

Contents

Message from the Director	2
Vision, Mission, Mandate	4
Strategic Planning: Visioning	6
Core Functions & Capabilities	7
A Closer Look: Strategic Initiatives	
Water	9
Bioterrorism	10
Hepatitis	11
Laboratory Public Health Surveillance	11
Laboratory Services Structure:	
Leadership Cluster Teams	12
Platform Technology Teams	13
Darrel Cook	16
Programs:	
Biological Safety Services	17
Infection Control & Prevention	19
Informatics	21
Molecular Diagnostics	23
Quality Assurance	25
Laboratory Services Sections:	
Enteric Bacteriology	28
Environmental Microbiology	30
General Bacteriology	34
Mycobacteriology/Mycology	37
Parasitology	40
Technical Support Services	43
Virology	45
Zoonotic Diseases & Emerging Pathogens/ Non-Viral Serology	48
Publications & Conferences	51



A Message from the Director

Looking Back; Looking Forward

Judith Isaac-Renton, MD, DPH, FRCPC

Our annual report is an opportunity to look back on the year past and to assess our progress. 2000, my second year as Director of Laboratory Services has been as exciting as the first. All laboratory staff participated in our Visioning Process, an enormous in-house strategic planning undertaking. I am grateful to everyone who participated so energetically. Particular thanks to John Hamilton for his leadership and his project management skills.

The laboratory-wide strategic planning process ended with written reports and prioritized recommendations from all the "Vision Teams." As I read and re-read the more than 200 suggestions, several themes emerged in the context of our new Vision and of our complex, changing health environment. These themes focused on the need to enhance our laboratory surveillance through molecular epidemiology and testing, to develop the many components of quality management in the laboratory, particularly staff development, and the need to improve our ability to exchange laboratory information. These themes form the basis of Laboratory Services' major five-year goals.

Five-Year Goals

- To be leaders in Molecular Testing
- To be leaders in Laboratory Quality Management Systems
- To be leaders in Laboratory Informatics

Action Planning started September 2000. Reaching these five-year goals within the present fiscal constraints and within the complex BC laboratory environment will be a major challenge. We have set many wheels in motion in a systematic and careful way. We remain alert to the need to ensure that lines of communication between us and all our clients are open and that they are informed of the many changes underway in Laboratory Services. I am grateful in this regard to members of the Laboratory Advisory Committee.

We have already begun to see good progress! Check our last two newsletters (February and September 2001). I think that this report and our report for Year 2001 will show how we are moving ahead. Our laboratory mandate is clear. Our vision is clear.

This message is entitled, "Looking Back; Looking Forward." This is reflective of the "visioning" process that we have all been engaged in. Building on our strong foundation, we have moved to implement our plans and launch new programs.

Leadership

Leadership

- *Creation of five new Leadership Clusters*
- *Creation of several new cross-sectional Programs Teams*
- *Creation of five new Platform Technology Teams*



Special Pathogens
CL3 Laboratory

In the past year we have positioned ourselves to respond as a public health laboratory to new and emerging threats to the public health. Among these is the threat of bioterrorism. With our state-of-the-art laboratory facilities and our leadership in the area of biosafety, BCCDC will continue to play a significant role in protecting of the health and security of the people of British Columbia and of Canada.

My thanks to all the Laboratory Services staff for a great year; they have been so supportive and have readily taken on the extra work change brings! I am also grateful for the support of the Executive Team at BCCDC and my fellow Public Health Directors. Year 2001 promises to see many more exciting new developments. BCCDC Laboratory Services is ready to respond, as we continue to change.

Vision

- *We strive to be a competitive, knowledge-based enterprise committed to improving community health through innovation, education and research*
- *We value our people and their exceptional contribution*
- *We aspire to provide services in an accountable manner*

Mission

To provide leadership in microbiology laboratory services for the detection and control of communicable disease, through learning, sharing information and policy development.



British Columbia Centre for Disease Control

Mandate

Public Health is a practice which "...embraces all those actions that are directed to the assessment of health and disease problems in the population; the formulation of policies dealing with such problems, and the assurance of environmental, behavioural and medical services designed to accelerate favourable health trends and reduce the unfavourable." ¹

We practise Public Health as laboratorians. The mandate of BCCDC Laboratory Services is to carry out Public Health and Reference, Medical and Environmental Microbiology. As part of this mandate, our highly trained staff carry out diverse tasks from analytical testing to interpretation of test results for patients as well as entire communities. We have integrated, programmatic services such as our Bioterrorism Response and Containment Level 3 Biosafety Services Program. We support public health workers in all regions of British Columbia through knowledge synthesis and information sharing.

¹ Afifii, A et al, Annual Review of Public Health, 1994.

Strategic Planning

Visioning

Visioning

Planning

Early in 2000 Laboratory Services began a year-long strategic planning process. An extraordinary meeting of Medical Health Officers helped identify client priorities. The Laboratory Director prepared a report for BCCDC executive. Following approval of the report, the Laboratory Executive Team met in January to start strategic planning by drafting new Vision and Mission statements. The draft statements were circulated to all laboratory staff for comment.



Vision Teams Launch

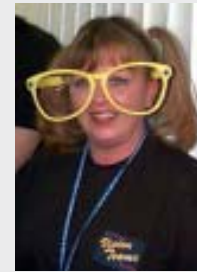
Vision Teams

In March we launched a participatory process of issues identification and process improvement involving laboratory technology staff. Ten vision teams representing laboratory sections were introduced at an all-staff kick off event (balloons by Amanda Vaz, cakes by Kevin Belobaba, Vision T-shirts by John Hamilton and Ninja head gear by Peter Ng).

Peter Ng
Vision Teams
Wrangler



Jackie Wright
looking at things
in a whole new way



Vision Teams presented their recommendations to their co-workers at Democracy Wall Pizza lunches. A sushi lunch was held for scientists from all laboratory sections to ensure that every person had opportunity for input.

Senior Staff Retreats

Other strategic planning work included two half-day retreats for senior staff (supervisors, senior scientists, medical microbiologists) with presentations on *New Wave Technologies* (Peter Ng), *Quo Vadis Quality* (Carol Shaw), *ISO and Us* (Mike Noble) and *Biosafety as a Quality Driver* (Ed Ratnarajah).

The staff recommendations arising from this exciting initiative have formed the basis of a comprehensive strategic plan. Our five-year goals arose from our all-staff planning. Implementation and action planning began in the fall of 2000.

BCCDC Laboratory Services

Core Functions & Capabilities

BCCDC Laboratory Services, like its counterparts in other provinces and in the United States are a critical component of the health care delivery system. All sectors of the public health infrastructure, including disease prevention and control, epidemiology and emergency preparedness and response depend on public health laboratories. Teams of clinical laboratory experts across Canada provide early warning signals of health risks, compile information to guide policy development and analyze data to assist in disease outbreak investigations and identify causes of disease to help with treatment and prevention.

The core functions and capabilities of BCCDC Laboratory Services are minimum requirements for meeting our commitment to provide optimal service to our communities throughout British Columbia. A publication detailing these core functions is available from the office of the Director.

- Communicable disease laboratory surveillance, prevention & control
- Outbreak & emergency response
- Biological Safety Services
- Containment Level 3 laboratory facilities
- Environmental health & food safety
- Reference & specialized diagnostic testing
- Integrated communicable disease data management
- Quality management systems
- Training & Education
- Public health-related research



Heather Rowe
Virology Services

Meeting these minimum requirements means that Laboratory Services must work within a complex environment to:

- Develop and strengthen partnerships, within regional, provincial, national & international systems
- Maintain strong communications with BC's Medical Health Officers, Provincial Health Office, Provincial Epidemiologists, Infectious Disease experts, Environmental Health Officers and Public Health Nurses.
- Participate in provincial strategic policy planning and development
- Develop creative ways to collaborate across sector boundaries to optimise resources and manage continuing change
- Develop accountabilities within a framework of evaluation

Protecting the Health of Our Communities

The Walkerton outbreak of *E. coli* O157:H7 showed us in tragic terms the dangers of not maintaining an adequate system of safeguards, checks and balance, of audits and independent assessments of drinking water quality. This horrific incident of an outbreak of waterborne *E. coli*, an emerging pathogen, is a Canadian wake-up call. Dr. Judy Isaac-Renton, Director, served as a member of an expert panel advising the Walkerton Commission. BCCDC Laboratory Services is a national leader in developing systems of Enhanced water Quality Assurance and surveillance.

Starting with the development of its Biological Safety Services Program in the 1990's and continuing through the reconstruction, certification and commissioning of its Containment Level 3 laboratory facilities, BCCDC Laboratory Services has taken a lead in protecting our communities from the threat of Bioterrorism and other biological threats.



Anna Li
Enhanced Water Laboratory

Emerging and re-emerging disease threats, such as cryptosporidiosis, HIV/AIDS, *E. coli* O157, *Helicobacter pylori*, giardiasis, Lyme disease, West Nile virus, antibiotic resistant superbugs, drug resistant tuberculosis and food and waterborne infections challenge our capacity to respond across Canada. British Columbia has the dubious honour of having the nation's highest rates of food and waterborne diseases and of hepatitis B and C.

The (US) National Academy of Sciences, Institute of Medicine report on Emerging Pathogens, noted that the infrastructure that public health laboratories bring to system-wide protection is critical. BCCDC Laboratory services, with partners across Canada, collects and contributes data to a national platform for surveillance and is intimately connected to the Canadian Informatics Public Health Surveillance (CIPHS) project through its leadership in the Public Health Information System (PHIS). BCCDC Laboratory Services is a member of PulseNet North and is piloting a PHIS-BioNumerics Joint Laboratory-Informatics Project. Our scientists and technicians are also working within the CIPHS data model on molecular fingerprinting. All of these initiatives are designed to give British Columbians the best available public health response system.

A Closer Look

Strategic Initiatives



Wedgemount Glacier
British Columbia

Water

Building on our expertise in drinking water, Laboratory Services has moved aggressively to provide an integrated approach to this global issue.



Network Centres of Excellence

Dr. Judy Isaac-Renton served as national Health Theme Leader for the RésEAU-WATERnet proposal responding to the Network Centres of Excellence (NCE) call for an integrated national approach to drinking water issues. She is part of the NCE/Canadian Water Network.

Walkerton Inquiry Expert Panel

Dr. Judy Isaac-Renton also served as a member of an expert panel, hosted at the University of Ottawa, to provide advice to Mr. Justice O'Connor in his investigation of the Walkerton, Ontario *E. coli* O157:H7



Quality Assurance of Drinking Water Testing

- BCCDC Laboratory Services has proposed an Emerging Pathogens Program, with a focus on drinking water.
- Laboratory Services has initiated a review of accreditation methods to support a program of inspection of water laboratories throughout BC.
- Strategic planning for microbial testing of drinking water is underway in response to the Walkerton outbreak. A Water Forum is being planned.
- Enhanced programs of Quality Assurance, Surveillance, Public Health Audits, Monitoring, Research & Development are being developed.
- Laboratory Services participated in inter-ministerial committees (Health & Environment) following the Auditor General's report on drinking water
- Contributions to the Provincial Health Officer's Report on Drinking Water

Collaborative Research

- Collaborative research with the US Centers for Disease Control and Prevention
- Major studies funded by the American Water Works Research Foundation
- Research funded by the NCE based at the University of Waterloo

A Closer Look

Strategic Initiatives

Bioterrorism

Bioterrorism Response

Satellite Symposium

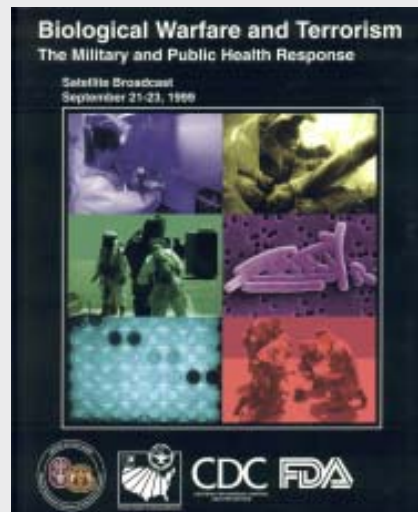
In September 1999 BCCDC Laboratory Services Biological Safety Services hosted a three-day satellite symposium "Biological Warfare & Terrorism: The Military & Public Health Response." In September 2000 we received and distributed to public health workers throughout BC the updated education materials. BCCDC continues to play a leading role in British Columbia's response capability to biological weapons and bioterrorism.

Bioterrorism Response Advisory Team (BRAT)

The Director appointed a team leader, Dr. M. Morshed to assist her in working with the team. This multi-disciplinary team chaired by Dr. P. Daly, Vancouver/Richmond Health Board, met throughout the year to develop a response template that could be used in other regions of BC. This material was presented at general scientific conferences such as the International Conference on Disaster Response and has been well received nationally and internationally.

Special Pathogens Laboratory

Containment Level 3 laboratories will give us a secure environment for dealing with special pathogens. Mr. Edward Ratnarajah was appointed Head, Biological Safety Services.



A Closer Look

Strategic Initiatives

Hepatitis

Hepatitis

Hepatitis Strategy for British Columbia

British Columbia has rates of infection of hepatitis B and hepatitis C that are four times the national average. Dr. Mel Krajden, Associate Director and Virologist, Laboratory Services in collaboration with Marleen Wong, Vancouver/Richmond Health Board, and with input from stakeholders throughout the province, developed a Hepatitis Strategy for British Columbia and submitted the document to government in 1999.

In December, 2000 the Ministry of Health announced funding for hepatitis programs based on the recommendations of the Strategy document. A total of \$5 million per year was allocated to these new interdisciplinary programs.

New Hepatitis Programs

- \$3.7 million for enhanced hepatitis A & B immunization programs
- \$2.6 million of this to Regional Health Authorities for implementation of immunization programs
- Universal infant hepatitis B vaccination
- One time catch-up hepatitis B immunization for children at higher risk
- Expanded A & B vaccination for people at higher risk
- \$650,000/year for molecular diagnostic testing
- \$600,000 for mapping of informatics needs and for co-ordinating structure
- BC Hepatitis Services established January 2, 2001 as a program at BCCDC

Dr. Mel Krajden was appointed Director of the new program. BC Hepatitis Services is developing a data model for the collection of patient information in collaboration with other members of the Canadian Viral Hepatitis Network.

Surveillance

Laboratory Public Health Surveillance

Further progress was made in several areas.

- Establishment of the Canadian Public Health Laboratory Directors' Forum, with anticipated support of the National Microbiology Laboratory
- Participation in the Canadian Disease Surveillance System Working Group developing data standards, definitions and reportable disease lists
- Participation in the Canadian Integrated Public Health Surveillance project (CIPHS)
- Development of Fingerprinting-Public Health Information System pilot project

BCCDC Laboratory Services

Laboratory Services Structure

Services are carried out within a matrix structure. New Leadership Cluster Teams, Platform Technology Teams and Program Teams work closely with individual laboratory sections to improve communications, enhance information exchange and encourage the best use of highly sophisticated technologies.

Leadership Cluster Teams

Leadership Cluster Teams are made up of a medical microbiologist, a senior scientist, a laboratory supervisor, health science officers (HSOs) and others, as appropriate. Each Cluster Team assumes responsibility for the management of resources within their specific cluster and reports to the director.

Bacteriology Cluster

The Bacteriology Cluster Team worked through the start up of critical new molecular testing programs for Methicillin-resistant *Staphylococcus aureus*.

Members of the Cluster are Dr. Sylvie Champagne (Dr. Gwen Stephens), Medical Microbiologist, Dr. Swee Han Goh, Senior Scientist, Carol Shaw, Laboratory Supervisor, David Chan, Tazim Rahim, Nancy Lowther and Ingrid Pocock and Bruce Gamage, Infection Control Practitioner.

Containment Level 3/Mycobacteriology Cluster

This team is responsible for Containment Level 3 facilities and for Mycobacteriology/ Mycology. The group meets regularly to exchange information and discuss projects such as the molecular fingerprinting of *Mycobacterium tuberculosis* isolates.

