**Notre mission**

Mobiliser les ressources scientifiques et financières sur la scène nationale et internationale afin de diminuer l’incidence de la mammite, de réduire les pertes économiques et de maintenir la qualité du lait par une recherche concertée et un transfert efficace et rapide des résultats aux utilisateurs.

**Centre administratif :**

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C. P. 5000, Saint-Hyacinthe (Québec) J2S 7C6
Téléphone : 450 773-8521, poste 8618
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**Institution hôte :** Université de Montréal

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WORDS FROM THE CHAIRMAN OF THE STEERING COMMITTEE AND THE SCIENTIFIC DIRECTOR

We are pleased to share with you the results of the work done by a pan-Canadian team dedicated to a single mission: reducing the impact of mastitis! During the year 2009-2010, this team was able to make great inroads in research, knowledge transfer and various training programs while consolidating even further the bonds that unite us.

After completing the fourth year of our research program, we are excited about reaping the benefits of such a tremendous amount of effort. CBMRN representatives have taken part in every national and international stage to present to our partners and to the scientific community results and discoveries in the development of new tools against mastitis.

Over the last four years, we created the Core Research Platform and generated tangible results in several fields including diagnostics, genetics, treatments, management practices, pathogen virulence, animal behaviour and pathogen-host interactions. In addition, four new research projects have been initiated in 2010.

Knowledge transfer activities have literally exploded this year with the production of a host of tools that have garnered a lot of interest. Our portfolio now offers illustrated factsheets, videos, calculation tools and a newspaper devoted to research which has been distributed to the 13,500 dairy producers across Canada, with the assistance of provincial dairy associations. We have also scored another hit with the production of a kit specially designed for veterinarians. This kit, which has fuelled a provincial strategy on udder health in Québec, will soon be available in English and we will spare no effort in making sure it has as much success in all Canadians provinces.

This year, a lot of the Network’s resources were mobilized by a very important issue: the continuation of our activities beyond 2011. In March of 2009, the Steering Committee embarked into a strategic planning process designed to lay the groundwork for the Network’s second phase of 2011-2016. With the help of a consulting firm, the recommendations of our partners and other organizations and the support of our members, a brand new vision emerged from the extensive consultation process: the sustainable production of safe, high-quality milk. This new vision encompasses 1) understanding the fundamental mechanisms involved in the persistence of pathogens in dairy herds which hinders the sustainable production of safe, high-quality milk, 2) developing new management practices, and 3) transferring new knowledge to dairy producers, veterinarians and other stakeholders.

Over the next year, we will be soliciting the financial support of current and new partners alike, in addition to ensuring the continuation of public funding for the second phase of the CBMRN. For the period from November 2010 to December 2012, the CBMRN will contribute to the Dairy Farmers of Canada’s Dairy Science Cluster. The projects undertaken within the framework of the Dairy Science Cluster will be in line with the new emerging vision of the Network.

As we enter the last stretch of the Network’s 2006-2011 cycle, it promises to be an eventful year with the completion of our research program, the establishment of a sound basis for the second phase and the consolidation of funding. Fortunately, we can rely on a devoted multidisciplinary team to overcome the numerous challenges that lie ahead. In closing, we would like to express our warmest thanks to the whole team for their unwavering dedication and enthusiasm.

We invite you to read on and find out more about our progress over the last year!
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**2009-2010 COMMITTEES, PANEL AND ADMINISTRATIVE TEAM**

**Steering Committee**

The Steering Committee is responsible for the governance, administration and direction of the Network.

**Ouessou Cherif Aidara**  
Officer, Office of Vice-Principal of Research and International Relations, McGill University

**James Cross**  
Associate Dean, Research and Graduate Education, Faculty of Veterinary Medicine, University of Calgary

**Pauline Duivenvoorden**  
Dairy Producer, Dairy Farmers of Canada

**Reint Jan Dykstra**  
Dairy Producer, Dairy Farmers of Canada

**Pierre-Richard Gaudreault**  
Director, Service de la recherche et de la création, Université de Sherbrooke

**Kevin R. Hall**  
Vice-President (Research), University of Guelph

**Mario Jacques (observer)**  
Associate Dean, Research and Graduate Studies, Faculté de médecine vétérinaire, Université de Montréal

