs. Sheila Woodcock Dr. Gregory Flynn Ms. Dawn Ogram
Implementation Update			Mrs. Linda Crawford
Pilot Accreditation Visits: Impact Analysis			Ms. Maide Yazar Mrs. Linda Crawford
Pilot Accreditation Visits: Site Experiences			Mr. Maurice Goulet Dr. Michel Bonin Dr. Sheila Boss Dr. Brian Rudrick
Concurrent Breakout Sessions:			
Session A: Self-Assessments: A "How To" Guide			Mrs. Joanne Bishop Ms. Carol Turner
Session B: Peer Assessments: What to Expect			Mrs. Linda Crawford Ms. Betty Anne Clark
Session C: The OLA Requirements: A Closer Look			Mrs. Julie Coffey Mrs. Sheila Woodcock
Joint QMP-LS/Michener Institute Workshops			
Effusion Cytology: Challenges, Pitfalls & Ancillary Studies	February	Toronto	Mr. Scott MacDonald
Gynecological Cytology Update	October	Toronto	Mr. Scott MacDonald
Other			
On-line education courses Introduction to Hematology: The Erythrocyte	Introduced in 1997		Mr. John Lafferty
Erythrocyte Disorders: Detection and Diagnosis	Introduced in 2000		Mr. John Lafferty

CHEMISTRY**Chemistry-General**

Albumin
 Albumin Excretion Rate (AER)
 Bicarbonate
 Bilirubin, Total
 Blood Gases (pH, pCO₂, pO₂, Na⁺, K⁺, Glucose, Ionized Calcium)
 Hb A_{1c}
 Calcium, Total
 Chloride
 Creatinine
 Glucose
 Magnesium
 Phosphate
 Potassium
 Protein, Total
 Sodium
 Urate
 Urea
 Urine Chemistry (Quantitative Protein, Sodium, Potassium, Creatinine, Osmolality)

Drug Monitoring

Acetaminophen
 Carbamazepine
 Cyclosporine
 Digoxin
 Drugs of Abuse
 Ethanol
 Gentamicin
 Lithium
 Phenobarbital
 Phenytoin
 Salicylate
 Tacrolimus
 Theophylline
 Tobramycin
 Valproic Acid
 Vancomycin

Endocrinology

Total Triiodothyronine (TT₃)
 Thyrotropin (TSH)
 Free Thyroxine (FT₄)
 Free Triiodothyronine (FT₃)
 Vitamin B₁₂
 Ferritin
 Cortisol
 Total Testosterone
 Follicle Stimulating Hormone (FSH)
 Luteinizing Hormone (LH)
 Progesterone
 Prolactin
 Chorionic Gonadotropin (CG)
 Alpha Fetoprotein (AFP)
 Estradiol
 Prostate Specific Antigen (PSA)
 Free PSA
 Dehydroepiandrosterone sulphate (DHEA-S)

Enzymes, Cardiac Markers & Lipids

Alkaline Phosphatase (ALP)
 Alanine Aminotransferase (ALT)

Amylase
 Aspartate Aminotransferase (AST)
 Gamma Glutamyl Transferase (GGT)
 Homocysteine
 Lactate Dehydrogenase, Total (LD)
 Lipase
 Total Creatine Kinase (Total CK)
 CK-2
 Serum Myoglobin
 Serum Troponin I
 Serum Troponin T
 Cholesterol
 Triglycerides
 HDL-cholesterol (HDL-C)
 Calculated LDL-cholesterol (LDL-C)

Immunology

Antinuclear Antibody (ANA)
 Rheumatoid Factor (RF)
 Antimicrobial Antibody (MAH)
 C-reactive Protein (CRP)
 High Sensitivity CRP
 Anti-DNA

Specific Proteins:

IgG
 IgA
 IgM
 IgE
 C3
 C4

Protein Electrophoresis**Maternal Serum Screening****Serum Analytes:**

Alpha Fetoprotein (AFP)
 Chorionic Gonadotropin (CG)
 Unconjugated Estriol (uE₃)

Multiple of Median (MoM):

AFP, CG, and uE₃

Initial Positive Rate (IPR):

Trisomy 18
 Trisomy 21
 Open Neural Tube Defect (ONTD)

HEMATOLOGY**Bone Marrow****Aspirate and Biopsy****Coagulation**

Prothrombin Time (PT)
 International Normalized Ratio (INR)
 Activated Partial Thromboplastin Time (APTT)
 Factor VIII
 Factor IX
 D-dimer
 Thrombophilia Investigation:
 Activated Protein C (APC) Resistance
 Antithrombin III
 Protein C
 Protein S
 Factor V Leiden