Members of the team include Dr. Bill Black, Medical Microbiologist, Dr. Manuel Altamirano-Dimas, Dr. Mabel Rodrigues (Amelia Trinidad, Acting Supervisor), Marie Amos, Darrel Cook and Edward Ratnarajah, Head, Biological Safety Services.

Environmental Services Cluster

This Cluster meets weekly to discuss projects such as Norwalk Virus outbreaks in long term care facilities and the molecular sequencing of bacterial, parasitic or viral isolates. Food and water-borne pathogens are a focus.

The team includes Dr. Judy Isaac-Renton, Dr. Corinne Ong, Ana Pacagnella, Quantine Wong and Joe Fung, Lorraine McIntyre and Lorna Tom.

Virology Services Cluster

The Virology Services Cluster leads virus isolation, virus serology and molecular testing services. Electron microscopy services are also managed by this Cluster.

The team includes Dr. Mel Krajden, Gail McNabb, Annie Mak and Ron Gillies, Dr. Warren Hill, Darrel Cook, and Elsie Wong, STD/AIDS Control Division, acting for federal and provincial research initiatives.

Zoonoses and Emerging Pathogens Cluster

The CDC, Atlanta, identified emerging pathogens as the most significant threat to health for the 21st century and has targeted their prevention as a fundamental concern. (See *Preventing Emerging Diseases: A Strategy for the 21st Century*, US Department of Health and Human Services, CDC, Atlanta Georgia, October, 1998.)

Vector-borne and zoonotic diseases, such as Lyme Disease, and *Helicobacter pylori* as well as West Nile Virus and Hantavirus are a focus of this Cluster.

Dr. Muhammad Morshed, Head, Zoonotic Diseases and Clinical Scientist, Quantine Wong, and Yvonne Simpson (HSO) make up the team, assisted by Dr. Isaac-Renton and Dr. Champagne (Dr. Stephens).

Platform Technology Teams

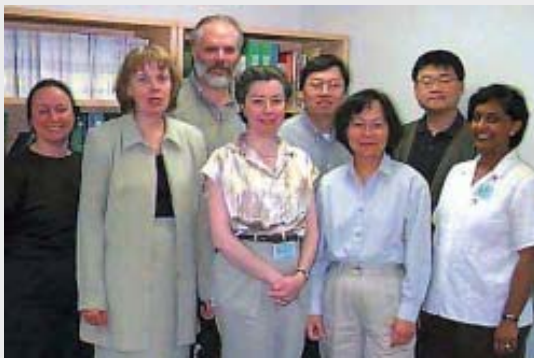
Highly sophisticated laboratory technologies and methods are applied across laboratory sections to maximize quality keep BCCDC Laboratory Services at the cutting edge of laboratory science. Interdisciplinary teams manage the technologies.

Pulsed Field Gel Electrophoresis (PFGE)

PFGE is a DNA fingerprinting method used to separate large (Kb sized) fragments of DNA. The fragments are prepared from genomic bacterial DNA (typically 2000-5000 Kb total size) which is cut using a restriction enzyme (RE). The fragments are separated through an agarose matrix into distinct bands using pulsed electric fields. Fragment patterns from related (same source) isolates will be identical whereas unrelated isolates may look quite different.

At BCCDC Laboratory Services PFGE is currently used for *E. coli* O157:H7, *Salmonella* spp, *Shigella* spp, *Bordetella pertussis*, *Nisseria meningitidis* and Methicillin Resistant *Staphylococcus aureus* (MRSA). We collect and type organisms from all over the province as an "early warning system" for epidemiological purposes. This is especially true in the case of food-related outbreaks.

PFGE gives us a standardized and reproducible DNA fingerprinting method which is used to uncover, monitor and manage outbreaks quickly.



PFGE Team I to r:
L. McIntyre, C. Shaw, R. Sevigny,
A. Paccagnella, S. Goh, K. Law,
P. Ng, M. Rodrigues

Nucleic Amplification

The Qiagen BioRobot 9604 is an automated nucleic acid purification instrument. It allows standardized, consistent performance and automated high-throughput routine specimen processing for PCR testing. It can extract viral RNA from plasma or serum or genomic DNA from blood.

Virology Services uses the BioRobot for extraction of HCV Viral RNA for qualitative and quantitative PCR. Use of the BioRobot for RNA extraction saves considerable time and labour. We can increase the sensitivity of the HCV-PCR assay by about 5 to 8 fold, which increases the accuracy of diagnosis of active infection.

The Light Cycler is the fastest polymerase chain reaction (PCR) thermal cycler available. It performs 30 amplification cycles in less than 30 minutes, a process which normally takes hours. The built-in sensitive fluorescence detector enables a real-time quantitation of the amplification products by measuring fluorescent intensity. Such measurement of PCR-kinetics and quantification offers new analytical options.

Uses of the Light Cycler

- Qualitative analysis of PCR products
- Quantitative real-time kinetic analysis
- Single point or complex mutations detection
- Differentiation of signals of specific products from non-specific primer-dimers

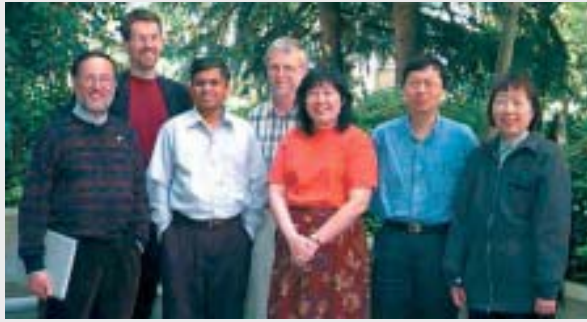


Nucleic Amplification Team I to r:
A. Mak, M. Krajden, G. McNabb,
K. Gunadasa

DNA Sequencing

DNA sequencing is a process for determining the exact order of the chemical building blocks (called bases and abbreviated A, T, C, and G) in the genome of an organism. They are used by scientists to explore an organism's biology and other complex phenomena.

New methods range from enhancements in gel-based technologies to the development of novel, gel-less automated approaches, such as DNA chips and Mass Spectrometry. Sequencers such as Laboratory Services' ABI 310 and 3110 Prisms, use multiple tiny (capillary) tubes to run standard electrophoretic separations.



DNA Sequencing Team I to r:
A. Altamirano-Dimas, R. Parkes,
M. Morshed, S. Byrne, C. Ong,
S. Goh, A. Li

Genomes, which vary in size from hundreds to millions of bases, must first be broken into much shorter pieces. Each short piece is used as a template to generate a set of fragments that differ in length from each other by a single base that will be identified in a later step. The fragments in a set are separated by gel electrophoresis. Fluorescent dyes allow separation of all four fragments in a single lane on the gel. The final base at the end of each fragment is identified.

After the bases are “read,” computers are used to assemble the short sequences into long continuous stretches that are analyzed for errors, gene-coding regions and other characteristics.



Flow Cytometry Group I to r:
H. Lu, J. Isaac-Renton, J. Fung,
L. McIntyre, R. Parkes, C. Ong,
M. Morshed

Flow Cytometry

Flow Cytometry measures properties of cell suspensions and can divide up large populations of cells based on their size, charge, optics and structure. Flow cytometry allows information about cells to be collected, processed by computer and displayed graphically in real time.

Cells in suspension flow in single file through a laser-illuminated volume. During the passage through the laser, the cells scatter light and emit fluorescence. Both forward and side scatter of light is proportional to the size, shape and “optical homogeneity” or intracellular granularity of the cells. Different colour fluorescent tags attached to antibodies can bind surface marker antigens to divide cell populations. Filters and mirrors similar to those on a microscope detect fluorescent signals on the cells. Information is collected and converted to digital values that are stored on a computer.

Other Microbial Typing

This group applies existing molecular techniques to the fingerprinting of *Mycobacterium tuberculosis*. Two techniques are used, Restriction Fragment Length Polymorphism (RFLP) and spoligotyping.

Tuberculosis isolates are grown in culture and isolated DNA is cut by restriction enzymes creating DNA fragments of various lengths. The fragments are electrophoresed and fragments transferred to a support membrane and probed for the presence of the IS6110 insert. Tuberculosis isolates are considered the same if they share identical IS6110 RFLP patterns.

RFLP analysis of tuberculosis isolates may be useful for determining the distribution of isolates during outbreaks and evaluating whether a recurrence of disease in a previously treated patient is the result of reinfection or reactivation.

Other Microbial Typing Team I to r:
M. Rodrigues, M. Altamirano-Dimas,
W. Black, E. Bessuille



Darrel Cook, MSc, ART, RSM(CCM)
Laboratory Manager

Darrel Cook

Darrel Cook was appointed Laboratory Manager, BCCDC Laboratory Services in April 2000. Darrel joined Laboratory Services, then the Provincial Laboratory, as Supervisor, Virology Services in 1985. He brings to his new position a vast experience in laboratory sciences, research and management.

He is a member of the Canadian College of Microbiologists, the Canadian Society for Medical Laboratory Science, the British Columbia Society of Laboratory Science and is secretary-treasurer of the Canadian Association of Clinical Microbiology & Infectious Diseases.

Darrel also holds memberships in the International AIDS Society, the Pan American Society for Clinical Virology, the Canadian Association for HIV Research and the Quality Council of British Columbia.

Programs

Biosafety

Biological Safety Services

Biosafety Program

An important step, early in the year, was the development of a Biological Safety Services Business Plan. The plan helped to define the role of biosafety at the BCCDC and in British Columbia and identified the need for additional resources. Neil Chin joined the Program as Assistant Biosafety Officer, Planning and Response. The plan also identified a number of challenges the Program would face as it was deployed, including the capacity to respond to incidents of bioterrorism.



Laboratory Biosafety Advisory Council (LBAC)

Representatives of all Laboratory sections serve on LBAC. Besides bringing Biosafety concerns to the attention of the Program, LBAC members are educators and assist with Biosafety issues in their respective laboratories.



Members of the LBAC practising spill response

Containment Level 3 Laboratories

CL3 Laboratories

Laboratory Services, led by the Biological Safety Program, and in partnership with staff from BC Building Corporation, began reconstruction of its state-of-the-art Containment Level 3 laboratories. The initiative included redesign of mechanical, architectural and electrical systems to improve functionality and bring the laboratories into compliance with Health Canada guidelines. Enhanced power, voice and data lines were included in the redesign to strengthen the emergency response capacity and systems were designed to allow for direct control over decontamination processes. By the end of the year, tear-down and reconstruction, with extensive associated program development, were well underway. Certification and commissioning were targeted for 2001. Many thanks to Brad Smith, William Man, John Taylor and Don Strutt of BC Buildings Corporation for their untiring efforts.

CL3 Health Surveillance

Working with Work Well Consulting and with Bruce Gamage, Laboratory Services Infection Control Consultant, a program of enhanced health surveillance for workers CL3 laboratories was developed.

CL3 Standard Operating Procedures Manual

In preparation for the commissioning of BCCDC's CL3 laboratories, Ed Ratnarajah and Neil Chin continued work on the development of a comprehensive CL3 Standard Operating Procedures Manual. All aspects of the operation and maintenance of these highly sophisticated systems will be covered in the manual, with sign-off by the Director, Laboratory Services expected in 2001.

CL3



Edward Ratnarajah
Head, Biological Safety Services

Emergency Response Action Plan

BCCDC Laboratory Services plays a major role in the federal government's Emergency Response Assistance Plan for Risk Group 4 (RG4) infectious substances affecting humans. Edward Ratnarajah is the Provincial/Territorial Response Team Leader for British Columbia. The Laboratory Services Medical Microbiologist On Call (Drs. Isaac-Renton, Krajden and Black) is also a member of the team and is responsible to appraise the situation in an Emergency Call Report and identify critical response issues. In all RG4 incidents, primary responsibility rests with the federal Centre for Emergency Preparedness and Response; responsibility for spill containment and clean-up rests with The Provincial Response Team.

Laboratory



Neil Chin & Ed Ratnarajah
RG4 Emergency Response

Programs

Provincial Infection Control & Prevention Program

Projects & Services

Bruce Gamage, Infection Control Consultant, BCCDC Laboratory Services, serves as a provincial infection control practitioner. Working in tandem with experts in infection control in the acute care sector, the program co-ordinated and participated in a number of initiatives related to infection control and antibiotic resistance in regional, provincial and national arenas. The program focuses on helping public health workers and institutions such as long-term care facilities that have no acute care affiliations.

Infection Control Consulting

Information on general and specific infection control precautions and procedures is available for Infection Control Practitioners and other health care professionals in hospitals, residential care facilities and community organizations. This consultation is provided primarily through telephone and e-mail contact.

Infection Control Education

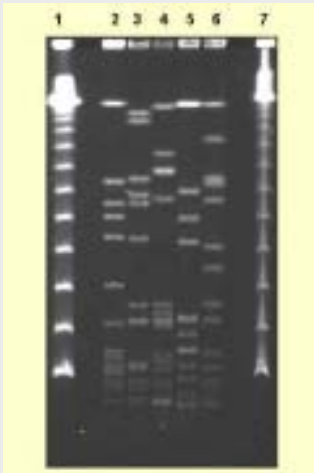
- UBC School of Nursing, "Infection Control Practices for Home Care Nursing"
- Vancouver/Richmond Health Board, "Antibiotic Resistant Organisms in Home Care and Community health Nursing"
- Presentations on antibiotic resistant organisms to several lower mainland residential care facilities
- Symposium, "Influenza: the Elusive Plague" for health care providers



A. Bruce Gamage, RN, BSN, CIC

Microbial Fingerprinting for Infection Control

The Program co-ordinates fingerprinting of bacterial isolates, using PFGE, for laboratory outbreak or cluster investigations of Methicillin Resistant *Staphylococcus aureus* (MRSA). Testing requests are made through the Infection Control Consultant.



PFGE Gel, MRSA

Infection Control

Guideline Development & Review

The Provincial Health Office sponsored an Antimicrobial Resistance Action Planning Workshop in June, 2000. Representation included medical microbiologists, public health workers and infection control practitioners. Priority was given to the development of practical, evidence-based guidelines to reduce the spread of antibiotic resistant organisms (ARO's). The guidelines will eliminate barriers to patient movement between institutions and other service providers and will provide guidance for the screening of patients for (ARO's) to decrease the spread to high risk patients. The provincial guidelines are being developed in consultation with leaders in infection control in acute care and extended care sectors.

Bruce Gamage co-ordinated a review of the existing BC Guidelines for Control of Methicillin-resistant *S. aureus* and Vancomycin-resistant *Enterococci*; hospital and community-based infection control practitioners, medical microbiologists, epidemiologists and infectious disease specialists participated in the review. The revised guidelines were distributed to all health regions in the province.

Other Initiatives

The Ministry of Health introduced a new Influenza Immunization and Health facility Exclusion Policy. Bruce Gamage served as member of the Provincial Influenza Working Group whose mandate was to promote vaccination among health care workers and those at high risk for complications from influenza infection.

Bruce Gamage is president, BC Practitioners in Infection Control and an incoming board member of the Community and Hospital Infection Control Association of Canada (CHICA-Canada). He serves as CHICA representative on a working group of the Canadian Nurses Association - Caring for Patients with Hepatitis C. The group will develop care plans for hepatitis C patients in hospital, community and long term care facilities.

Programs

Laboratory Informatics

Informatics Initiatives

In a sophisticated and highly automated microbiology laboratory environment, information technology (IT) is a crucial support to programming. An integrated program of informatics initiatives is underway. BCCDC Laboratory Services is developing IT partnerships within the province and across Canada.

IT Core Initiative

In March, 2000, the IT Core Group of senior medical and technical staff was formed to assist the Director in identifying and implementing cutting-edge health informatics technology. The Core Group was charged with assessing, evaluating and improving the IT environment within Laboratory Services, addressing health informatics issues and prioritizing and resourcing informatics projects. The Core Group links with the Laboratory Computer Users' Group and provides a forum for idea and information exchange.

Electronic Data Interchange (EDI) Projects

Initiated in 1998, EDI is now in place with four of our clients, BC BioMedical Laboratories, MDS Metro Laboratories, BCCDC TB Control Division and BCCDC STD Control Division. Submissions from these clients represent a large component of Laboratory Services workload; EDI has enhanced the quality of our service by reducing transcription errors and increasing the efficiency of data entry.