**Pierre Lampron, Chairman of the Committee**  
Dairy Producer, Fédération des producteurs de lait du Québec

**Sylvain Langlois (non-voting member)**  
Account Manager, NSERC

**Annik L’Espérance (Secretary, observer)**  
Network Manager, CBMRN

**Denis Mayrand (observer)**  
Adjoint au vice-recteur à la recherche et à la création, Université Laval

**Nadia Nour**  
Research Officer, Bureau Recherche-Développement-Valorisation, Université de Montréal

**Andrew Potter**  
CBMRN Scientist, Vaccine and Infectious Disease Organization, University of Saskatchewan

**Jim Richards (External Expert)**  
Institute for Biological Sciences, National Research Council of Canada

**Daniel Rivard**  
General Manager, Novalait inc.

**Daniel Scholl (non-voting member)**  
CBMRN Scientific Director, Université de Montréal

**Jacques Surprenant (observer)**  
Science Director, Agriculture and Agri-Food Canada

**Ron Versteeg**  
Dairy Producer, Dairy Farmers of Ontario

**Jeff Wichtel**  
Associate Dean, Graduate Studies and Research, Faculty of Veterinary Medicine, University of Prince Edward Island

**Scientific Committee**

The Scientific Committee is responsible for the scientific program and recommends research directions to the Steering Committee.

**Julie Baillargeon (observer)**  
Transfer Manager, CBMRN

**Herman Barkema**  
CBMRN Scientist and Monitoring Theme Representative, University of Calgary

**Reint Jan Dykstra**  
Dairy Producer, Dairy Farmers of New Brunswick

**Élise Gosselin**  
Coordinatrice de valorisation, Novalait inc.

**Greg Keefe**  
CBMRN Scientist, University of Prince Edward Island

**Pierre Lacasse**  
CBMRN Scientist and Control Theme Representative, DSRDC - Agriculture and Agri-Food Canada

**Annik L’Espérance (Secretary, observer)**  
Network Manager, CBMRN

**François Malouin**  
CBMRN Scientist, Université de Sherbrooke

**Douglas Morrison**  
Dairy Producer, Fédération des producteurs de lait du Québec

**Stephen Oliver**  
External Expert, University of Tennessee

**Marie-Ève Paradis**  
Scientific Assistant, CBMRN

**Andrew Potter**  
CBMRN Scientist, Vaccine and Infectious Disease Organization, University of Saskatchewan

**Jean-Philippe Roy**  
CBMRN Scientist, Université de Montréal

**Wim Ruysch**  
Dairy Producer, Alberta Milk

**Daniel Scholl**  
CBMRN Scientific Director, Université de Montréal

**Ron Versteeg**  
Dairy Producer, Dairy Farmers of Ontario

**Ruth Zadoks**  
External Expert, University of Edinburgh

**Transfer Committee**

The Transfer Committee advises on knowledge transfer best practices.

**Julie Baillargeon**  
Transfer Manager, CBMRN

**Pauline Bilodeau**  
Technology Transfer Officer, Agriculture and Agri-Food Canada

**Vincent Caldwell**  
Dairy Practitioner, Clinique vétérinaire Coaticook

**Kara Irving**  
Dairy Producer, Dairy Farmers of Nova Scotia

**Steve Mason**  
Chief Editor, Dairyman’s Digest

**Guillaume Thibault**  
Field Services Representative, Dairy Farmers of Ontario

**Étienne Tremblay**  
Training Officer and Advisor, Valacta

**Scientific Advisory Panel**

The Panel provides critical assessment of yearly progress made by the Network.

**Dr. Theo Lam**  
GD Animal Health Service, The Netherlands

**Dr. Larry Smith**  
The Ohio State University, United States

We would like to thank all our committee members and observers as well as members of the Scientific Advisory Panel for their time, dedication and cooperation throughout the year. Our most sincere thanks!
Administrative Team

The Administrative Team is responsible for the day-to-day management of Network activities.