Flow Cytometry

Lymphocyte Immunophenotyping (HIV)
Leukocyte Immunophenotyping
(Hematological Investigation)
CD34+ Stem Cell Enumeration

Red Cell Disorders

Hemoglobin S Screen
Hemoglobin Fraction Quantitation
Fetal Maternal Hemorrhage
Glucose-6-phosphate Dehydrogenase (G6PD)

Morphology

Peripheral Blood Film:
Differential Leukocyte Count
Descriptive Morphology
Clinical Relevance

Routine Hematology

Leukocyte Count
Erythrocyte Count
Hemoglobin
Hematocrit
Mean Corpuscular Volume
Thrombocyte Count
Reticulocyte Count
Automated Leukocyte Differential

Transfusion Medicine

ABO and Rh Grouping and Interpretation
Antibody Detection
Antibody Identification
Direct Antiglobulin Testing (DAGT)
Crossmatching
Phenotyping
Elutions
Titrations

MICROBIOLOGY**Bacteriology**

Aerobic and anaerobic isolation and identification
of organisms from:
Blood
Genital specimens
Throat swabs
Urine
Body fluids
Other swabs/pus
Sputum
Stool samples
Serological grouping and identification
Quantitative urine cultures
Interpretation and reporting of cultures
Antimicrobial susceptibility testing
Interpretation and reporting of susceptibility findings
Gram stain interpretation
Special stains

Mycobacteriology

Detection of acid-fast bacilli from direct smears
Quantification of acid-fast bacilli

Mycology

Isolation and identification of:
Dermatophytes
Moulds
Yeasts
Wet preparations for fungal elements

Parasitology

Wet preparation examination of stool samples
Preparation of faecal concentrates
Staining of samples for gastrointestinal parasites
Identification and quantification of parasites
Use of special stains

Virology

Antibody detection:
Cytomegalovirus
Hepatitis A and B
Hepatitis C
HIV
Rubella
VZV
Antigen Detection:
Chlamydia trachomatis
Respiratory Syncytial Virus
Influenza A virus

GENETICS**Cytogenetics**

Blood
Bone Marrow
Tumour
Tissue
Amnion Cells

Molecular Diagnostics of Inherited Diseases**ANATOMIC PATHOLOGY****Histopathology****Histotechnology**

Routine stains
Special stains
Immuno-histochemistry stains

Cytopathology

Gynecological
Non-Gynecological
Respiratory:
Sputum
Bronchial washings
Bronchial brushings
Urinary
Body fluids
Fine needle aspiration of breast
Fine needle aspiration of head and neck:
Thyroid
Lymph node
Salivary glands

OTHER**Point-of-Care Testing**

Glucose Meters

Chemistry	CHEM				
	0301	0303	0305	0307	0310
	209	151	206	153	206
	129	67	174	81	89
	22	9	40	11	31
	9	1	15	4	6
	29	14	52	15	30
	0	0	0	1	0
	Total Receiving survey				
	Total number of labs presented				
Significant Error					
Lesser Error					
Correspondence					
OSC recommended					

Drug Monitoring	DRUG				
	0301	0303	0305	0307	0310
	119	116	165	142	170
	74	77	64	106	85
	26	6	13	28	14
	2	3	2	3	2
	22	11	13	27	19
	0	0	0	0	0
	Total Receiving survey				
	Total number of labs presented				
Significant Error					
Lesser Error					
Correspondence					
OSC recommended					

Enzymes	ENZY			
	0301	0303	0306	0310
	204	200	194	196
	57	99	37	103
	3	11	2	6
	2	5	1	3
	10	16	3	8
	0	0	0	0
	Total Receiving survey			
	Total number of labs presented			
Significant Error				
Lesser Error				
Correspondence				
OSC recommended				

Lipids	LIPS		
	0301	0306	0310
	142	138	136
	80	99	80
	27	12	18
	0	2	1
	27	14	17
	0	0	0
	Total Receiving survey		
	Total number of labs presented		
Significant Error			
Lesser Error			
Correspondence			
OSC recommended			