Laboratory Services is an active participant, with BCCDC Information Management, in provincial groups exploring data standards and other issues around exchange of laboratory results provincially and nationally.

In collaboration with Coast Garibaldi Health Region, BCCDC Laboratory Services is piloting a project to transmit water testing results directly to the health region.

Canadian Integrated Public Health Surveillance System (CIPHS)

The federally funded CIPHS project, part of a pan-Canadian Health Informatics Project is mapping out an electronic public health surveillance network. All provinces and territories are partners in this initiative. Laboratory Services is a proud participant in CIPHS and, if funded, will submit laboratory results including molecular fingerprinting data, to the Public Health Information System.

BioNumerics

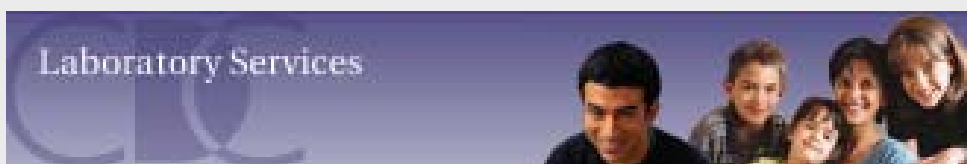
This powerful software can manage any type of biological experimental data, from phenotypical tests to nucleic acid sequences. The application supports our extensive molecular testing and epidemiology initiatives. Analysis has so far been focused on DNA fingerprinting data from Pulsed Field Gel Electrophoresis (PFGE) and Restriction Fragment Length Polymorphism (RFLP) experiments. Other applications are actively being explored.

These BioNumerics databases allow laboratory scientists to compare DNA fingerprint patterns with those in other databases, including that maintained by the National Laboratory in Winnipeg. As a participant in PulseNet North, a Canadian molecular subtyping network for the surveillance of disease, BCCDC Laboratory Services has embarked on a journey that will result in a national surveillance network. A new BioNumerics pilot project linking this laboratory surveillance to the Public Health Information System has been proposed. By evaluating our own and those from other provincial and national sources, BCCDC Laboratory Services offers the citizens of British Columbia an enhanced surveillance and health alert service.

Laboratory Services was able to sound an early alarm on foodborne *E. coli* O157 outbreak, preventing much illness, saving lives and an estimated \$3 million in health care costs.



PulseNet North, a national molecular subtyping network



Web Site Development

2000 saw the beginning of a process of redevelopment of BCCDC's web site, and with it the redevelopment of the Laboratory Services web site. We look forward to a more user-friendly site.

Programs

Molecular Services

Molecular Services is the program around which the Platform Technology teams revolve. It leads all laboratory sections in the development of molecular testing for epidemiology, public health and reference testing. A new Laboratory services-wide “Protocol for Validation and Implementation of New Tests” is one initiative led by the program. The protocol will ensure standardized high quality planning, review and evaluation of all new tests or methods. Senior Scientists and section Supervisors work in close collaboration with the program.

A new Molecular Epidemiology Team (MET) comprised of the Director, the Supervisor, Molecular Services and Ms. Ana Paccagnella. Ana is the MET Co-ordinator and brings Epidemiology Services together with Laboratory Services in a project management format.

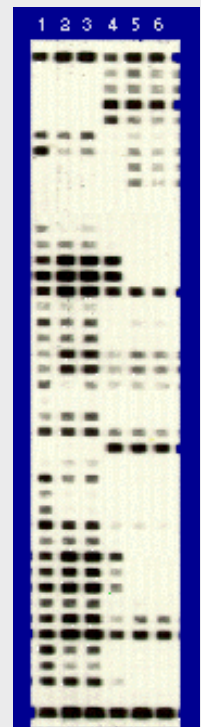
Projects & Services

Molecular Fingerprinting of *Mycobacterium tuberculosis*

Fingerprinting of *Mycobacterium tuberculosis* isolates using IS6110 restriction fragment length polymorphism (RFLP) and spoligotyping methods began. Over 250 isolates of *M. tuberculosis* by IS6110-RFLP have been characterized. The banding profiles are analyzed for the detection of isolates with identical patterns. Clusters of isolates with identical patterns indicates infection with a common strain. This information is used by Tuberculosis Control to determine if an outbreak has occurred. Dr. M. Altamirano-Dimas leads the work.



ABI 310 DNA Sequencer used for species identification



Spoligotyping gel for *M. tuberculosis*

Hepatitis C Genotyping & Subtyping

Hepatitis C viruses (HCV) are grouped into 6 genotypes, of which 1 resists interferon and requires prolonged therapy. A less expensive modified sequence-based method is used to identify HCV genotypes. The program tested this modified method in a blind comparison with the standard kit; results indicated that the modified method compared favourably and has the additional benefit of providing sequence information that can help determine the relationships among different viral strains. This work was led by Dr. S. Byrne.



Qiagen BioRobot 9604 used for genotyping and subtyping

Hepatitis B Virus (YMDD Mutants) Resistance

Severe chronic HBV infections are now treated with Lamivudine, an antiviral nucleoside analog. Although this is effective, resistance develops due to mutations in the polymerase region of the gene at a locus termed YMDD. To identify these mutants we determine the DNA sequence of a portion of the polymerase gene containing this region. This work was led by Dr. S. Byrne.

HBV Precore Mutants

During active replication or reactivation HBV produce a protein called the e-antigen. Antibodies to e-antigen appear to have some effect in controlling the degree of reactivation. To skirt the immune response, viral mutants, which do not produce e-antigen, may develop. These seem to be associated with more severe disease. We have been evaluating sequencing methods to detect these precore mutants. This work was led by Dr. S. Byrne.

16S and Chaperonin 60 (Cpn60) Genes

The present bacterial identification format is the polymerase chain reaction (PCR) amplification of selected targets in the bacterial genome. Organisms under investigation include *Staphylococcus*, *Streptococcus*, *Enterococcus*, *Campylobacter*, *Arcobacter*, *Vibrio*, *Legionella*, *Aeromonas*, *Listeria*, *Haemophilus*, *Lactobacillus*, *Gardnerella*, *Neisseria* and *Arthrobacter*. This work was primarily led by Dr. S Goh.

A collaboration with the NRC/PBI, funded by the Canadian Biotechnology Strategy, is underway using microarray biochip technology.

Cryptosporidium Genotyping

There are at least two genotypes of this protozoan parasite which has caused many large water-borne outbreaks. One of these genotypes is transmissible by humans only; the other can be spread from animals to humans and vice versa. The water-borne outbreaks of cryptosporidiosis that occurred in BC were genotyped by PCR and sequenced. This work has been recognized across Canada and is led by Dr. C.S. Ong.



DNA Double Helix

Chlamydia pneumoniae and its Potential Role in Atherosclerosis

Chlamydia pneumoniae, a very common human respiratory pathogen has been implicated as a causative agent in the development of atherosclerosis and onset of sudden myocardial infarct. A new research program, in collaboration with UBC CDC using high-density microarray biochip is presently under way to better understand the causation of *Chlamydia pneumoniae*-induced heart disease.

Treponema Pallidum Genotyping

T. pallidum is the agent of syphilis. A PCR-based method of direct detection has been developed. A method of fingerprinting this spirochetal bacterium was also established and evaluated. This work was led Dr. M. Morshed.

Borrelia Genotyping

PCR detection and genotyping of Lyme Disease isolates has been developed. This work was led by Dr. M. Morshed.

Programs

Quality Assurance

- Continuous Quality Improvement
- Internal Quality Assessment
- Staff Development
- External Proficiency
- ISO 9000/15189

Quality Team

The new Laboratory Services Quality Team was established with Carol Shaw as its first chair. In this role Carol attended the *NCCLS Forum: Applying Quality Systems to Health Care* in Virginia and presented the essentials of laboratory quality management (now codified in NCCLS GP26a) at the Senior Staff retreat. Amelia Trinidad, Acting Supervisor, Mycobacteriology & Mycology, stepped in to lead the Quality team late in the year. Carol continues to lead the Continuous Quality Improvement Team.

As Laboratory Services moves toward certification by the International Organizations of Standards, ISO 9000/15189 have become familiar terms. All our quality initiatives support this goal. A gap analysis was carried out and results presented to the BCCDC Executive.

Carol Shaw
CQI Team Chair



Amelia Trinidad
Quality Team Chair

Continuous Quality Improvement

The CQI Team constantly identifies methods which improve laboratory competency, efficiency and service usage. The team has representatives from all laboratory sections and has developed four new Quality Indicators. It reviews turnaround times and Quality Service Incidents that affect more than one section.

Internal Quality Assessment

The Internal Quality Assessment Team's mandate is to support the Quality Co-ordinator in ensuring that the Quality Management System is efficiently implemented to achieve our quality objectives. The team conducts quality audits of all laboratory sections and follows up to ensure remediation. The team is led by Quantine Wong, Supervisor Parasitology & Non-Viral Serology and Amelia Trinidad.

Staff Development Team

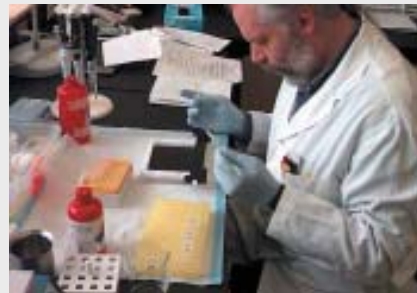
Led by Lorraine McIntyre and Richard Sevigny, the 11-member Staff Development Team works to create a pool of expert knowledge workers in Laboratory Services by fostering a supportive learning and research environment. Its successful programs include:

Virology Lecture Series

A series of 12 lectures, given by experts in the field, was enthusiastically received and is now distributed by the BC Society of Laboratory Science.



Kevin Belobaba
Research Officer



Richard Sevigny
Staff Development Team

Virutal Lunch Computer Education Series

Kevin Belobaba, Research Officer, Laboratory Services presented a series of lunch-hour workshops covering a myriad of topics for computer users. The series was extremely popular with staff and continues.



Lorraine McIntyre
Chair, Staff Development



Quantine Wong

Platform Technology Tours and Poster Presentation

A learning adventure for laboratory staff that originated with the Vision Teams, Platform Technology Tours provided staff with an opportunity to familiarize themselves with cutting-edge technologies and to see how these are used at BCCDC. A series of 5 posters was developed as part of the initiative and posted prominently in laboratory corridors.

Malaria Workshop

A one-day hands-on workshop and lecture program was organized and carried out by Quantine Wong and the Parasitology section. It was over-subscribed and attended by pathologists and technologists from all over BC including some of our staff. Following recent malaria-related deaths, the BC Society of Laboratory Science has requested a joint venture with Laboratory Services to repeat this successful program.

ISO 9000

ISO Team

Lead by Amelia Trinidad, who took a Quality Management Institute course, the ISO Team has completed a gap analysis with consultants from BRI International. The resulting report encourages further movement towards International Organization of Standards (ISO) certification and identification of resources available to this significant undertaking. One important recommendation of the report is the creation of a new Quality Co-ordinator position.

Senior laboratory staff identified ISO certification as a goal (big, hairy, audacious goal – BHAG) for Laboratory Services at the Senior Staff Strategic Visioning Retreat.

Quality Systems International 9000 (QSI)

BCCDC Laboratory Services is moving toward compliance and certification by the International Organization of Standards (ISO).

As part of this initiative and working closely with BCCDC's Information Management Division, we have acquired and are implementing QSI 9000 document control software. The program provides a comprehensive, paper-free solution to achieve compliance with many international and industry-wide standards, including ISO. Theresa Roberts of Information Management is Project Manager. She works in collaboration with the Laboratory Manager and a team of laboratory staff on implementation.

Enteric Bacteriology

Core Services

- Cultures and identifies enteric pathogens
- Serotypes and subtypes enteric pathogens
- Investigates outbreaks of enteric disease
- PCR testing for Enterohaemorrhagic *E. coli* or Verotoxin producing *E. coli*, Enteroinvasive *E. coli* and *Shigella* and Enteroadherent *E. coli*
- Partners with provincial and federal agencies

Testing Services

Direct Faecal Verotoxin Assay (DFVA) testing and the PCR test for the detection of verotoxin producing *E. coli* have proved invaluable in detecting non O157 *E. coli*. Of the 57 DFVA positive stools only 17 were O157:H7 (29.8%). 6 stools were Verotoxin positive but were culture negative (10.5%) and 34 were not O157:H7 (59.6%). All were positive for either Verotoxin 1 or 2 or both. One of these, *E. coli* O48:H45 proved to have a slightly different Verotoxin gene sequence resulting in a slightly different VT2 toxin (VT2d-.OX3a). The only way to find these was by using the Verotoxin Assay and the PCR test. BCCDC encourages submission of stool specimens for Verotoxin Assay.

The section received 288 *E. coli* for O157:H7 confirmation from all over the province. Of these 148 were positive for O157. These isolates were subtyped by Pulsed Field Gel Electrophoresis (PFGE) using the PulseNet Standardized Protocol.

The section is an active member of PulseNet North (National Microbiology Laboratory, Winnipeg). PulseNet standardized protocols for *E. coli*, *Salmonella* and *Shigella* are used for fingerprinting. PulseNet North shares PFGE patterns with laboratories throughout North America to control the spread of these organisms.

Top 10 Salmonella Serovars Isolated in BC

Isolate	Human Source	All Sources
<i>Salmonella</i> Enteritidis	244	282
<i>Salmonella</i> Typhimurium	142	203
<i>Salmonella</i> Heidelberg	72	103
<i>Salmonella</i> Hadar	47	52
<i>Salmonella</i> Newport	21	21
<i>Salmonella</i> Braenderup	20	23
<i>Salmonella</i> Java more correctly named <i>Salmonella</i> Paratyphi B var. Java	18	18
<i>Salmonella</i> enterica 4,5,12:i:-	18	23
<i>Salmonella</i> Montevideo	16	17
<i>Salmonella</i> Saint Paul	15	15
<i>Salmonella</i> Typhi	15	15
<i>Salmonella</i> Javiana	15	15



Fran Seward

The breakdown of all *Salmonella* serotypes can be found in the appendix.

Outbreak Detection and Investigation/2000



Ana Paccagnella

- *Salmonella* Enteritidis associated with a bakery
- *Shigella flexneri* 3 in a family returned from Africa
- *Salmonella* Heidelberg associated with a picnic; actual source was not proven

Education and Training

Staff members were trained in the PFGE Standardized Protocols for *E. coli*, *Salmonella* and *Shigella*. Ana Paccagnella, section Supervisor, attended the following meetings:

- May 21-25, 2000, American Society for Microbiology Annual General Meeting in Los Angeles, California
- May 2-4, 2000, PulseNet Annual General Meeting in Minneapolis, Minnesota
- October 24-25, 2000, PulseNet North Meeting at the National Microbiology Laboratory, Winnipeg, Manitoba

Laboratory Services Sections

Environmental Services

Core Services

- Outbreak Co-ordination & Surveillance Program
- Provincial Water Laboratory Quality Assurance Program
- Food Quality Check Program
- Enhanced Water Program
- Public Health Drinking Water Audit Program
- Environmental sample surveillance for microbial contamination
- Clinical specimen testing for specific etiological agents
- Food poisoning outbreak investigations

Programs

Advisory Committee for Water Microbiology Laboratory Testing

Chaired by the Director, this is a joint private-public group that reports to the Provincial Health Officer. As the increase in drinking water testing continues, its province-wide work will grow.

Water Quality Audit

- Provides auditing for regional health authorities
- Water samples tested for total coliform, faecal coliform and other organisms as required

Water Surveillance (Testing)

Partners with regional Public Health authorities in interpreting testing results

Food Quality Check

- Provides sanitary quality testing of ready-to-eat food from food service establishments
- Food samples tested for total aerobic mesophilic bacteria, coliform, fecal coliform and *Staphylococcus aureus*

Outbreak Surveillance & Co-ordination

This program developed provincial guidelines for the laboratory investigation of outbreaks. The Outbreak Co-ordinator is part of Environmental Services. The program recently detected unusual numbers of gastroenteritis in long-term care facilities and worked with the Provincial Infection Control Program and public health workers to develop co-ordinated response protocols and improved molecular testing.