First row, from left to right:

Annik L’Espérance, Network Manager
Daniel Scholl, Scientific Director
Hélène Poirier, Project Transfer Manager

Second row, from left to right:

Anne-Marie Christen, Project Transfer Manager
Marie-Ève Paradis, Scientific Assistant
Isabelle Jodoin, Secretary

Absent of the picture:

Julie Baillargeon, Transfer Manager

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2009-2010 MEMBERS AND COLLABORATORS

Herman Barkema, University of Calgary
Nathalie Bissonnette, DSRDC - Agriculture and Agri-Food Canada
Patrick Boerlin, University of Guelph
Émile Bouchard, Université de Montréal
Luc DesCôteaux, Université de Montréal
Trevor DeVries, University of Guelph
Ian Dohoo, University of Prince Edward Island
Denis DuTremblay, Université de Montréal
Philip Griebel, VIDO – University of Saskatchewan
Niel A. Karrow, University of Guelph
Greg Keefe, University of Prince Edward Island
David Kelton, University of Guelph

Pierre Lacasse, DSRDC - Agriculture and Agri-Food Canada
David Léger, Public Health Agency of Canada
Kenneth Leslie, University of Guelph
Bonnie Mallard, University of Guelph
François Malouin, Université de Sherbrooke
J. T. McClure, University of Prince Edward Island
Serge Messier, Université de Montréal
John Middleton, University of Missouri
Musangu Ngeleka, University of Saskatchewan
Stephen Oliver, University of Tennessee
Jose Perez-Casal, VIDO – University of Saskatchewan

Cristina Petersson-Wolfe, Virginia Tech
Andrew Potter, VIDO – University of Saskatchewan
Claude Robert, Université Laval
Jean-Philippe Roy, Université de Montréal
Daniel Scholl, Université de Montréal
Moussa Sory Diarra, PARC - Agriculture and Agri-Food Canada
Henrik Stryhn, University of Prince Edward Island
Brian Talbot, Université de Sherbrooke
Grant Tomita, Hawaii Department of Agriculture
Xin Zhao, McGill University

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CBMRN ORGANIZATIONAL CHART

Core Research Platform
Coordinator: D. Scholl

Research Themes
Monitoring Theme
Representative: H. Barkema

Control Theme
Representative: P. Lacasse

Steering Committee
Scientific Advisory Panel

Scientific Director
D. Scholl

Scientific Committee
Transfer Committee

Administrative Team
PARTNERSHIP,
THE WAY OF THE FUTURE

The CBMRN was conceived in response to the desire of dairy producers to set up a nation-wide research network on mastitis. This network was to assemble various Canadian experts to create a new synergy that would generate novel solutions to fight this disease. Today, the Network exists because of the collective effort of several public and private organizations. The advantage of funding a research network lies in the leverage effect generated by the contribution of private partners. For the period of 2006-2011, their joint contribution created a leverage effect of 1:6.7 that led to the achievement of the Network’s objectives. Major funding was provided by the Natural Sciences and Engineering Research Council of Canada and by Canadian dairy producers who have been present in all CBMRN activity sectors from the beginning.
The second phase 2011-2016

The first phase of the funding is nearing completion and considering the positive impact stemming from the Network’s activities, the Steering Committee has given the Director a mandate to initiate a strategic plan for the development of a second funding phase that would extend from 2011 to 2016. In the summer of 2009, all current partners as well as several other organizations from the dairy and public sectors—a total of 20 organizations—were surveyed to determine their level of satisfaction with the Network and their research priorities. A focus group and an *ad hoc* Scientific Strategy Committee were created and consulted.

This extensive consultation led to the formulation of a new vision focusing on the sustainable production of safe, high-quality milk. The new research program will be divided in three major themes: the host, the pathogens and the environment, while maintaining continuity with current research. These new avenues of research opportunities still require closer examination and will be presented to our financial partners in 2010-2011.

A tour of partner organizations

During the fall and winter, Daniel Scholl went on a tour of dairy producer organizations that are Network partners. The members of the various boards of directors of these organizations had the opportunity to hear about the most recent results and outcomes of Network activities along with a preview of the emerging vision of the second phase of the CBMRN under consideration.

As part of this tour, the Dairy Farmers of Canada (DFC) invited the CBMRN to participate in the Dairy Science Cluster they had set up as part of the Canadian Agri-Science Clusters Initiative of Agriculture and Agri-Food Canada. The Network happily accepted an amount of $950,000 for the period of November 2010 to December 2012, a sum that will be allocated to research activities that are in line with our new vision.

Acknowledgement

The CBMRN would not be what it is today if it had not been for all the fruitful partnerships that have developed since its creation in 2001. These partnerships have led to great collective achievements and they are the basis on which we can build and consider a second phase with a great deal of optimism. Thank you!
• Uniform criteria for the interpretation of bacteriological test results from milk for intramammary infection diagnosis were developed and validated.