Endocrinology					Immunology					Maternal Serum Screening				Point of Care Testing					
ENDO					IMGY					MSS				POCT					
0303 0304 0306 0309 0311					0303 0304 0306 0309 0311					0303 0304				0309					
127 123 123 123 122					75 74 72 71 71					7 7				196					
16 15 32 20 19					36 38 16 23 18					0 0				4					
2 3 4 4 9					8 5 2 4 6					0 0				0					
1 1 9 0 4					1 1 2 3 1					0 0				0					
3 12 14 7 12					24 12 4 8 8					0 0				0					
0 0 0 0 0					0 0 0 0 0					0 0				0					
Total Receiving survey					Total Receiving survey					Total Receiving survey				Total Receiving survey					
Total number of labs presented					Total number of labs presented					Total number of labs presented				Total number of labs presented					
Significant Error					Significant Error					Significant Error				Significant Error					
Lesser Error					Lesser Error					Lesser Error				Lesser Error					
Correspondence					Correspondence					Correspondence				Correspondence					
OSC recommended					OSC recommended					OSC recommended				OSC recommended					
Hematology					Red Cell Disorders				Flow Cytometry				Coagulation			Morphology			
HEMA					RCD				FLOW				COAG			MORP			
0303 0305 0308 0310					0304 0308				0303 0309 0311				0302 0308			0302 0304 0308 0311			
67 218 67 217					87 33				19 19 12				206 201			213 209 207 206			
5 34 10 17					16 4				8 5 7				36 14			4 17 13 30			
3 8 8 5					3 1				1 0 2				7 1			0 6 5 10			
0 13 0 3					4 0				0 2 0				6 10			4 2 1 12			
5 21 8 16					16 4				6 2 5				37 13			4 12 11 22			
0 0 0 0					0 0				0 0 0				0 0			0 0 0 0			
Total Receiving survey					Total Receiving survey				Total Receiving survey				Total Receiving survey			Total Receiving survey			
Total number of labs presented					Total number of labs presented				Total number of labs presented				Total number of labs presented			Total number of labs presented			
Significant error					Significant error				Significant error				Significant error			Significant error			
Lesser Error					Lesser Error				Lesser Error				Lesser Error			Lesser Error			
Correspondence					Correspondence				Correspondence				Correspondence			Correspondence			
OSC recommended					OSC recommended				OSC recommended				OSC recommended			OSC recommended			
Transfusion Medicine					Bacteriology					Mycology			Parasitology			Virology			
TMED					BACT					MYCO			PARA			VIRO			
0303 0305 0308 0311					0303 0306 0309 0311					0303 0307			0304 0310			0302 0304 0308 0311			
177 176 176 176					118 115 114 103					24 23			26 26			65 48 50 68			
113 117 46 42					54 82 79 63					12 13			12 10			19 28 17 19			
3 1 2 3					27 28 13 29					0 1			1 0			9 0 0 1			
194 25 13 8					12 20 19 16					0 0			11 1			0 0 0 0			
108 60 29 24					44 63 63 48					7 10			6 3			14 18 16 10			
0 0 0 0					0 0 0 0					0 0			1 0			0 0 0 0			
Total Receiving survey					Total Receiving survey					Total Receiving survey			Total Receiving survey			Total Receiving survey			
Total number of labs presented					Total number of labs presented					Total number of labs presented			Total number of labs presented			Total number of labs presented			
Significant error					Significant Error					Significant Error			Significant Error			Significant Error			
Lesser Error					Lesser Error					Lesser Error			Lesser Error			Lesser Error			
Correspondence					Correspondence					Correspondence			Correspondence			Correspondence			
OSC recommended					OSC recommended					OSC recommended			OSC recommended			OSC recommended			
Anatomic Pathology					Cytology			Genetics											
PATH					CYTO			GENE											
0306					0107			0303 0305 0308											
79					89			11 11 11											
17					0			11 11 11											
11					0			0 0 0											
7					0			0 0 0											
17					0			5 0 6											
0					0			0 0 0											
Total Receiving survey					Total Receiving survey			Total Receiving survey											
Total number of labs presented					Total number of labs presented			Total number of labs presented											
Significant Error					Significant Error			Significant Error											
Lesser Error					Lesser Error			Lesser Error											
Correspondence					Correspondence			Correspondence											
OSC recommended					OSC recommended			OSC recommended											