Special Projects

Evaluation of Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) for *Norwalk*-like Virus

Environmental Microbiology evaluated a RT-PCR procedure for detecting *Norwalk*-like virus (NLV) in specimens from patients with gastroenteritis. Preliminary data show that this procedure is much more sensitive than direct electron microscopy and can increase the detection rate of *Norwalk*-like virus by more than two fold. It is also being linked to sequencing of NLV for molecular epidemiology purposes—rapid detection, control and development of prevention strategies.

Outbreak Investigations

Viral Gastroenteritis

A viral etiology was suspected in 46 outbreaks based on clinical and epidemiological data. *Norwalk*-like virus was confirmed as the causative agent by electron microscopy in 8 and *Rotavirus* in 3 outbreaks. Of the 46 outbreaks, 39 were associated with long term care facilities. 7 occurred in an elementary school, a company gathering, a school music festival, an amusement centre, a Bible camp, a day-care centre and a restaurant. 8 of the outbreaks in care facilities were confirmed as *Norwalk*-like virus and 2 were confirmed as *Rotavirus*. *Rotavirus* and *Adenovirus* were identified as the etiological agents in the day-care centre outbreak.



Media for *Salmonella* testing



Joe Fung, Supervisor

Salmonella Enteritidis

48 laboratory confirmed cases of *Salmonella* Enteritidis were reported in the lower mainland. Epidemiological investigation determined a significant association between illness and exposure to products of a local bakery. Bulk egg, egg baste, egg tarts, coconut cream bun, raisin pound cake, plain sweet bun, ham and corn bun and coconut flake samples were collected and submitted for testing. *Salmonella* Enteritidis was isolated from the egg baste and from one of the coconut flake samples. Pulse Field Gel Electrophoresis analysis showed that strains of *Salmonella* Enteritidis isolated from patients were indistinguishable from strains isolated from the food samples.

Environmental

Special Investigations

Campylobacter Investigation

An investigation of *Campylobacter* infection in the Port Douglas area was carried out.

Pseudomonas aeruginosa Folliculitis Investigation

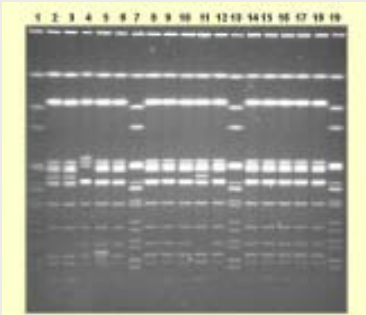
Water samples from pools, water slides and hot tubs were submitted for investigation for *Pseudomonas* folliculitis.

Botulism Investigation

Clinical and food specimens from 11 suspected botulism outbreaks were examined; 2 were suspected infant or intestinal botulism. One suspected intestinal botulism was confirmed as *Clostridium botulinum* type A. The organism was isolated and type A botulinal toxin was detected in the fæces of the infant.

Vibrio cholerae Investigation

Members of a family became ill with diarrhoea after eating salted eggs brought from the Philippines by a visiting relative. A stool culture of the pregnant woman yielded growth of *Vibrio cholerae* 01 Ogawa. A sample of the eggs, submitted to the laboratory for culture, yielded growth of *Vibrio cholerae* 01 Ogawa; egg white and egg yolk were culture negative while egg shells were *V. cholerae* positive.



PFGE Gel for Salmonella

Quality is a key component of all our processes.

Proficiency Testing, Quality Control & Developmental Programs

The Enhanced Water Program is active in external proficiency testing. Laboratory Services participated in the US Environmental Protection Agency *Giardia* and *Cryptosporidium* proficiency testing program, the only Canadian laboratory to do so. The section collaborated in proficiency testing for Alberta using the Information Collection Rule method. The section also collaborates on research and developmental studies.

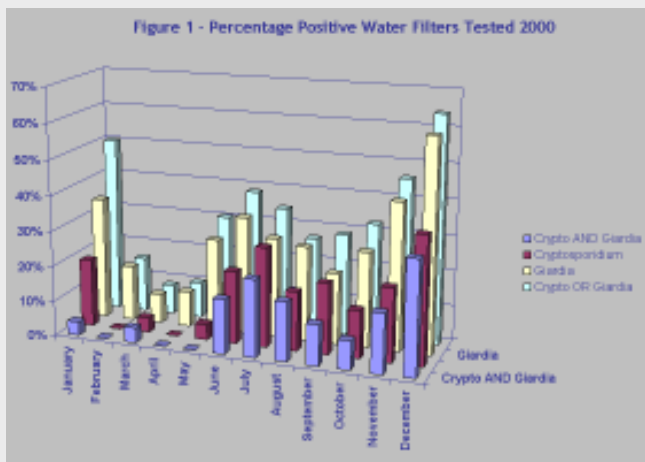
Enhanced Water Program

The Enhanced Water Program works closely with Medical Health Officers and health unit staff, water utilities, epidemiologists and research scientists. These collaborative partnerships provide us with opportunities to communicate knowledge and further our understanding of emerging water-borne pathogens such as *Toxoplasma*, *Cryptosporidium* and *Giardia*.

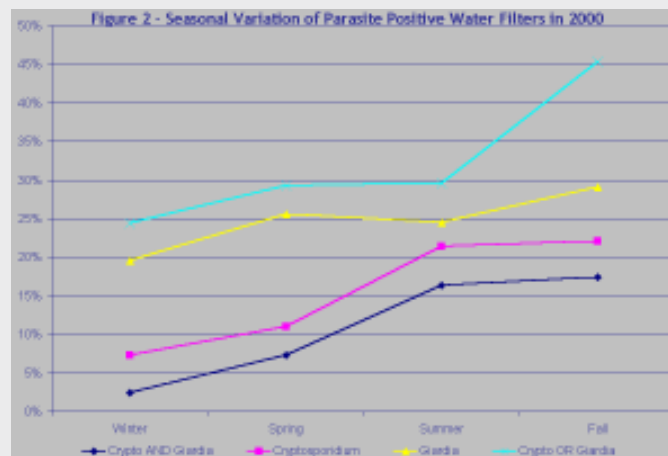
Waterborne outbreaks of cryptosporidiosis and giardiasis are associated with the consumption of contaminated drinking water. Testing of water filters for these emerging pathogens increased 10% over 1999 levels.

Cryptosporidium and *Giardia* Studies

Methods for analyzing *Cryptosporidium* and *Giardia* continue to be challenging. A year-long study comparing Envirochek filters to standard string wound filters was presented at the May 2000 Canadian Water Works Association's National Conference. The section works with many collaborators in public health throughout BC to evaluate new techniques for testing; among these is the use of serology for risk assessment or as a predictor of decreased water quality events.



Cryptosporidium and *Giardia* remained prevalent in all the water tested (Figure 1). Fewer *Cryptosporidium* parasites were detected in 2000. More water filters tested positive for *Giardia* than for *Cryptosporidium*. An increase in the amounts of parasites detected occurs around spring freshet and persists over the summer months (Figure 2).



Laboratory Services Sections

General Bacteriology

Core Services

- Outbreak detection, investigation and management
- Provincial bacterial reference testing
- Molecular epidemiology & diagnostic testing
- Antimicrobial susceptibility testing
- Culture, identification and typing of bacterial isolates

Testing Services

Antimicrobial Susceptibilities

Minimal inhibitory concentration (MIC) testing using appropriate NCCLS protocols is carried out in this section. Tests include the E-test on Mueller Hinton agar (5% sheep blood) for *Neisseria meningitidis*, beta lactamase and MIC tests for *Neisseria gonorrhoeae*.

Molecular Methods

Polymerase chain reaction-restriction length fragment polymorphism (PCR-RFLP) typing of *Staphylococcus aureus* using the coagulase gene locus was used for several years and an analysis of the patterns identified has been carried out. Further development of the pulsed field gel electrophoresis (PFGE) technique started in 1999 and continued in 2000. Staff were trained at the National Microbiology Laboratory in Winnipeg. PCR testing is also used for the detection of *Chlamydia trachomatis* and *Bordetella pertussis* (whooping cough).

Projects

Provincial Antibiotic Resistance Study

The Section played a leadership role in a 12-month provincial study of antibiotic resistant organisms. This enhanced laboratory-based surveillance study was funded by the Ministry of Health through BCCDC and led by the BC Chapter of the Canadian Association of Medical Microbiologists. Collaborators at BCCDC include Laboratory Services, Epidemiology Services and Information Management Divisions. The collection and characterization of bacterial isolates was carried out in collaboration with 8 laboratories including community and acute care, tertiary and quaternary care hospital laboratories. Analysis of the epidemiologic and laboratory data is underway.

Bordetella pertussis Outbreak/2000

A province-wide outbreak of *Bordetella pertussis* infection began in early 2000 and peaked in June (Figure 1). The greatest number of pertussis infections were detected in the Capital, Okanagan Similkameen, Central Vancouver Island and Thompson Health Regions. This outbreak was more extensive than the outbreak which occurred in 1996-97.

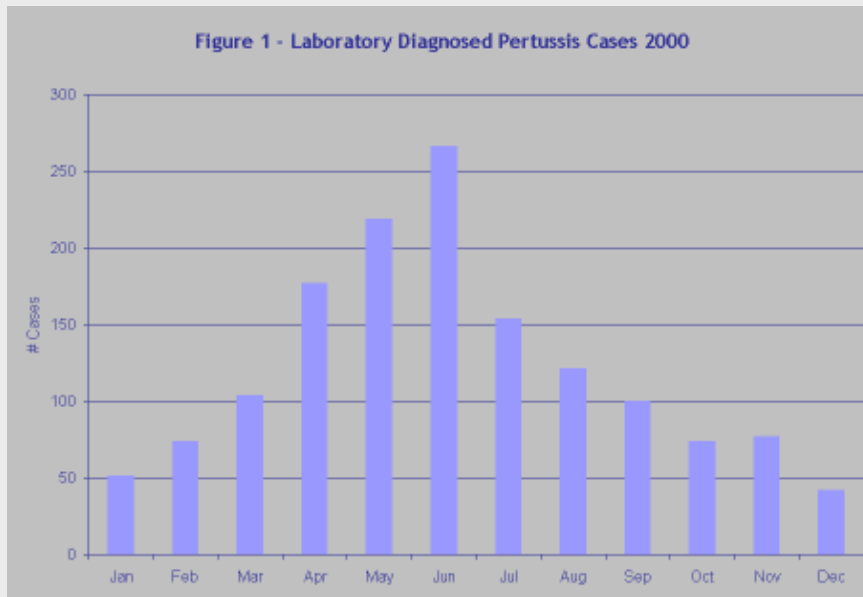


Table 1 shows that the number of culture-positive patients in 2000 was twice that seen in 1996-97. Of 678 culture-positive patients, 642 were positive for *B. pertussis*; 36 were positive for *B. parapertussis*. Replacement of the DFA test in 1998 with the more sensitive PCR test for the direct detection of pertussis from nasopharyngeal specimens also resulted in an increase in the numbers of pertussis infections detected in 2000. The total number of laboratory diagnosed cases of pertussis in 2000 was four times that of the 1996-97 outbreak.

Table 1 - Bordetella Pertussis Tests 1995-96 to 2000

Year	Cultures		DFA Tests		Total*	
	# Tested	# (%) Positive	# Tested	# (%) Positive	# Tested	# (%) Positive
1995-96	1,638	186 (11.4)	1,602	88 (5.5)	1,638	197 (12.0)
1996-97	3,254	339 (10.4)	3,044	128 (4.2)	3,254	358 (11.0)
1997-98	1,954	168 (8.6)	1,834	70 (3.8)	1,954	185 (9.5)
Year	Cultures		PCR Tests**		Total*	
	# Tested	# (%) Positive	# Tested	# (%) Positive	# Tested	# (%) Positive
1998	1,777	149 (8.4)	1,406	198 (14.1)	1,777	229 (12.9)
1999	3,304	209 (6.9)	3,076	346 (11.2)	3,076	356 (11.6)
2000	10,310	678 (6.6)	10,317	1,390 (13.5)	10,317	1,456 (14.1)

*Total = Total number of patients tested or positive by either culture or DFA/PCR

** PCR Tests - PCR test introduced April 1, 1998; DFA test discontinued

Education and Teaching

General Bacteriology Section participated in the STD Control Training Program for public health nurses, by holding laboratory sessions in February, May and October.



Ingrid Pocock

Ingrid Pocock, General Bacteriology scientist, traveled to Vietnam for 2 weeks in April, 2000 to train laboratory staff at the Cafe Hy Vong and Binh Thanh STD Clinics in Ho Chi Minh City. This is a nationally funded initiative led by BCCDC STD Control.



Vietnamese delegation presents plaque to BCCDC to acknowledge participation in STD Control in Vietnam

Carol Shaw, Supervisor, General Bacteriology Section has contributed much time and energy to promoting Quality Assurance initiatives in Laboratory Services. Carol has served as Quality Team Leader and leads our Continuous Quality Improvement (CQI) Team.



Carol Shaw

Laboratory Services Sections

Mycobacteriology *Mycology*

Core Services

- British Columbia's diagnostic and reference laboratory for tuberculosis and Non-tuberculous Mycobacteria
- Molecular testing services
- Drug susceptibility testing for tuberculosis
- Mycology services

Testing Services

The section tested 23,314 specimens for *Mycobacterium tuberculosis* and non-tuberculous mycobacteria. 301 cultures were referred for identification and confirmation. Of the 22,242 specimens examined by microscopy 969 (4%) were positive for acid fast bacilli, an indication of the potential for transmission.

Consistent with American Thoracic Society recommendations, all specimens were set up using both solid and liquid media. In 2000, the section implemented use of the MB/BacT-Bact/ALERT 3D Mycobacteria Detection System (Organon Teknika), an automated method for growth of Mycobacteria using a liquid medium.

Molecular Confirmatory Testing

The *M. tuberculosis* Direct (MTD) GEN-probe method is used to confirm smear-positive specimens. A total of 545 MTD tests were performed; 164 tests were on sputa, 102 on other specimens. Negative and positive probe results were further confirmed by culture. A second GEN-probe method is used on positive cultures.

Susceptibility Testing

All new *Mycobacterium tuberculosis* isolates are tested for drug susceptibility using the radiometric method. Isolates showing resistance to more than one drug are confirmed with the agar plate method. Isolates showing resistance to isoniazid and rifampin are automatically tested against pyrazinamide and second-line drugs. 516 susceptibility tests were performed. The section participates in the National Surveillance System for monitoring *Mycobacterium tuberculosis* drug resistance patterns.

Susceptibility testing for *Mycobacterium avium-intracellulare* is available with consultation. The section uses radiometric broth macrodilution method for determination of minimal inhibitory concentration (MIC). Mycobacteria that are rapid growers are tested for susceptibility to a standard panel of antibiotic agents using the e-test MIC method. Non-tuberculous mycobacteria isolates are tested for drug susceptibility on physician request.

Clare Kong preparing specimens for RFLP



Special Projects

DNA Fingerprinting

As part of the Laboratory Services Platform Technology initiative and in collaboration with Dr. Mark Fitzgerald, BCCDC Tuberculosis Control, the section evaluated a protocol for DNA fingerprinting of tuberculosis isolates using IS6110 Restriction Fragment Length Polymorphism (RFLP). This molecular epidemiology tool is used to evaluate clusters of infection.

Containment Level 3 Laboratory

The section is actively involved in the CL3 certification project led by Biological Safety Services.

Collaborative Research Projects

In collaboration with Dr. Mark Fitzgerald and the US Centers for Disease Control and Prevention, staff are involved in the project "A Pilot Study to Evaluate Nucleic Acid Amplification Tests to Predict Relapse of Tuberculosis and to Monitor the Effectiveness of Treatment."