• A bilingual questionnaire used for collecting information on farm management practices within the National Cohort of Dairy Farms was validated and made available as a standard Canadian and international mastitis epidemiology research tool.

• The risk of contracting new intramammary infections was shown to be reduced in cows that lie down 40 to 60 minutes after milking; it increases again if the interval between milking and lying down reaches 60 minutes or more.

• Three bacterial genes expressed during intramammary infections were identified for the development of a future vaccine against *Staphylococcus aureus*. A provisional patent was obtained in March 2010.

• The discovery of two bovine genes associated with the genetic trait for somatic cell count and two other genes expressed differently in cows depending on the type of *S. aureus* strain causing an intramammary infection.

• A single injection of a microencapsulated vaccine against coliforms would trigger approximately the same immune response as several injections of a commercial vaccine. An invention disclosure was submitted and a provisional patent application is being prepared.

• The use of the Petrifilm™ test as a mastitis treatment indicator led to a reduction of nearly 40% in the use of antibiotics on participating farms without any short-term negative effect on udder health.

• The natural immune response of cows varies from one individual to another, from one herd to another, and from one province to another. This may imply that genetic selection could be used successfully to improve the natural resistance of cows against mastitis.

• Five new projects were undertaken over the year.
The Core Research Platform

Scientists: Daniel Scholl, Serge Messier, Grant Tomita, Jean-Philippe Roy, Luc DesCôtesaux, Émile Bouchard and Denis DuTremblay, Université de Montréal; Herman Barkema, University of Calgary; Trevor DeVries, University of Guelph; Ian Dohoo and Greg Keefe, University of Prince Edward Island; Musango Ngeleka, University of Saskatchewan

Duration: 2007-2011. (Budget for 2006-2010: $2,405,781)

The Core Research Platform (Platform) is the centre of CBMRN research activities. Its main components are the National Cohort of Dairy Farms, the Mastitis Laboratory Network and the Mastitis Pathogen Culture Collection.

1. National Cohort of Dairy Farms

Coordinator: Daniel Scholl, Université de Montréal, Québec

In short…

• 91 dairy farms distributed across six Canadian provinces with an average of 85 cows per farm and an average milk production of 32 kg/cow/day.
• Over 2007 and 2008, these farms provided data on their management and udder health practices and allowed for the collection of 137,000 milk samples and 700 DNA samples.
• The farms also provided data that was used to determine and characterize intramammary infection and clinical infection rates across Canada.
• A central database consisting of information about demographics, herd management, health, use of antibiotics, genetics and production at the cow and herd level was compiled. This database is cross-referenced with bacterial isolates that make up the Mastitis Pathogen Culture Collection.

| Distribution of Cohort farms per region and somatic cell counts (SCC) |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|
| SCC (cells/ml)              | Alberta | Québec | Ontario | Atlantic Provinces |
| < 150 000                   | 5       | 10    | 5      | 3                |
| 150 000 – 300 000           | 9       | 10    | 16     | 11               |
| > 300 000                   | 3       | 9     | 6      | 4                |
Summary of various practices in use on Cohort farms

94% have a standard milking procedure
34% use the California Mastitis Test (CMT) on a regular basis
60% milk cows with chronic mastitis last
42% vaccinate against coliform mastitis
90% shave or singe udder hair
55% of calvings occur in a maternity pen

On average, soiled bedding is removed 2.8 times a day

Proportion of pathogens causing clinical mastitis on Cohort farms

- Contaminated samples 10.1%
- Staphylococcus aureus 13.8%
- Escherichia coli 10.7%
- Klebsiella spp. 2.8%
- Other Streptococcus spp. (other than agalactiae) 7.9%
- Streptococcus uberis 5.4%
- Streptococcus dysgalactiae 4.7%
- Coagulase-negative staphylococci 2.9%
- No significant growth 35.7%
- Other 6.1%

Since November 2009, monthly data from dairy herd improvement agencies (CanWest DHI and Valacta) have been collected for all Cohort cows and are available through the central database.
2. Mastitis Laboratory Network

Coordinator: Serge Messier, Université de Montréal, Québec

In short…

- 4 diagnostic laboratories in Canada: Saint-Hyacinthe, Prince Edward Island, Saskatchewan and Calgary.
- All laboratories utilize the same procedures, based on international standards, for the identification of pathogenic bacteria found in milk samples.
- These laboratories contribute to the training of highly skilled personnel.
- These laboratories have cultured all of the milk samples received from Cohort farms and have identified and recorded all pathogenic bacteria found in the samples. Bacteria are stored and archived in the Mastitis Pathogen Culture Collection.