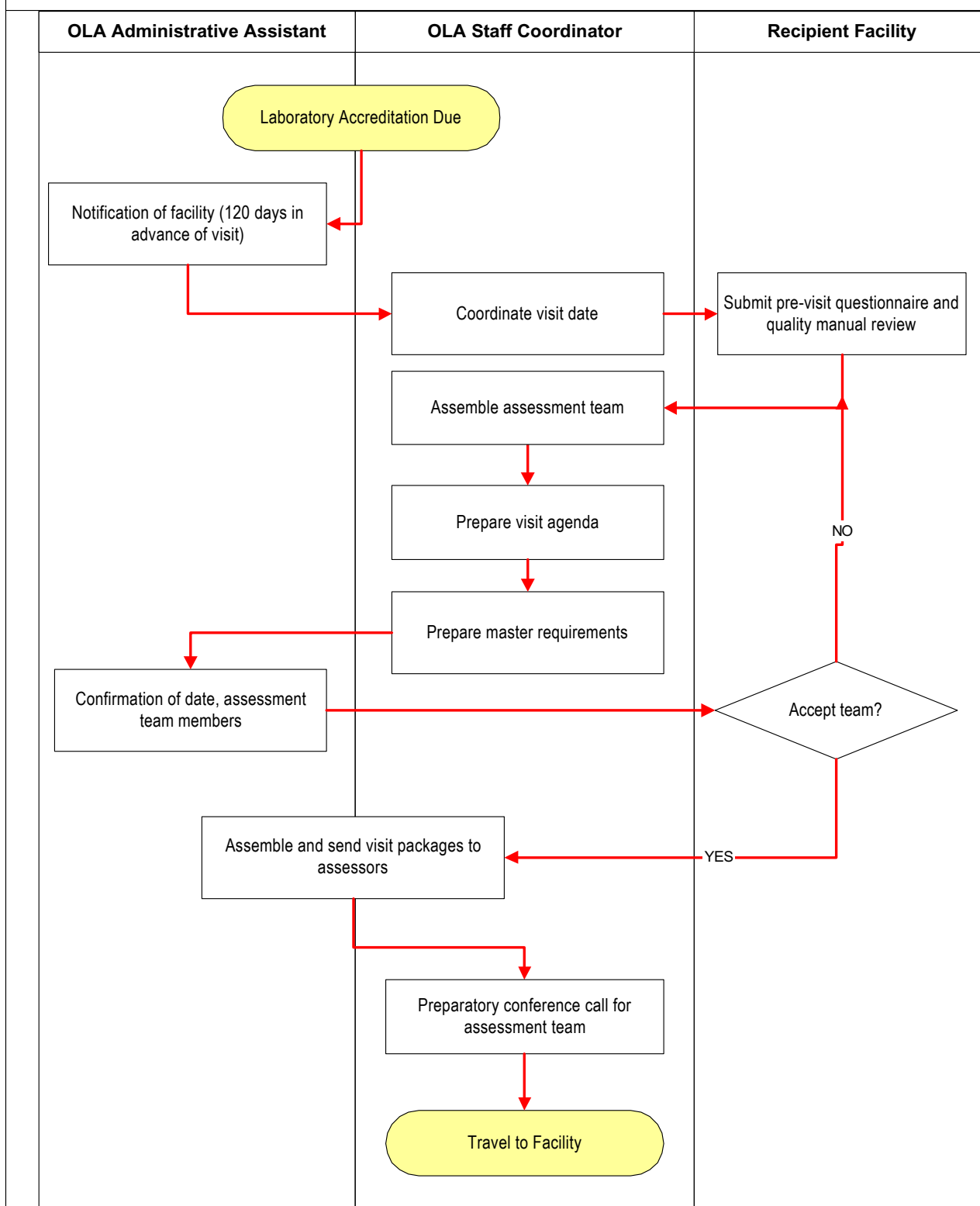
OLA ASSESSOR TRAINING SESSIONS

Date	Location	No. of Assessors
January 28–30, 2003	Milton, Ontario	18
February 10–12, 2003	QMP-LS	18
February 24–26, 2003	QMP-LS	15
March 19–21, 2003	QMP-LS	16