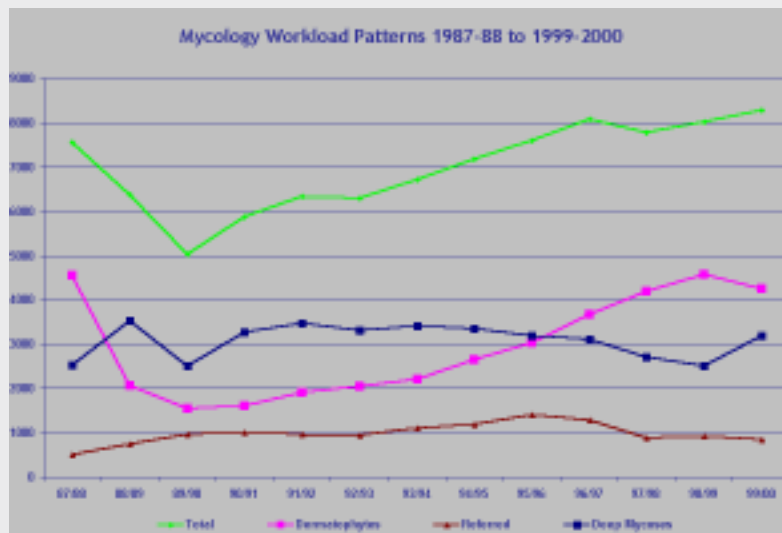
Sultana Mithani

Mycology Testing

The Mycology Section performed a total of 5,695 tests; of these 1,574 (27%) specimens were for examination for dermatophytes, 3,311 (58%) were specimens for testing for deep mycoses and 810 (15%) were referred specimens for further identification.

New Services – Mycology

- *Nocardia* susceptibility testing on isolates from sterile sites upon physician request
- PCR testing for *Candida* species performed on isolates not fully identified by the Analytical Profile Index (API) method



Education and Training

3 General Pathology resident medical postgraduates and 9 medical students from the University of British Columbia were trained in the section.

A dermatology resident spent 18 days in the section as part of the Royal College of Physicians & Surgeons of Canada program at UBC.

Laboratory Services Sections

Parasitology

Core Services

- Outbreak investigation & surveillance
- Public health parasitology
- Provincial reference laboratory
- Diagnostic & medical consultative services
- Molecular testing services
- Education & training

Automation and new technologies have had a relatively minor impact on medical parasitology.

The high level of service provided by the section is dependent on the experience and expertise of highly trained and experienced medical technologists. A medical, technical and scientific team provides provincial leadership in parasitology.

New Initiatives

Physician Guidelines

Guidelines for physicians ordering parasitology tests were implemented; a program of Quality Assurance monitoring the efficacy of these guidelines was begun.

Molecular Diagnostics

The section investigated nucleic-acid diagnostic tests, molecular markers and other new diagnostic methods for *Plasmodium falciparum* (malaria).

Proficiency Testing

Parasitology Section participates in CAP (College of American Pathologists) External Proficiency Testing and CMPT (Canadian Medical Proficiency Testing) Programs. It is also a founding participant in the McGill Centre for Tropical Disease Malaria Proficiency Testing Program. The section is a reference centre for the CMPT Program.



Quantine Wong, Supervisor

Quality is a key component of all our processes.

Continuous Quality Improvement Initiatives

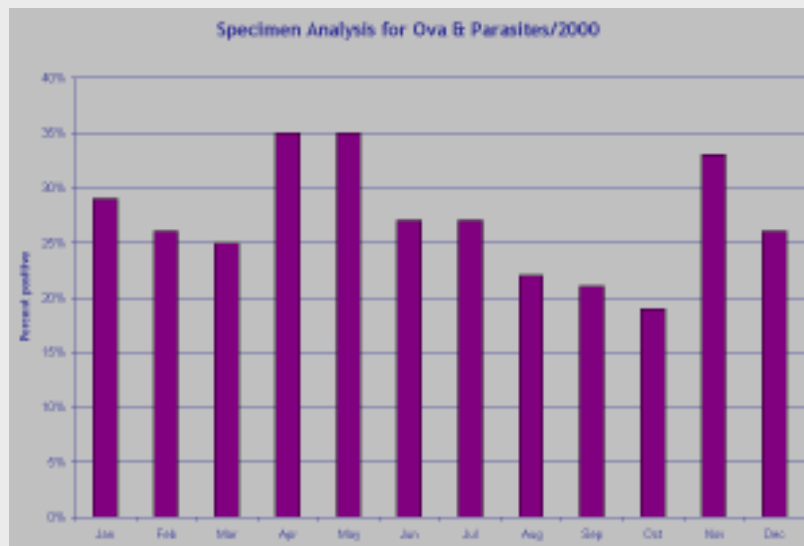
- Education seminars for staff
- Increased safety awareness
- Computer enhancements
- Participating in the BCCDC Laboratory Bioterrorist Response Team
- Participating in the new Environmental Services cluster group
- Strategic Planning and Visioning 2000
- Procedural modifications to enhance diagnosis, improve turn-around times, safety and cost recovery

Education and Training

UBC's Department of Pathology and Laboratory Medicine offers a Bachelor of Medical Laboratory Science (BMLSc) degree program. The section hosted a parastiology workshop, one component of the degree program.

The section developed and held a malaria workshop for haematopathologists and haematology technologists from the lower mainland of BC. The "wet workshop" was carried out in collaboration with senior Parasitology Consultant, Magda Moricz.

3 resident medical postgraduates and 4 technologists were trained in parasite identification. 9 groups of students toured the Parasitology Laboratory as part of an overall community service plan developed to provide an understanding of BCCDC Laboratory Services. One high school student spent time in the section to observe science in action.



Malaria Surveillance

Malaria due to *Plasmodium falciparum*, while not common in BC, is a medical emergency. This species is very frequently resistant to many anti-malarial agents. The section currently uses standard microscopy procedures (the gold standard) for the detection and speciation of malaria. The section carries out reference testing for species identification of malaria. As part of its provincial Quality Assurance program it conducts training in diagnostic testing.

Malarial Species Identified

<i>Plasmodium vivax</i>	13
<i>Plasmodium falciparum</i>	9
<i>Plasmodium malariae</i>	7
Species undetermined	3

Blood & Tissue Specialty Testing

The most important blood and tissue parasite for the section is malaria. The diagnosis of malaria from thin blood films is not complicated if the number of malaria parasites is moderate to high. Patients may develop serious symptoms with a low parasitemia. Such parasitemias are difficult to detect by examination of thin blood films alone; properly prepared thick films from peripheral blood must be examined. Preparation and examination of thick smears is an accreditation requirement of both the British Columbia Diagnostic Accreditation Program (College of Physicians and Surgeons) and CAP. The advantage of thick film examination is that a larger volume (16-30 fold higher) of blood can be examined in a given number of high-power fields. When technologists and pathologists in the laboratory are proficient in reading thick blood films, they are able to detect malaria parasites when corresponding thin blood films are negative. The section also performs specialty testing and reference services for other blood and tissue parasites including culture for *Leishmania* and *Acanthamoeba*.

Comparative Project

Following a 12-month study comparing an antigen detection method, a PCR detection and speciation method with standard microscopy, the section implemented the MAKROmed malaria rapid test, a coloured immunochromatographic assay. This test is an adjunct to microscopy for the detection and confirmation of *P. falciparum* malaria in whole blood. This dipstick test has a sensitivity of >98.5% and a specificity of 98.6%, can be carried out quickly and requires very little laboratory space, equipment and training. It does not provide reliable discrimination between mixed infections and infections other than *P. falciparum*. An in-house nucleic-acid amplification technique (PCR-RFLP) is used when microscopy is unable to identify the species of malaria.



Vision Teams Launch

Strategic Planning

The section participated in BCCDC Laboratory Services' Strategic Planning and Visioning 2000 Project. Recommendations of the Vision Team are being implemented. Quality, Informatics and Molecular Epidemiology are the focus of future development. Quantine Wong, Supervisor is leader of the Internal Quality Assessment (IQA) Team.

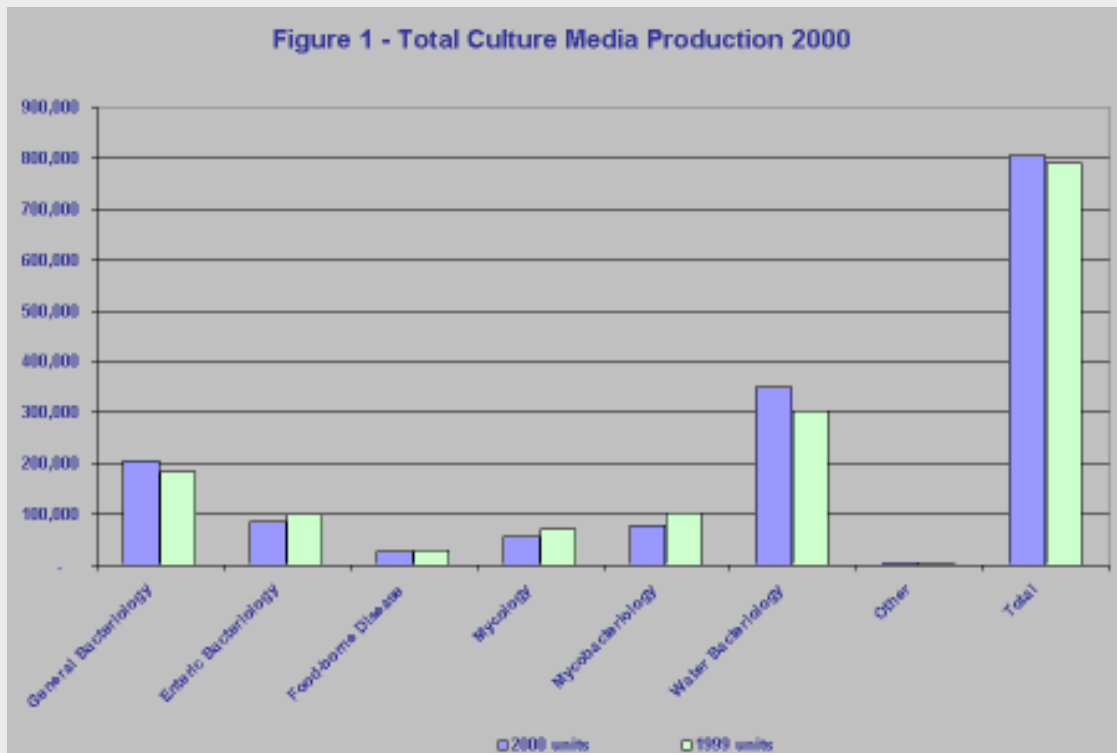
Laboratory Services Sections

Technical Support Services

Core Services

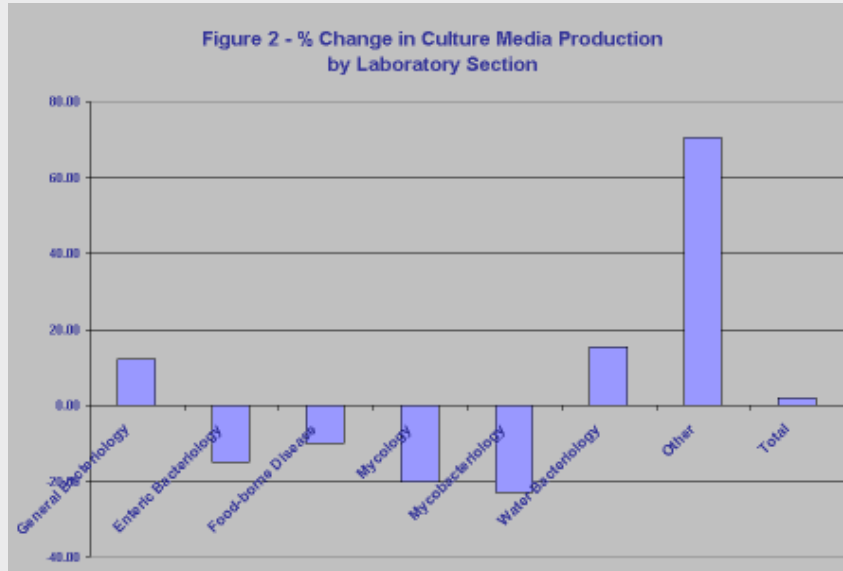
- Manufactures culture media for in-house users
- Receives and dispatches laboratory specimens
- Cleans and sterilizes laboratory glassware
- Decontaminates infectious waste

Quality is a key component of all our processes.





Winnie Mar



Technical

Media Production

Technical Support Services produces more than 400 different types and variations of culture media, reagents and solutions. As laboratory sections change the schedules of tests they perform or take on new responsibilities, their media needs also change. Figure 1 illustrates the changes in media production for year 2000 over 1999. Figure 2 shows the percentage change in media production for each laboratory section.

Staff in Technical Support Services responded to unusually high media requirements because of the increase in testing for *B. pertussis* as a result of the outbreak of the disease in British Columbia.



Mohammed Alladin
Permjit Sandhu
John Chan

Laboratory Services Sections

Virology

Core Services

- Comprehensive diagnostic & medical consultative services
- Provincial reference laboratory
- Molecular testing services
- Clinical trials & applied research
- HIV testing

Testing Initiatives

Molecular Testing

The use of molecular assays in Virology continued to increase in 2000. The Roche quantitative hepatitis C (HCV) PCR test was made available, primarily for monitoring the viral load of selected populations undergoing treatment. The Human Papillomavirus (HPV) Hybrid Capture qualitative assay and hepatitis B (HBV) quantitative Hybrid Capture assay by Digene were also added to the test menu. The Digene assays are a signal amplification hybridization microplate assay using chemiluminescence for detection of viral DNA.

The Qiagen Biorobot used for extraction of plasma specimens improved HCV PCR sensitivity by 8-10 fold and reduced hands-on time. To enhance tracking of specimen data, a bar coding system was used for tracking specimens related to research studies so that data could be accurately generated.

The section began a collaborative study with Molecular Services to investigate the use of sequence-based HCV genotyping versus the Innogenetics Inno-Lipa HCV II kit. This study will evaluate accuracy, turnaround time, sequencing failure rates and cost.



Annie Mak, Molecular Virology

Clinical Trials and Applied Research

- Perinatal and sexual transmission of HCV — Dr. M. Krajden, Dr. D. Money
- HCV study involving monitoring of treatment protocols — Dr. F. Anderson, Dr. M. Krajden
- HBV vertical transmission study — Dr. M. Krajden, Mohamad Khan
- HCV - Innogenetics Inno-Lipa HCV II versus sequenced based HCV genotyping — Dr. S. Byrne, G. McNabb, Dr. M. Krajden
- Human Papillomavirus in women presenting for colposcopy at BC Cancer Agency using the HPV Digene hybrid capture assay
- Detection of respiratory viruses using R-mix (MinkLung/A549) cells during the 2000 respiratory season
- Evaluation of the use of the Quidel Influenza point-of-care test in long term care facilities with collaborators from Victoria and Kamloops



Ron Gillies, Virus Isolation

Evaluation of Diagnostic Tests

During the respiratory season of 2000/2001 Virus Isolation began an evaluation of the use of R-Mix cells (MinkLung/A549 from Diagnostics Hybrids) using a rapid shell vial assay. The purpose of this comparative study of R-mix cells versus the standard protocol for detection of Influenza A, B, Parainfluenza 1, 2, 3, Adenovirus and Respiratory Syncytial virus (RSV) is to decrease turnaround time for culture of these viruses and to increase sensitivity. The outcome of this evaluation will tentatively establish an improved protocol for the detection of respiratory viruses during the 2001/2002 season. In this project the use of two new SimuFluor™ fluorescent reagents was also evaluated. These Simufluor™ reagents allow detection of two or more viruses with one reagent containing two fluorochromes, Simufluor InfA/InfB and Respiratory virus screen/RSV. In light of preliminary results, Virus Isolation staff switched from Bartels individual fluorescent reagents to Simufluor™ for direct fluorescent antibody testing and culture confirmation.