3. Mastitis Pathogen Culture Collection

Coordinators: Serge Messier and Marie-Ève Paradis, Université de Montréal, Québec

In short…

- Access to 17,000 bacterial isolates from cow quarters and milk bulk tanks.
- Thanks to a unique identification system, each bacterial isolate is cross-referenced to data from the specific host cow (region, infection duration, clinical signs, treatments, parity, etc.), farm management practices and, for several cows, DNA samples.
- An incredible source of biological material that plays a critical role in several CBMRN research projects. This resource is also made available for research scientists outside the Network. At present, three external collaboration projects are using the Mastitis Pathogen Culture Collection.
Two new projects began in 2009 in the context of the Platform!

1. Optimization of Core Research Platform data access and use

Initiated in September 2009, this new project is designed to create links between demographic, epidemiological and bacteriological data. These links will simplify the search for and gathering of data for current and future research. For example, a scientist will be able to easily identify and request *S. aureus* isolates that come from cows with clinical symptoms in free-stall herds with high somatic cell counts.

This project was merged into a newly funded project called “Mastitis Open Linked Data” directed by Ian Dohoo, Greg Keefe and Crawford Revie of University of Prince Edward Island (see page 26 of the Report).

2. Validation of the use of a gas chromatography technique as an alternative method for the identification of coagulase-negative staphylococci (CNS) species

CNS are a group of several bacterial species for which the coagulase laboratory test produces a negative result. Species identification of CNS is not performed on a routine basis because comprehensive and costly laboratory procedures. Still, knowing precisely what species of CNS is involved in certain intramammary infections would help scientists to better understand their role and impact in mastitis.

John Middleton, from University of Missouri, has employed DNA analysis to speciate several CNS isolates from the Mastitis Pathogen Culture Collection. His results will serve as a foundation for Marie-Ève Paradis and Serge Messier (*Université de Montréal*) in determining if the gas chromatography technique is as capable in speciating CNS isolates. This technique is less costly and simpler to use than DNA analysis. Results will be available in 2011.

**Deliverables:**

1. Database for the study of mastitis on Canadian dairy farms
   - **Target users:** Canadian and international scientists

2. Mastitis Pathogen Culture Collection
   - **Target users:** Canadian and international scientists as well as biomedical industry companies

3. Robust and flexible computing base that simplifies navigation among Platform data and allows integration of new data generated by scientists
   - **Target users:** Canadian and international scientists as well as biomedical industry companies
   - **Transfer horizon:** 2010-2011

4. New and improved laboratory capacity and trained personnel in high-volume bacteriological analysis of milk samples
   - **Target users:** Canadian and international scientists

5. Linkage of dairy cow DNA repository with data on the natural immune resistance and udder health of those particular cows
   - **Target users:** Canadian and international scientists
Reducing the incidence of clinical mastitis and of subclinical intramammary infections is the main objective of any mastitis management program. In the longer term, the Monitoring Theme is focused on developing new knowledge and technologies for the diagnosis and monitoring of intramammary infections and mastitis. The specific objectives of the theme are the development of fast detection methods of mastitis causing pathogens, the development of new strategies designed to enhance udder health monitoring and the characterization of virulence factors of major and emerging pathogens. There are currently three research projects under this theme.

Validation of a PCR laboratory test for the rapid identification of bacteria in milk

Lead Scientist: Daniel Scholl, Université de Montréal, Québec
Collaborators: Serge Messier, Université de Montréal; Steve Oliver, University of Tennessee; Greg Keefe, University of Prince Edward Island

The “polymerase chain reaction” (PCR) test is gaining popularity for the detection of intramammary infections in dairy cows. This fast technique has an interesting potential and could be more sensitive and more convenient than bacterial culturing. This project compares the probability of generating false positive and false negative results between the PCR technique and standard bacterial culturing of milk samples for the detection of bacteria that are responsible for intramammary infections. The results of the project will help producers, veterinarians and other stakeholders in the dairy sector to gain a better understanding of the role that PCR testing and bacterial culturing can play in the diagnosis and monitoring of mastitis.