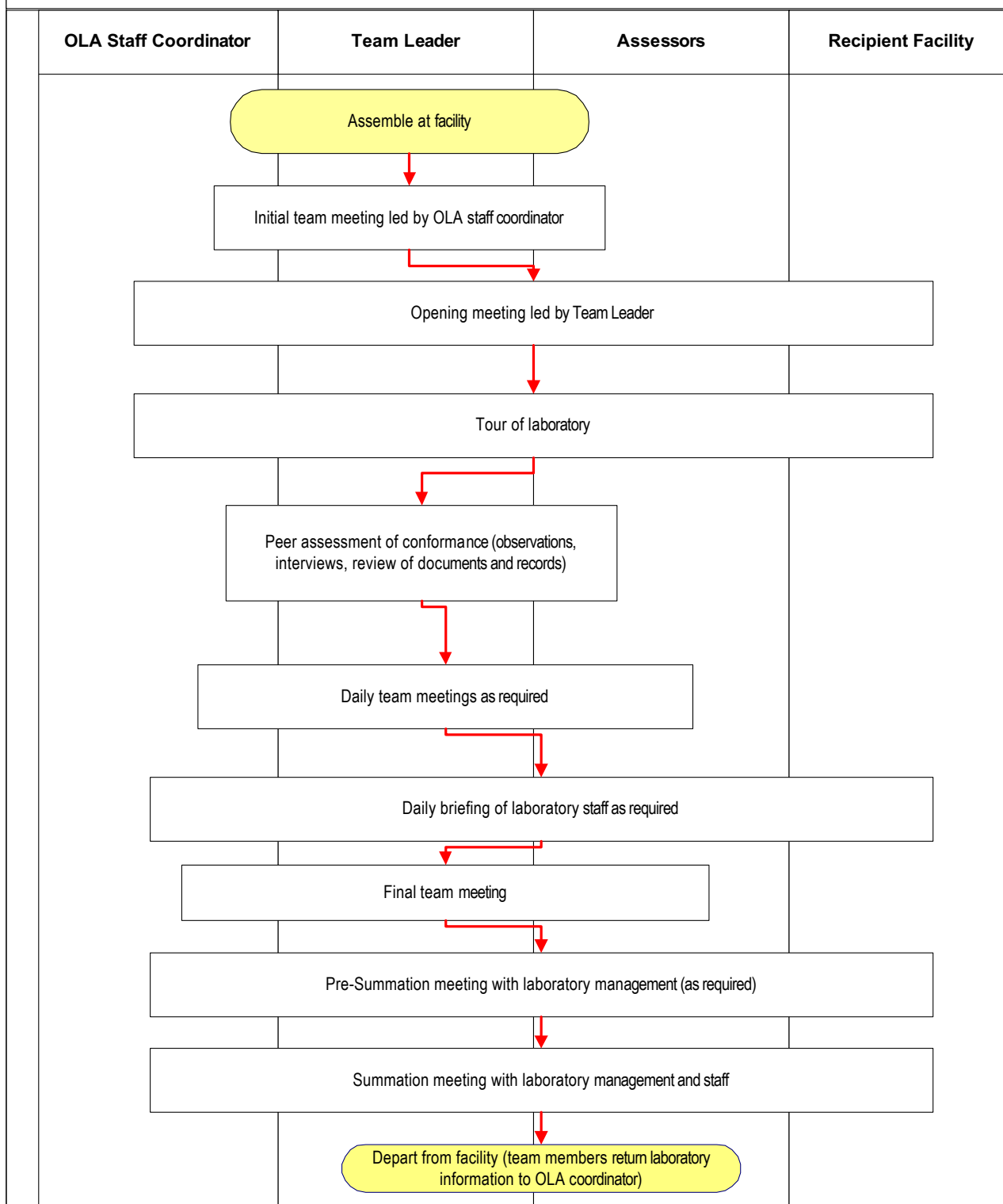
Am I Ready for Accreditation?

Location	Sessions	Date	QMP-LS Staff	Attendees
Brockville General Hospital Brockville, Ontario	2	January	Mrs. Linda Crawford	120
Gamma Dyna-care Oshawa, Ontario	2	January	Mrs. Linda Crawford	24
Kingston General Hospital Kingston, Ontario	2	January	Mrs. Linda Crawford	160
Credit Valley Hospital, Mississauga, Ontario	1	January	Mrs. Julie Coffey	130
North York General Hospital North York, Ontario	1	January	Mrs. Julie Coffey	50
Scarborough Hospital (Grace site) Scarborough, Ontario	1	January	Mrs. Julie Coffey	90
Scarborough Hospital (General site) Scarborough, Ontario	2	January	Mrs. Julie Coffey	90
Central Public Health Laboratories Etobicoke, Ontario	1	January	Mrs. Linda Crawford	110
The Hospital for Sick Children Toronto, Ontario	2	February	Mrs. Joanne Bishop	60
Huntsville and District Memorial Hospital Huntsville, Ontario	1	February	Mrs. Joanne Bishop	20
Kenora-Rainy River Regional Laboratories, Thunder Bay Regional Hospital and Northshore Lake Superior Laboratory Program, Northwest Ontario	1	February	Mrs. Linda Crawford	35

OLA Peer Assessment : Pre-Visit Activities



Process - OLA Peer Assessment Visit



Process - OLA Peer Assessment Post-visit