Virus culture tubes

The section evaluated the use of the Quidel Quick Vue influenza point-of-care kit in long term health facilities in Victoria and Kamloops. The facilities submitted a duplicate specimen for virus culture testing. Forty-seven specimens were tested by Quick Vue at these facilities. Two Influenza A were detected by the kit and culture. Two Influenza B were negative by Quickvue and detected by culture. There were nine other isolates found by culture, one Parainfluenza 1, four Parainfluenza 3 and four RSV. Further evaluation of the kits is required.



Gail McNabb, Supervisor

Quality is a key component of all our processes.

Education and Training

Virology Services initiated a Virology Interest Group. Representatives of BCCDC, UBC, BC Women's & Children's Hospital, Canadian Blood Services and Viridae meet to discuss common issues.

Dr. Mel Krajden, Dr. Sean Byrne, Dr. Muhammad Morshed, Darrel Cook, Gail McNabb, Annie Mak and Ron Gillies presented an educational virology course to staff of BCCDC.



Leslie Wilton
Virus Serology



Alice Teeple
HIV Laboratory

Laboratory Services Sections

Zoonotic Diseases & Emerging Pathogens Non-Viral Serology

Core Services

- Diagnostic & consultative services
- Research & development for zoonotic & emerging diseases
- Outbreak investigation
- Reference laboratory
- Molecular testing services

Zoonotic Diseases and Emerging Pathogens

The Section provides testing, diagnostic and reference services related to zoonotic and emerging diseases, including:

- Culture of Lyme disease and relapsing fever spirochetes
- PCR-based testing for Lyme disease
- Relapsing fever serology
- Ehrlichiosis serology
- Surveillance for Hantavirus-infected rodents

Non-Viral Serology

The Non-Viral Serology laboratory diagnoses syphilis, *Helicobacter pylori*, Lyme disease and other parasitic diseases such as toxoplasmosis, Hydatid disease, toxocariasis and amoebiasis.

Syphilis

95,129 specimens were tested for syphilis using the Rapid Plasma Reagin test (RPR) and, when required, the Microhaemagglutination *T. pallidum* (MHA-TP) and Fluorescent Treponemal Antibody Absorption (FTA-Abs) tests. The section is evaluating a new treponemal test method, the Line Immunoassay. Preliminary results have been presented for scientific review.

Helicobacter pylori

Section staff performed an investigation of serological test methods. A comprehensive public health response program is under development.

Research Projects

Lyme Disease

The first *Borrelia burgdorferi* strain was isolated in British Columbia in 1993 from an *Ixodes pacificus* tick. Subsequently, *B. burgdorferi* has been detected in ticks and mice.

The section amplified the rrf (5S)-rrl (23S) intergenic spacer region of 32 strains isolated from ticks and deer mice and the PCR products were sequenced. 22 isolates were from *I. pacificus*, 6 from *I. angustus* and 4 from deer mice. The sequence data showed that among 32 strains, 29 strains matched with *B. burgdorferi sensu stricto* whereas three strains matched with *B. bissettii*. Two *B. bissettii* strains were isolated from *I. angustus* ticks and the other from *I. pacificus*.

Two genospecies of *B. burgdorferi sensu lato* prevailed in BC. This is also the first report of the presence of *B. bissettii* in nature from an *I. angustus* tick. The Lyme disease spirochete was isolated from an *I. pacificus* tick retrieved from a dog in Surrey, BC.



M.G. Morshed
PhD, RSM(CCM)

Ontario Lyme Disease Project

This research is done in conjunction with the Lyme Disease Association of Ontario.



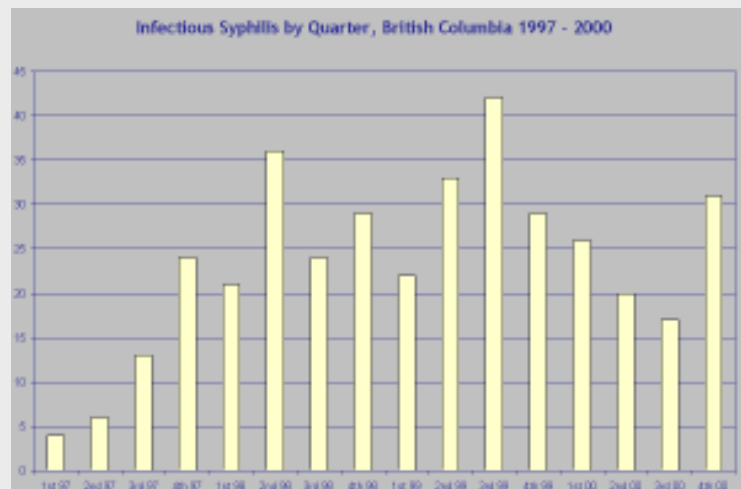
Preparing a tick for culture

The Association submitted 421 Ixodid ticks for borrelial studies. Of these, 273 were collected from at Rondeau Provincial Park, 134 were removed from domestic hosts (canine, feline, human) and 14 were from passerine birds. Seventeen blacklegged ticks, *I. scapularis*, removed from domestic hosts with no history of out-of-province travel were positive for *B. burgdorferi*, the Lyme disease spirochete.

Nine samples of blood were submitted from dogs and cats that were infested with *B. burgdorferi*-positive blacklegged ticks. Eighteen small mammals from Rondeau Provincial Park were PCR tested for the presence of *B. burgdorferi*. The majority of ticks submitted were *I. scapularis*, a competent vector for Lyme disease.

DNA Testing for Syphilis

Diagnosis of syphilis by dark-field microscopy (DFM) and Direct Fluorescent Assay (DFA) has limitations. The study compared a previously described gene amplification method based on the *poIA* locus on the DNA polymerase 1 of *T. pallidum* with traditional DFM/DFA. 20 patients were included in this study; 19 patients had visited the BCCDC's STD Clinics with genital ulcer disease (GUD). One specimen was collected from a baby in Vancouver. 18 GUD specimens, tested by DFM/DFA and *poIA* PCR were 100% specific as defined by serology. The sensitivity was 73% for DFM/DFA and 85% for *poIA* PCR. The *poIA* PCR base detection method may be more sensitive than combined DFM/DFA. Extracted DNA from these specimens allows molecular typing of *Treponema pallidum* for molecular epidemiology.



Molecular Epidemiology of *Helicobacter pylori*

Helicobacter pylori infection is a significant risk factor for both gastric and duodenal ulcers, gastric adenocarcinoma and MALT lymphoma. In collaboration with Molecular Services and Environmental Services, the section evaluated commercially available serology test kits and began to develop an active public health program for this emerging pathogen.



Ixodes pacificus

Ehrlichiosis DNA Testing

The *Amblyomma americanum* and *Dermacentor variabilis* ticks are considered likely vectors for *Ehrlichia chaffeensis*, the causative organism for Human Monocytic Ehrlichiosis; *Ixodes scapularis* is considered the likely vector for Human Granulocytic Ehrlichiosis. Preliminary evidence indicates that *I. pacificus* may carry Ehrlichia-like agents in BC. *E. chaffeensis* has been detected from *I. pacificus* ticks in California.

The section has initiated a project to amplify Ehrlichia DNA from Ehrlichia positive ticks screened by IFA.

International Zoonotic Outbreaks



World Health Organization

Leptospirosis

Leptospirosis is caused by a spirochete transmitted to humans through water contaminated with urine from infected animals. Patients may suffer kidney damage, meningitis or liver failure.

In 2000, Eco-Challenge was held in Sabah, Malaysian Borneo, one of the last wild places on earth. Hundreds of people from attended. CDC Atlanta provided evidence that the cause of acute febrile illness among participants was leptospirosis.

Rift Valley Fever is a zoonotic disease of cattle, sheep, camels, goats, etc. The virus is spread to humans by the bite of infected mosquitoes and through contact with body fluids of infected animals. Outbreaks were reported in 2000 in Saudi Arabia and Yemen.

Ebola Haemorrhagic Fever causes death in 50-90% of cases. The virus is transmitted by direct contact with the blood, secretions, organs or semen of infected persons. In October 2000, World Health Organization reported the first confirmed Ebola virus case in Uganda and by December 2000, the total number of cases rose to 426 with 172 deaths.

West Nile Fever first occurred in New York City in 1999 with 62 confirmed cases and 7 deaths. Israel reported 151 cases with 76 hospitalized and 12 deaths. Canada continues to monitor the situation.

Sources: CDC Atlanta, Georgia; MMWR Weekly; WHO Outbreak News; Promed

Publications & Conferences

Manuel Altamirano, PhD

Sharma M, Altamirano M, Prasad HK, Myneedo VP and Nand N. Characterization by single strand conformation polymorphism of mutations in the rpoB gene of rifampin-resistant *Mycobacterium tuberculosis* in strains from Vancouver, Mexico City and New Delhi. J Assoc Physicians India 48:565-67, 2000.

Elaine Bessuille, BSc

Black, W., Rodrigues, M., Bessuille, E. "Comparative Performance Characteristics of Various Media Combinations in the Laboratory Diagnosis of *M. tuberculosis* (M.tb) and non-tuberculosis mycobacteria (NTM)." Presented at the 68th Conjoint Meeting on Infectious Diseases, Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa, Nov. 5-8, 2000.

Black, W. Rodrigues, M., Bessuille, E. "Evaluation of the Bact/ALERT3D Mycobacteria Detection system." 21st annual Congress of the European Society of Mycobacteriology, Vienna, July 2-5, 2000

Phillips, P., Chan, K., Hogg, R., Bessuille, E. Black, W., Talbot, J. O'Shaughnessy, M., Montaner, J. "Azithromycin Prophylaxis for *Mycobacterium avium* complex during the Era of Highly Active Antiretroviral Therapy: Evaluation of a Provincial Program." "39th Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, 1999.

William Black, MB, FRCPC, FRC Path

Black, W., Rodrigues, M., Bessuille, E. "Comparative Performance Characteristics of Various Media Combinations in the Laboratory Diagnosis of *M. tuberculosis* (M.tb) and non-tuberculosis mycobacteria (NTM)." Presented at the 68th Conjoint Meeting on Infectious Diseases, Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa, Nov. 5-8, 2000.

Black, W., Rodrigues, M., Bessuille, E. "Evaluation of the Bact/ALERT3D Mycobacteria Detection system." 21st annual Congress of the European Society of Mycobacteriology, Vienna, July 2-5, 2000

Sean Byrne, PhD

Mahenthalingam, E., J.Bischof, S.K.Byrne, C.Radomski, J.E.Davies, Y.Av-Gay and P.Vandamme. DNA-based diagnostic approaches for the identification of *Burkholderia cepacia* complex bacterial pathogens: *Burkholderia vietnamiensis*, *Burkholderia multivorans*, *Burkholderia stabilis*, *Burkholderia cepacia* genomovar I and *Burkholderia cepacia* genomovar III. J Clin Microbiol 2000 Sep;38(9):3165-73

Webber SA, NJ Wilson, AK Junker, SK Byrne, A Perry, EE Thomas, L Book, M Tipple, MW Patterson, GG Sandor. 2001. Postpericardiotomy syndrome: no evidence for a viral etiology. Cardiol Young 2001 Jan;11(1):67-74

Scott, J.D., K. Fernando, S.N. Banerjee, L.A. Durden, S.K. Byrne, M. Banerjee, R. Mann, M.G. Morshed. 2001. Birds disperse Ixodid (Acari: Ixodidae) and *Borrelia burgdorferi*-infected ticks in Canada. Entomology Society of America 38: 493-500.

Parkes R., T. Lo, Q. Wong, J.L. Isaac-Renton, S.K. Byrne. 2001. Comparison of nested PCR-RFLP, the Path antigen detection method and microscopy for the detection and identification of malaria parasites. Canadian Journal of Microbiology (in press)

R. Parkes, T. Lo, Q. Wong, J. Isaac-Renton, S.K. Byrne. 1999. Detection and Speciation of Malaria using PCR-RFLP Analysis and its Comparison to Standard Microscopy. 67th Conjoint Meeting on Infectious Diseases.

Role of extraction method on Hepatitis C virus (HCV) Rt-PER sensitivity. Mak A, Byrne S, Scalia V, Palmer D, Sher G, Hill W, Krajden M. Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa, Nov.2000.

Sher GD, Scalia V, Zuber ED, Hrytzak J, Byrne S, Petersen N, Krajden M. Hepatitis C virus (HCV) RNA stability in EDTA Plasma tubes containing the anticoagulants CPDA-1 and CP2D. In: Program and Abstracts of the 26th Congress of the International Society of Blood Transfusion ISBT 2000, July 9-14, 2000 Vienna, Austria.

Byrne S.K., R.Parkes, R.Chen and M.Krajden. 2000. Selection of Hepatitis B Virus (HBV) Gene Regions for Molecular Epidemiological Subtyping. 68th Conjoint Meeting on Infectious Diseases. Ottawa.

Morshed M.G., K.Fernando, S.K. Byrne, R.Chen, R.Mann, Q. Wong, J.L.Isaac-Renton. The rrf(5S)-rrl(23S) Intergenic spacer region sequence data revealed the presence of *Borrelia bissettii* from *Ixodus pacificus* and *Ixodus angustus* ticks. 2001.American Society of Microbiology General Meeting.

Morshed M.G., K.Fernando, S.K.Byrne, R.Parkes, R.Mann, Q. Wong, J.L.Isaac-Renton. 2001. Molecular characterization of Lyme disease spirochetes isolated from British Columbia. 56th INCDNCM Conference, Winnipeg.

Reuben Chen, BSc

Byrne S.K., R.Parkes, R.Chen and M.Krajden. 2000. Selection of Hepatitis B Virus (HBV) Gene Regions for Molecular Epidemiological Subtyping. 68th Conjoint Meeting on Infectious Diseases. Ottawa.

Morshed M.G., K.Fernando, S.K. Byrne, R.Chen, R.Mann, Q. Wong, J.L.Isaac-Renton. The rrf(5S)-rrl(23S) Intergenic spacer region sequence data revealed the presence of *Borrelia bissettii* from *Ixodus pacificus* and *Ixodus angustus* ticks. 2001.American Society of Microbiology General Meeting.

Darrel Cook, MSc, ART, RSM(CCM)

Cook D, Wilton L, Patrick D, Zou S, Sherman M, Krajden M. Prevalence of Antibodies to Hepatitis A virus in a cohort of women of child-bearing age. Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa, Nov. 2000

Tipples G, Stephens G, Reynolds R, Sherlock C, Bowler M, Hoy B, Cook D. Detection of a clinical Varicella-zoster virus with a mutation in the 3B3 monoclonal antibody epitope. Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa Nov.2000.

Patrick D, Dawar M, Cook D, Bigham M, Krajden M. Evaluating a universal pre-adolescent hepatitis B immunization program 7 years after implementation in British Columbia. Canadian Immunization Conference, Halifax NS, December 2000.

Chen Z, Cook D, Krajden M, Fonseca K, Kim J. Rapid multiplex amplification and detection of HIV and HCV using the Lightcycler rapid thermal cycler. 68th Conjoint Meeting on Infectious Diseases, Canadian Association for Clinical Microbiology & Infectious Diseases, Ottawa, November 2000.

Cook D, Wilton L, Patrick D, Zou S, Sherman M, Krajden M. Prevalence of antibodies to hepatitis A virus in a cohort of women of childbearing age. 68th Conjoint Meeting on Infectious Diseases, Canadian Association for Clinical Microbiology & Infectious Diseases, Ottawa, November 2000.

Tipples GA, Stephens GM, Reynolds R, Sherlock C, Bowler M, Hoy B, Cook D. Detection of a clinical varicella-zoster virus with a mutation in the 3B3 monoclonal antibody epitope. 68th Conjoint Meeting on Infectious Diseases, Canadian Association for Clinical Microbiology & Infectious Diseases, Ottawa, November 2000.

Patrick DM, Dawar M, Krajden M, Cook D, Ng H, Lam ML, Rekart ML. *Herpes simplex* type 2 seroprevalence in Canadian women. 40th Interscience Conference on Antimicrobial Agents and Chemotherapy, Toronto, September 2000.

Patrick DM, Dawar M, Cook D, Bigham M, Ng H, Krajden M. What can antenatal seroprevalence tell us after seven years of pre-adolescent hepatitis B immunization? 40th Interscience Conference on Antimicrobial Agents and Chemotherapy, Toronto, September 2000.