- So far, 1,626 milk samples from clinical mastitis cases as well as 1,500 milk samples from apparently healthy cows have been selected from the central database and analyzed by PCR in the laboratory of Dr. Stephen Oliver, University of Tennessee, Knoxville, USA. Collaboration is in negotiation with SafeGuard Biosystems Inc., Toronto, Canada and Finzymes Oy, Espoo, Finland, for the validation of their PCR systems in the current conditions found on Canadian dairy farms.

- With the help of milk culture results available from the Mastitis Pathogen Culture Collection, some preliminary and exploratory analyses were conducted. These analyses show that the severity of mastitis would seem to influence, in certain cases, the performance of the PCR test and the bacterial culturing. Indeed, they show a decrease of 16% in the sensitivity of the PCR test when a milk sample comes from a swollen quarter.

- The performance of definitive Bayesian analyses to estimate the rates of false negatives and false positives is progressing. The process has reached the stage of determination of anticipated rates, by an expert panel.
Cross-classification and adjusted percent agreement (PABAK) for milk samples from cases of clinical mastitis

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Culture</th>
<th>PCR+</th>
<th>PCR-</th>
<th>PABAK</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>+</td>
<td>135</td>
<td>56</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>70</td>
<td>1,365</td>
<td></td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>+</td>
<td>56</td>
<td>67</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>114</td>
<td>1,389</td>
<td></td>
</tr>
<tr>
<td><em>Streptococcus uberis</em></td>
<td>+</td>
<td>41</td>
<td>26</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>70</td>
<td>1,489</td>
<td></td>
</tr>
<tr>
<td><em>Streptococcus agalactiae</em></td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>2</td>
<td>1,624</td>
<td></td>
</tr>
</tbody>
</table>

Cross-classification and adjusted percent agreement (PABAK) for milk samples from apparently healthy cows

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Culture</th>
<th>PCR+</th>
<th>PCR-</th>
<th>PABAK</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>+</td>
<td>37</td>
<td>13</td>
<td>0.88</td>
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<td></td>
<td>-</td>
<td>71</td>
<td>1,379</td>
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<tr>
<td><em>Escherichia coli</em></td>
<td>+</td>
<td>1</td>
<td>1</td>
<td>0.96</td>
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<td></td>
<td>-</td>
<td>26</td>
<td>1,472</td>
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<tr>
<td><em>Streptococcus uberis</em></td>
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<td>41</td>
<td>26</td>
<td>0.98</td>
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<td>-</td>
<td>13</td>
<td>1,486</td>
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<tr>
<td><em>Streptococcus agalactiae</em></td>
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<td>0</td>
<td>0</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>15</td>
<td>1,485</td>
<td></td>
</tr>
</tbody>
</table>

**Deliverables:**

1. Assessment of the reliability of routine bacterial culturing and of three PCR systems in detecting mastitis causing pathogens

   **Target users:** Diagnostic laboratories, veterinarians, dairy producers and other dairy sector stakeholders

   **Transfer horizon:** 2010-2011

   **Additional funding:** Approximately $150,000 in kind
Investigation of the occurrence and monitoring of new udder infections

Lead Scientist: Ian Dohoo, University of Prince Edward Island, Prince Edward Island
Collaborators: Daniel Scholl, Université de Montréal; Henrik Stryhn and Greg Keefe, University of Prince Edward Island; Herman Barkema, University of Calgary; Ken Leslie and David Kelton, University of Guelph
Duration: 2006-2011. (Budget for 2006-2010: $345,784)

Historically, most of the research conducted on mastitis was based on prevalence data. However, the level of mastitis within a herd is strongly dependent on the frequency of new udder infections. The main objective of this study is to determine the incidence rate of intramammary infections during the lactation and dry period on Canadian dairy farms.

The first step in achieving this goal is to develop scientific definitions to interpret when the analysis of a milk sample indicates an intramammary infection and a new intramammary infection.

- Different criteria were analyzed in order to classify a quarter as infected or not infected based on three milk samples collected at one-week intervals. In conclusion, there is an infection if a pathogen is isolated by culture with at least 1,000 colonies (1,000 CFU/ml) or if the same pathogen is isolated at least twice within a three-week span.

- Different criteria were also analyzed in order to classify a quarter as infected or not infected based on a single milk sample. In general, to obtain an adequate level of sensitivity, an infection should be deemed to be present with the simple detection of a pathogen in the culture.

- The use of two milk samples taken on the same day (duplicate samples) instead of a single sample may at times turn out to be beneficial. The manner in which the results are interpreted directs the test precision. Parallel interpretation (positive + negative = positive) increases the detection of infections and reduces the detection of non-infections while serial interpretation (positive + negative = negative) produces the opposite effect. The addition of a third sample (triplicate) yield a gain in diagnostic precision that is too modest versus the additional costs involved.

- The content and the English-French equivalence of the questionnaire used to collect information from Cohort producers about management practices in use at the farm were validated. This questionnaire could potentially become a standard international research tool for mastitis epidemiology.

Preliminary results show that:

As part of a routine monitoring program, a milk sample taken from each quarter is usually more useful than a composite sample for the identification of several pathogens.

Producers who wish to reduce their somatic cell counts should place more emphasis on milking procedures and systemic dry-cow treatment.

Deliverables:

1. A standard questionnaire to collect information about management practices on the farm
   - Target users: Canadian and international scientists
   - Transfer Horizon: 2009

2. Validated definitions of an intramammary infection and of a new intramammary infection
   - Target users: Canadian and international scientists, veterinarians
   - Transfer Horizon: 2010

3. Specific management practices for the prevention of new intramammary infections during lactation and the dry period
   - Target users: Dairy producers, veterinarians and other dairy sector stakeholders
   - Transfer Horizon: 2009-2012

Additional funding: $37,500 for the support of two graduate students
Identification of the genes that enable *Staphylococcus aureus* to cause chronic intramammary infections

**Lead Scientist:** François Malouin, *Université de Sherbrooke*, Québec  
**Collaborators:** Pierre Lacasse and Moussa Sory Diarra, Agriculture and Agri-Food Canada; Daniel Scholl, Serge Messier and Jean-Philippe Roy, *Université de Montréal*; Brian Talbot, *Université de Sherbrooke*; Bonnie Mallard, University of Guelph  
**Duration:** 2006-2011. (Budget for 2006-2010: $571,567)

Certain strains of *S. aureus* express specific virulence genes during mastitis. The hypothesis of this research project is that these genes may lead to chronic infections. Should this hypothesis prove to be correct, the genes involved chronic mastitis would become potential targets for the development of vaccines, treatments or diagnostic tools. This project is focused on the use of molecular techniques to identify virulence genes which allow *S. aureus* to infect the mammary gland and cause mastitis.

- Three new genes present in many types of *S. aureus* strains and expressed during intramammary infections have been identified and selected for the development of a future vaccine. A provisional patent was obtained in March 2010.
- The discovery of another gene has also led to the development of a new antibiotic with a novel mode of action against *S. aureus*. Preliminary experiments conducted on mice have shown that this new antibiotic would have the ability to kill *S. aureus* effectively. Provisional patents were obtained in June 2009 and February 2010.
- The weak expression of a specific gene along with a high level of biofilm production was observed in *S. aureus* strains isolated from mastitis cases that persisted throughout the dry period. This discovery opens the door to the development of diagnostic tests for markers of infection chronicity.
- The characterization of *S. aureus* strains present in intramammary infections that do not respond to antibiotic treatments is ongoing. The goal is to find out if strains that do not respond to antibiotics are the same that cause chronic mastitis. Preliminary results show that non-responsive strains have increased biofilm production in the presence of antibiotics.

**Deliverables:**

1. Diagnostic tool for the identification of *S. aureus* strains that cause chronic intramammary infections  
   **Target users:** Diagnostic laboratories  
   **Transfer horizon:** 2011

2. Vaccine and antibiotic against *S. aureus*  
   **Target users:** Dairy producers and veterinarians  
   **Transfer horizon:** 5 to 10 years

**Additional funding:** $171,000 for research activities
Control Theme

Theme Representative: Pierre Lacasse, Dairy and Swine Research and Development Centre (DSRDC), Agriculture and Agri-Food Canada, Québec

Numerous management practices are promoted as ways to prevent mastitis, but those practices do not always reduce the incidence of intramammary infections. The research program of the Control Theme focuses on the development of knowledge, new practices, products, and technology to reduce the incidence and prevalence of intramammary infections and clinical mastitis. The specific objectives of this theme are to increase cow resistance to pathogens, develop new therapeutic strategies and assess the relationship between the use of antibiotic treatments and the development of antimicrobial resistance. Six research projects are conducted under this theme.