Cote Y, Therien L, Cook D et al. Multicentre evaluation of FAST CHECK HIV-1/2 WHOLE BLOOD. Ninth Annual Conference on HIV/AIDS Research, Canadian Association for HIV Research, Montreal, April 2000.

Therien L, Cook D et al. Multicentre evaluation of FAST CHECK HIV-1/2 SERUM. Ninth Annual Conference on HIV/AIDS Research, Canadian Association for HIV Research, Montreal, April 2000.

Philip Cook, BSc, RT

Anderson F, Rock N, Wallston L, Mak A, Gunadasa K, Cook P, Hill WD, Krajden M. Early Phase Hepatitis C virus (HCV) Load response to Interferon/Ribavirin therapy. Canadian Association for Clinical Microbiology and Infectious Disease, Ottawa, Nov.2000

Keerthi Fernando, BSc, MSc

Scott, J.D., K. Fernando, S.N. Banerjee, L.A. Durden, S.K. Byrne, M. Banerjee, R. Mann, M.G. Morshed. 2001. Birds disperse Ixodid (Acari: Ixodidae) and *Borrelia burgdorferi*-infected ticks in Canada. Entomology Society of America 38: 493-500.

Morshed, M.G., J.D. Scott, S.N. Banerjee, K. Fernando, R. Mann and J. Isaac-Renton. 2000. First isolation of Lyme disease spirochete, *Borrelia burgdorferi*, from blacklegged tick, *Ixodes scapularis*, collected from at Rondeau Provincial Park, Ontario. CDRR 26(06): 42-44

S. N. Banerjee, M. Banerjee, K. Fernando, J.D. Scott, R. Mann, M.G. Morshed, 2000. Presence of Lyme disease spirochete, *Borrelia burgdorferi* in the blacklegged tick, *Ixodes scapularis* in Southern Ontario. CMAJ 162:1567-1569.

Morshed M.G., K. Fernando, S.K. Byrne, R. Chen, R. Mann, Q. Wong, J.L. Isaac-Renton. The rrf(5S)-rrl(23S) Intergenic spacer region sequence data revealed the presence of *Borrelia bissettii* from *Ixodus pacificus* and *Ixodus angustus* ticks. 2001. American Society of Microbiology General Meeting.

Morshed M.G., K. Fernando, S.K. Byrne, R. Parkes, R. Mann, Q. Wong, J.L. Isaac-Renton. 2001. Molecular characterization of Lyme disease spirochetes isolated from British Columbia. 56th INCDNMC Conference, Winnipeg.

Swee-Han Goh, PhD

Goh, S.H., R.D. Facklam, M. Chang, J.E. Hill, G.J. Tyrrell, E.M.C. Burns, D. Chan, C. He, T. Rahim, C. Shaw, and S.M. Hemmingsen. 2000. Identification of Enterococcus species and phenotypically similar Lactococcus and Vagococcus species by reverse checkerboard hybridization to chaperonin 60 gene sequences. J. Clin. Microbiol. 38:3953-3959.

Brousseau, R., J.E. Hill, G. Prefontaine, S.H. Goh, J. Harel and S.M. Hemmingsen. 2001 *Streptococcus suis* serotypes characterized by analysis of cpn60 gene sequences. Appl. Environ. Microbiol. In press.

Kingsley Gunadasa, BSc

Anderson F, Rock N, Wallston L, Mak A, Gunadasa K, Cook P, Hill WD, Krajden M. Early Phase Hepatitis C virus (HCV) Load response to Interferon/Ribavirin therapy. Canadian Association for Clinical Microbiology and Infectious Disease, Ottawa, Nov. 2000

Loan Hoang, BSc

L. McIntyre, L. Hoang, C.S.L. Ong, P. Lee and J.L. Isaac-Renton. 2000. Evaluation of Molecular Techniques to Biotype *Giardia duodenalis* Collected During an Outbreak. J. Parasitol. 86(1):172-177.

L. McIntyre, L. Hoang, L. Li, M. Khan, B. Wong, J. Fung and J.L. Isaac-Renton. Evaluation of Water Testing Methods in Three Communities to Quantitate *Cryptosporidium* oocysts and *Giardia* cysts in Raw Drinking Water Sources. P-10. 9th National Conference on Drinking Water, CWWA, May, 2000.

Benny Hoy, BSc, RT

Tipples GA, Stephens GM, Reynolds R, Sherlock C, Bowler M, Hoy B, Cook D. Detection of a clinical varicella-zoster virus with a mutation in the 3B3 monoclonal antibody epitope. 68th Conjoint Meeting on Infectious Diseases, Canadian Association for Clinical Microbiology & Infectious Diseases, Ottawa, November 2000.

Dr. Judith Isaac-Renton, MD, FRCPC, DPH

L. McIntyre, L. Hoang, C.S.L. Ong, P. Lee and J.L. Isaac-Renton. 2000. Evaluation of Molecular Techniques to Biotype *Giardia duodenalis* Collected During an Outbreak. J. Parasitol. 86(1):172-177.

L. McIntyre, L. Hoang, L. Li, M. Khan, B. Wong, J. Fung and J.L. Isaac-Renton. Evaluation of Water Testing Methods in Three Communities to Quantitate *Cryptosporidium* oocysts and *Giardia* cysts in Raw Drinking Water Sources. P-10. 9th National Conference on Drinking Water, CWWA, Saskatoon SK, May, 2000.

Parkes R., T. Lo, Q.Wong, J.L. Isaac-Renton, S.K. Byrne. Comparison of nested PCR-RFLP, the Path antigen detection method and microscopy for the detection and identification of malaria parasites. Canadian Journal of Microbiology (in press)

Morshed, M.G., J.D. Scott, S.N. Banerjee, K. Fernando, R Mann and J. Isaac-Renton. 2000. First isolation of Lyme disease spirochete, *Borrelia burgdorferi*, from blacklegged tick, *Ixodes scapularis*, collected from at Rondeau Provincial Park, Ontario. CDDR 26(06): 42-44

McIntyre L, Fung J, Isaac-Renton J, Ong C, Khan M. A tri-community study to compare water testing methods quantitating the *Giardia* cysts and *Cryptosporidium* oocysts in raw drinking water sources. 9th National Conference on Drinking Water, Regina, SK, May 2000.

Isaac-Renton JL, Bowie WR, Ong C., Li A, Khan M, McLean M, Lammie PJ, Priest J. Validation of serology methods for detection of *Cryptosporidium* in human populations. 9th National Conference on Drinking Water, Regina, SK, May 2000 and 1st Annual Research Gala Dept. Of Pathology & Laboratory Medicine, UBC. Vancouver, BC May 2000.

Ong CSL, Winkler R, Wetzstein M, Isaac-Renton JL. *Cryptosporidium* spp. in outbreak community watersheds. 55th International Conference on Diseases in Nature Communicable to Man, Fort Collins, CO, Aug 2000.

Ong CSL, Eisler DL, Fyfe MW, Isaac-Renton JL. Molecular Epidemiological Investigation of *Cryptosporidiosis* Outbreaks in BC. 1st Annual Research Gala Dept. Of Pathology & Laboratory Medicine, UBC. Vancouver, BC May 2000 and UBC Faculty of Medicine Golden Jubilee 2000, Vancouver BC Nov 2000.

Morshed M.G., K.Fernando, S.K. Byrne, R.Chen, R.Mann, Q. Wong, J.L. Isaac-Renton. The rrf(5S)-rrl(23S) Intergenic spacer region sequence data revealed the presence of *Borrelia bissettii* from *Ixodus pacificus* and *Ixodus angustus* ticks. 2001.American Society of Microbiology General Meeting.

Morshed M.G., K.Fernando, S.K.Byrne, R.Parkes, R.Mann, Q. Wong, J.L. Isaac-Renton. Molecular characterization of Lyme disease spirochetes isolated from British Columbia. 56th INCDNCM Conference, Winnipeg.

Morshed M.G., K.Fernando, S.K. Byrne, R.Chen, R.Mann, Q. Wong, J.L. Isaac-Renton. The rrf(5S)-rrl(23S) Intergenic spacer region sequence data revealed the presence of *Borrelia bissettii* from *Ixodus pacificus* and *Ixodus angustus* ticks. 2001.American Society of Microbiology General Meeting.

Morshed M.G., K.Fernando, S.K.Byrne, R.Parkes, R.Mann, Q. Wong, J.L. Isaac-Renton. 2001. Molecular characterization of Lyme disease spirochetes isolated from British Columbia. 56th INCDNCM Conference, Winnipeg.

Morshed, M.G., J.D. Scott, S.N. Banerjee, K. Fernando, R Mann and J. Isaac-Renton. 2000. First isolation of Lyme disease spirochete, *Borrelia burgdorferi*, from blacklegged tick, *Ixodes scapularis*, collected from at Rondeau Provincial Park, Ontario. CDDR 26(06): 42-44

R. Parkes, T. Lo, Q. Wong, J. Isaac-Renton, S.K. Byrne. 1999. Detection and Speciation of Malaria using PCR-RFLP Analysis and its Comparison to Standard Microscopy. 67th Conjoint Meeting on Infectious Diseases.

Isaac-Renton J, McIntyre L, Khan M, Li A, Ong CS. Why Have We Forgotten *Giardia*? Proceedings, *Giardia* Conference, Canmore AB, September 2000.

Update of Testing for Parasites in Drinking Water. Canadian Conference on Public Health Inspections, Vancouver BC, April 2000.

Network of Centres of Excellence for Clean Water, National Health Theme Leader, RésEAU-WATERnet, Site visit/panel, Montreal PQ, May 2000.

Routes of Parasite Contamination of Food & Waterborne Parasites. European Federation of Parasitology Meeting, Posnan, Poland, September 2000.

Unusual Communicable Diseases: Systemic Approach to Management. 5th Asia-Pacific Conference on Disaster Medicine, Vancouver BC, September 2000.

Presentation, National Network of Centres of Excellence – Water, Montreal PQ, November 2000.

Mei Krajden, MD, FRCPC

Byrne S.K., R. Parkes, R. Chen and M. Krajden. 2000. Selection of Hepatitis B Virus (HBV) Gene Regions for Molecular Epidemiological Subtyping. 68th Conjoint Meeting on Infectious Diseases. Ottawa.

Cook D, Wilton L, Patrick D, Zou S, Sherman M, Krajden M. Prevalence of Antibodies to Hepatitis A virus in a cohort of women of child-bearing age. Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa, Nov. 2000

Anderson F, Rock N, Wallston L, Mak A, Gunadasa K, Cook P, Hill WD, Krajden M. Early Phase Hepatitis C virus (HCV) Load response to Interferon/Ribavirin therapy. Canadian Association for Clinical Microbiology and Infectious Disease, Ottawa, Nov. 2000

Mak A, Byrne S, Scalia V, Palmer D, Sher G, Hill W, Krajden M. Role of extraction method on Hepatitis C virus (HCV) Rt-PCR sensitivity. Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa, Nov. 2000.

Patrick D, Dawar M, Cook D, Bigham M, Krajden M. Evaluating a universal pre-adolescent hepatitis B immunization program 7 years after implementation in British Columbia. Canadian Immunization Conference, Halifax NS, December 2000.

Chen Z, Cook D, Krajden M, Fonseca K, Kim J. Rapid multiplex amplification and detection of HIV and HCV using the Lightcycler rapid thermal cycler. 68th Conjoint Meeting on Infectious Diseases, Canadian Association for Clinical Microbiology & Infectious Diseases, Ottawa, November 2000.

Cook D, Wilton L, Patrick D, Zou S, Sherman M, Krajden M. Prevalence of antibodies to hepatitis A virus in a cohort of women of childbearing age. 68th Conjoint Meeting on Infectious Diseases, Canadian Association for Clinical Microbiology & Infectious Diseases, Ottawa, November 2000.

Patrick DM, Dawar M, Krajden M, Cook D, Ng H, Lam ML, Rekart ML. Herpes simplex type 2 seroprevalence in Canadian women. 40th Interscience Conference on Antimicrobial Agents and Chemotherapy, Toronto, September 2000.

Patrick DM, Dawar M, Cook D, Bigham M, Ng H, Krajden M. What can antenatal seroprevalence tell us after seven years of pre-adolescent hepatitis B immunization? 40th Interscience Conference on Antimicrobial Agents and Chemotherapy, Toronto, September 2000.

Fung S, Conly J, Krajden M, Amos A, Richardson R. Enhanced Vaccination against Hepatitis B Virus (HBV) among Hemodialysis (HD) Patients Mitigates Need for Segregation of HBV Carriers. In: Program and Abstracts of the 40th Interscience Conference on Antimicrobial Agents and Chemotherapy ICAAC) September 17 - 20, 2000, Toronto, Ontario.

Gong Y, Cheung D, Gadawski I, Aimin W, Krajden M, Sacks SL. Quantitative analysis of duck Hepatitis B Virus (DHBV) covalently-closed circular DNA (CCCDNA) in duck hepatocytes undergoing antiviral therapy by real-time PCR; Session III: Hepatitis B and Viral Hepatitis and Liver Transplantation - HBV: Vi. In: Program and Abstracts of the 51st Annual Meeting of the American Association for the Study of Liver Diseases, October 27-31, 2000, Dallas, Texas.

Singh M, Dicaire A, Krajden M, Wakil AE, Sacks SL. Rapid quantitation of Hepatitis B Virus (HBV) covalently closed circular (CCC) and HBV Total (T) DNA from liver using fluorescence - labeled oligonucleotide probes; Session III: Hepatitis B and Viral Hepatitis and Liver Transplantation - Hepatitis. In: Program and Abstracts of the 51st Annual Meeting of the American Association for the Study of Liver Diseases, October 27-31, 2000, Dallas, Texas.

Krajden M, Sawyer, L, Leung K, Hendricks D, Comanor, L. The role of transcription mediated amplification in the HCV diagnostic algorithm. In: Program and Abstracts of the 51st Annual Meeting of the American Association for the Study of Liver Diseases, October 27 - 31, 2000, Dallas, Texas.

Byrne SK, Parkes R, Chen R, Krajden M. Selection of Hepatitis B Virus (HBV) Gene Regions for Molecular Epidemiological Subtyping. In: Program and Abstracts of the 68th Conjoint Meeting on Infectious Disease - Canadian Association for Clinical Microbiology and Infectious Diseases, Nov 5-8, 2000 Ottawa, Canada

Schreiber RA, Krajden M, Chaudhary R, Dobson SR, Israel DM. Vertical Transmission Of Hepatitis C : All Three Children In One Family. In: Program and Abstracts of the World Congress of Pediatric Gastroenterology, Hepatology & Nutrition, Aug 5-9, 2000, Boston, Mass.

Sher GD, Scalia V, Zuber ED, Hrytzak J, Byrne S, Petersen N, Krajden M. Hepatitis C virus (HCV) RNA stability in EDTA Plasma tubes containing the anticoagulants CPDA-1 and CP2D. In: Program and Abstracts of the 26th Congress of the International Society of Blood Transfusion ISBT 2000, July 9-14, 2000 Vienna, Austria.

November 17, 2000 Vancouver, BC
"What is a 'PCR?' How Can I Use These Tests Efficiently to Identify What?" at the 46th Annual St. Paul's Hospital Continuing Medical Education Conference for Primary Physicians

October 14, 2000 Vancouver, BC
"Detection and prevention of Hepatitis B and C: How to get the information you need from the Laboratory," at the Hot Topics in Gastroenterology CME course

October 20, 2000 Kamloops, BC
"The Continuum of Hepatitis C Care" at a Community and Public Health Workshop on Hepatitis C virus

June 22, 2000 Vancouver, BC
"Molecular Methods for Identification" at the Challenge 2000, 24th World Congress of Medical Technology

June 17, 2000 Vancouver, BC.

"Hepatitis A-G" at the Challenge 2000, 24th World Congress of Medical Technology

May 25, 2000 Vancouver, BC

"Update on Hepatitis" at the STD Professional Day, BCCDC

May 18, 2000 Kamloops, BC

"Hepatitis C Virus Infection: An Update to Family Doctors and Gastroenterologists"

May 19, 2000 Kamloops, BC

"Screening and Testing for Hepatitis B: Patients and their Families" at Glaxo Wellcome Hepatitis B Mentorship Program

February 9-13, 2000 Cancun, Mexico

"Laboratory Support for Antiviral Therapy for HCV" at the Update on Liver and Inflammatory Bowel Diseases

January 7- 8, 2000 Toronto, Ontario

"Diagnosis and Treatment of Cytomegalovirus (CMV) Infection" as part of a Canadian Blood Services and Canadian Blood and Marrow Transplant Group Consensus Conference, Prevention of PostTransfusion CMV in the Era of Universal Leukoreduction

Man Lee Lam, BSc

Patrick DM, Dawar M, Krajden M, Cook D, Ng H, Lam ML, Rekart ML. *Herpes simplex* type 2 seroprevalence in Canadian women. 40th Interscience Conference on Antimicrobial Agents and Chemotherapy, Toronto, September 2000

Anna Li, BSc, MSc

Isaac-Renton JL, Bowie WR, Ong C., Li A, Khan M, McLean M, Lammie PJ, Priest J. Validation of serology methods for detection of *Cryptosporidium* in human populations. 9th National Conference on Drinking Water, Regina, SK, May 2000 and 1st Annual Research Gala Dept. Of Pathology & Laboratory Medicine, UBC. Vancouver, BC May 2000.

Teresa Lo, BSc, RT

Parkes R., T. Lo, Q. Wong, J.L. Isaac-Renton, S.K. Byrne. 2001. Comparison of nested PCR-RFLP, the Path antigen detection method and microscopy for the detection and identification of malaria parasites. Canadian Journal of Microbiology (in press)

R. Parkes, T. Lo, Q. Wong, J. Isaac-Renton, S.K. Byrne. 1999. Detection and Speciation of Malaria using PCR-RFLP Analysis and its Comparison to Standard Microscopy. 67th Conjoint Meeting on Infectious Diseases.

Richard Parkes, Teresa Lo, Quantine Wong, Judith L. Isaac-Renton, Sean K. Byrne. Comparison of Nested PCR-RFLP, the PATH Antigen Detection Method and Microscopy for the detection and identification of malaria parasites. (submitted for publication)

Annie Mak, BSc, RT

Anderson F, Rock N, Wallston L, Mak A, Gunadasa K, Cook P, Hill WD, Krajden M. Early Phase Hepatitis C virus (HCV) Load response to Interferon/Ribavirin therapy. Canadian Association for Clinical Microbiology and Infectious Disease, Ottawa, Nov.2000

Mak A, Byrne S, Scalia V, Palmer D, Sher G, Hill W, Krajden M. Role of extraction method on Hepatitis C virus (HCV) RT-PER sensitivity. Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa, Nov.2000.

Robert Mann, RT

Scott, J.D., K. Fernando, S.N. Banerjee, L.A. Durden, S.K. Byrne, M. Banerjee, R. Mann, M.G. Morshed. 2001. Birds disperse Ixodid (Acari: Ixodidae) and *Borrelia burgdorferi*-infected ticks in Canada. Entomology Society of America 38: 493-500.

Morshed, M.G., J.D. Scott, S.N. Banerjee, K. Fernando, R. Mann and J. Isaac-Renton. 2000. First isolation of Lyme disease spirochete, *Borrelia burgdorferi*, from blacklegged tick, *Ixodes scapularis*, collected from at Rondeau Provincial Park, Ontario. CDR 26(06): 42-44

S. N. Banerjee, M. Banerjee, K. Fernando, J.D. Scott, R. Mann, M.G. Morshed, 2000. Presence of Lyme disease spirochete, *Borrelia burgdorferi* in the blacklegged tick, *Ixodes scapularis* in Southern Ontario. CMAJ 162:1567-1569.

Morshed M.G., K. Fernando, S.K. Byrne, R. Parkes, R. Mann, Q. Wong, J.L. Isaac-Renton. 2001. Molecular characterization of Lyme disease spirochetes isolated from British Columbia. 56th INCDNCM Conference, Winnipeg.

Lorraine McIntyre, BSc

L. McIntyre, L. Hoang, C.S.L. Ong, P. Lee and J.L. Isaac-Renton. 2000. Evaluation of Molecular Techniques to Biotype *Giardia duodenalis* Collected During an Outbreak. J. Parasitol. 86(1):172-177.

L. McIntyre, L. Hoang, L. Li, M. Khan, B. Wong, J. Fung and J.L. Isaac-Renton. Evaluation of Water Testing Methods in Three Communities to Quantitate *Cryptosporidium* oocysts and *Giardia* cysts in Raw Drinking Water Sources. P-10. 9th National Conference on Drinking Water, CWWA, May, 2000.

McIntyre L, Fung J, Isaac-Renton J, Ong C, Khan M. A tri-community study to compare water testing methods quantitating the *Giardia* cysts and *Cryptosporidium* oocysts in raw drinking water sources. 9th National Conference on Drinking Water, Regina, SK, May 2000.

Gail McNabb, BSc (Hons), ART

Harris P, McNabb G, Gregson D. Herpes simplex (HSV-1) Susceptibility to Acyclovir using flow cytometry versus a radiometric DNA hybridization assay.

Muhammad Morshed, PhD

Scott, J.D., K. Fernando, S.N. Banerjee, L.A. Durden, S.K. Byrne, M. Banerjee, R. Mann, M.G. Morshed. 2001. Birds disperse Ixodid (Acari: Ixodidae) and *Borrelia burgdorferi*-infected ticks in Canada. *Entomology Society of America* 38: 493-500.

Morshed, M.G., J.D. Scott, S.N. Banerjee, K. Fernando, R. Mann and J. Isaac-Renton. 2000. First isolation of Lyme disease spirochete, *Borrelia burgdorferi*, from blacklegged tick, *Ixodes scapularis*, collected from at Rondeau Provincial Park, Ontario. *CCDR* 26(06): 42-44
M. Shirai, J. Akada, K. Shibata, M. G. Morshed, T. Matsushita and T. Nakazawa. 2000. Accumulation of polyphosphate granules in *Helicobacter pylori* cells under anaerobic conditions. *J. Med. Microbiol.* 49: 513-519.

S. N. Banerjee, M. Banerjee, K. Fernando, J.D. Scott, R. Mann, M.G. Morshed, 2000. Presence of Lyme disease spirochete, *Borrelia burgdorferi* in the blacklegged tick, *Ixodes scapularis* in Southern Ontario. *CMAJ* 162:1567-1569.

Rekart M, D Patrick, A Jolly, T Wong, M Morshed, H Jones, C Montgomery, L Knowles, N Chakraborty, and J Maginley. 2000. Mass treatment/prophylaxis during an outbreak of infectious syphilis in Vancouver, British Columbia (BC). *CCDR* 26()

Simpson, Y., R. Gill, H. Jones and M. Morshed. 2000. Use of INNO-LIATM syphilis assay for patients with inconclusive Treponema serology. *Canadian Association for Clinical Microbiology and Infectious Diseases*. Ottawa, Ontario. Nov.5-8.

Morshed M G, " Tick-Borne Disease and its importance in British Columbia" in Institute for Aboriginal Health. Long House, UBC. June 22, 2000

Morshed M.G., K.Fernando, S.K. Byrne, R.Chen, R.Mann, Q. Wong, J.L.Isaac-Renton. The rrf(5S)-rrl(23S) Intergenic spacer region sequence data revealed the presence of *Borrelia bissettii* from *Ixodus pacificus* and *Ixodus angustus* ticks. 2001.American Society of Microbiology General Meeting.

Morshed M.G., K.Fernando, S.K.Byrne, R.Parkes, R.Mann, Q. Wong, J.L.Isaac-Renton. 2001. Molecular characterization of Lyme disease spirochetes isolated from British Columbia. 56th INCDNMC Conference, Winnipeg.

Corinne Ong, PhD

L. McIntyre, L. Hoang, C.S.L. Ong, P. Lee and J.L. Isaac-Renton. 2000. Evaluation of Molecular Techniques to Biotype *Giardia duodenalis* Collected During an Outbreak. *J. Parasitol.* 86(1):172-177.

"Cryptosporidium parvum: A tale of two genotypes" *Microbiology and Infectious Diseases Research Seminar*, January 2000

"Cryptosporidiosis and cyclosporiasis in children" BC Children's Hospital Pathology Rounds, March 2000

Isaac-Renton JL, Bowie WR, Ong C., Li A, Khan M, McLean M, Lammie PJ, Priest J. Validation of serology methods for detection of *Cryptosporidium* in human populations. 9th National Conference on Drinking Water, Regina, SK, May 2000 and 1st Annual Research Gala Dept. Of Pathology & Laboratory Medicine, UBC. Vancouver, BC May 2000.

Mcintyre L, Fung J, Isaac-Renton J, Ong C, Khan M. A tri-community study to compare water testing methods quantitating the *Giardia* cysts and *Cryptosporidium* oocysts in raw drinking water sources. 9th National Conference on Drinking Water, Regina, SK, May 2000.

Ong CSL, Winkler R, Wetzstein M, Isaac-Renton JL. *Cryptosporidium* spp. in outbreak community watersheds. 55th International Conference on Diseases in Nature Communicable to Man, Fort Collins, CO, Aug 2000.

Ong CSL, Eisler DL, Fyfe MW, Isaac-Renton JL. Molecular Epidemiological Investigation of *Cryptosporidiosis* Outbreaks in BC. 1st Annual Research Gala Dept. Of Pathology & Laboratory Medicine, UBC. Vancouver, BC May 2000 and UBC Faculty of Medicine Golden Jubilee 2000, Vancouver BC Nov 2000.

Ana Paccagnella, BSc, RT

Strauss B, Fyfe M, Higo K, Louie K, Cross D, Sisler M, Paccagnella A, Trinidad A, Kurzac C, Eng G, Zaharia B, Chan S. An outbreak of *Salmonella* Enteritidis linked to baked goods from a local bakery in lower Mainland, British Columbia. *Can Commun Dis Rep.* 2000 Oct 15;26(20):173-4. No abstract available. PMID: 11211702 [PubMed - indexed for MEDLINE]

Evaluation of the Oxoid Salmonella Latex Test Kit as a Screening Test for Salmonella. *American Society for Microbiology*, Los Angeles, California May 2000

Richard Parkes, BSc

Parkes R., T. Lo, Q.Wong, J.L. Isaac-Renton, S.K. Byrne. 2001. Comparison of nested PCR-RFLP, the Path antigen detection method and microscopy for the detection and identification of malaria parasites. *Canadian Journal of Microbiology* (in press)

Byrne S.K., R.Parkes, R.Chen and M.Krajden. 2000. Selection of Hepatitis B Virus (HBV) Gene Regions for Molecular Epidemiological Subtyping. 68th Conjoint Meeting on Infectious Diseases. Ottawa.

Morshed M.G., K.Fernando, S.K.Byrne, R.Parkes, R.Mann, Q. Wong, J.L.Isaac-Renton. 2001. Molecular characterization of Lyme disease spirochetes isolated from British Columbia. 56th INCDNMC Conference, Winnipeg.

R. Parkes, T. Lo, Q. Wong, J. Isaac-Renton, S. K. Byrne. 1999. Detection and Speciation of Malaria using PCR-RFLP Analysis and its Comparison to Standard Microscopy. 67th Conjoint Meeting on Infectious Diseases.

Richard Parkes, Teresa Lo, Quantine Wong, Judith L. Isaac-Renton, Sean K. Byrne. Comparison of Nested PCR-RFLP, the PATH Antigen Detection Method and Microscopy for the detection and identification of malaria parasites. (submitted for publication)

R. Parkes, T. Lo, Q. Wong, J. Isaac-Renton, S. K. Byrne. 1999. Detection and Speciation of Malaria using PCR-RFLP Analysis and its Comparison to Standard Microscopy. 67th Conjoint Meeting on Infectious Diseases.

Richard Parkes, Teresa Lo, Quantine Wong, Judith L. Isaac-Renton, Sean K. Byrne. Comparison of Nested PCR-RFLP, the PATH Antigen Detection Method and Microscopy for the detection and identification of malaria parasites. (submitted for publication)

Neely Peterson, RT

Sher GD, Scalia V, Zuber ED, Hrytzak J, Byrne S, Petersen N, Krajden M. Hepatitis C virus (HCV) RNA stability in EDTA Plasma tubes containing the anticoagulants CPDA-1 and CP2D. In: Program and Abstracts of the 26th Congress of the International Society of Blood Transfusion ISBT 2000, July 9-14, 2000 Vienna, Austria.

Mabel Rodrigues, PhD

Black, W., Rodrigues, M., Bessuille. "Comparative Performance Characteristics of Various Media Combinations in the Laboratory Diagnosis of *M. tuberculosis* (M.tb) and non-tuberculosis mycobacteria (NTM)." Presented at the 68th Conjoint Meeting on Infectious Diseases, Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa, Nov. 5-8, 2000.

Black, W. Rodrigues, M., Bessuille, E. "Evaluation of the Bact/ALERT3D Mycobacteria Detection system." 21st annual Congress of the European Society of Mycobacteriology, Vienna, Jul2-5, 2000

Yvonne Simpson, BSc, RT

Simpson, Y., R. Gill, H. Jones and M. Morshed. 2000. Use of INNO-LIATM syphilis assay for patients with inconclusive Treponema serology. Canadian Association for Clinical Microbiology and Infectious Diseases. Ottawa, Ontario. Nov.5-8.

Amelia Trinidad, BSPH, ART

Strauss B, Fyfe M, Higo K, Louie K, Cross D, Sisler M, Paccagnella A, Trinidad A, Kurzac C, Eng G, Zaharia B, Chan S. An outbreak of *Salmonella* Enteritidis linked to baked goods from a local bakery in lower Mainland, British Columbia. Can Commun Dis Rep. 2000 Oct 15;26(20):173-4. No abstract available. PMID: 11211702 [PubMed - indexed for MEDLINE]

Leslie Wilton, BSc

Cook D, Wilton L, Patrick D, Zou S, Shermna M, Krajden M. Prevalence of Antibodies to Hepatitis A virus in a cohort of women of child-bearing age. Canadian Association for Clinical Microbiology and Infectious Diseases, Ottawa, Nov.2000

Belinda Wong, BSc

L. McIntyre, L. Hoang, L. Li, M. Khan, B. Wong, J. Fung and J.L. Isaac-Renton. Evaluation of Water Testing Methods in Three Communities to Quantitate *Cryptosporidium* oocysts and *Giardia* cysts in Raw Drinking Water Sources. P-10. 9th National Conference on Drinking Water, CWWA, May, 2000.

Quantine Wong, BSc

Parkes R., T. Lo, Q.Wong, J.L. Isaac-Renton, S.K. Byrne. 2001. Comparison of nested PCR-RFLP, the Path antigen detection method and microscopy for the detection and identification of malaria parasites. Canadian Journal of Microbiology (in press)

R. Parkes, T. Lo, Q. Wong, J. Isaac-Renton, S. K. Byrne. 1999. Detection and Speciation of Malaria using PCR-RFLP Analysis and its Comparison to Standard Microscopy. 67th Conjoint Meeting on Infectious Diseases.

Richard Parkes, Teresa Lo, Quantine Wong, Judith L. Isaac-Renton, Sean K. Byrne. Comparison of Nested PCR-RFLP, the PATH Antigen Detection Method and Microscopy for the detection and identification of malaria parasites. (submitted for publication)

Morshed M.G., K.Fernando, S.K.Byrne, R.Parkes, R.Mann, Q. Wong, J.L.Isaac-Renton. 2001. Molecular characterization of Lyme disease spirochetes isolated from British Columbia. 56th INCDNMC Conference, Winnipeg.

Acknowledgements

K. Belobaba
S. Byrne
J. Chan
D. Cook
S. deLisser
C.P. (Joe) Fung
J. Hamilton
C. Lindsay
L. McIntyre
G. McNabb
M. Morshed
A. Paccagnella
Y. Santa Cruz
C. Shaw
Y. Simpson
A. Trinidad
Q. Wong