The use of genetic profiling to identify cows with enhanced immune defence against mastitis bacteria

Lead Scientist: Bonnie Mallard, University of Guelph, Ontario
Collaborators: Niel Karrow and Ken Leslie, University of Guelph; Claude Robert, Université Laval; Xin Zhao, McGill University; François Malouin, Université de Sherbrooke
Duration: 2006-2011. (Budget for 2006-2010: $750,175)

The immune system is genetically set to control the response to infectious diseases. The objective of this project is to identify genes and proteins associated with a strong immune response against mastitis, thereby allowing for the development of genetic indices leading to the selection of cows that have higher resistance and better performance.

- More than 800 cows from the Cohort and from the University of Guelph research station have now been classified as having a low, average or high immune response. It has been observed that the immune response varies not only among cows, but also among herds and from one Canadian province to the other. The team is now working to find out if there are correlations between the immune response of these cows and their general health and level of production.

- An analysis of the expression of genes and proteins among a group of 20 cows infected with 4 different strains of *S. aureus* was also performed. Two genes were expressed differently depending on the pathogen strain involved. In addition, a particular protein seems to possess antimicrobial properties against *S. aureus* and could become an important target for the development of new therapeutic strategies.

- The recognition of invading pathogens by the immune system involves certain genes. The analysis of one of those genes in 548 Holstein bulls did not show any association with the genetic index related to the somatic cell count. However, this gene seems to have some influence on the herd’s longevity and on fertility.
• It could become possible to detect mastitis through the measurement of certain proteins contained in milk. So far, almost a hundred proteins have been identified in milk as potential biomarkers that would enable the diagnosis of mastitis caused by *S. aureus* and *E. coli*.

• After genotyping 634 Holstein, Jersey and Guernsey bulls, two genes were discovered to be associated with the somatic cell count genetic trait. In addition, associations were also established among specific genetic sequences to health, somatic cell count, lactation persistence and milk production.

**Deliverables:**

1. Identification of genes or genotypes associated with a strong immune resistance against mastitis

   **Target users:** Dairy genetics and biomedical industries

   **Transfer horizon:** 5 to 10 years
Development of a DNA vaccine against *Staphylococcus aureus* mastitis

Lead Scientists: Brian Talbot, *Université de Sherbrooke*, Québec and Pierre Lacasse, DSRDC, Agriculture and Agri-Food Canada, Québec

Collaborators: François Malouin, *Université de Sherbrooke*; Moussa Sory Diarra, Agriculture and Agri-Food Canada; Andrew Potter, Philip Griebel and Jose Perez-Casal, University of Saskatchewan


From 2008-2009 a previously developed vaccine formulation against *S. aureus* was tested. Injecting the experimental vaccine in heifers triggered a significant immune response. However, the resulting response was not sufficient to provide adequate protection against infection. Several experiments were therefore conducted in 2009 in order to get a better understanding of this lack of protection. Four hypotheses were formulated:

1. **The antibodies produced by vaccinated heifers had no effect on the ability of *S. aureus* to cause infection**
   
   Two new experiments disprove this hypothesis and suggest that the antibodies present in the blood of vaccinated heifers had the ability to reduce the level of infection caused by *S. aureus*.

2. **The concentration of antibodies found in the milk was not sufficient to prevent infection**
   
   This hypothesis could explain the lack of protection, considering the fact that the quantity of antibodies in the milk was 10 to 100 times lower than that found in the blood of vaccinated mice.

3. **Prior to vaccination, the heifers already had antibodies against *S. aureus* in their blood, resulting in the production of non-protective antibodies following the vaccination**
   
   The presence or absence of antibodies against *S. aureus* in the blood of mice prior to vaccination did not seem to impact the effectiveness of the protection provided by the vaccine. However, the mouse and bovine models are not entirely comparable.

4. **The vaccine response was directed towards the activation of a single component of the immune response**
   
   This hypothesis remains plausible since the vaccine and adjuvants induce an essentially IgG1 response.

**Deliverables:**

1. Results that could be used by other research groups working on the development of a similar vaccine

   **Target users:** Canadian and international scientists
Development of a vaccine against coliform mastitis

Lead Scientist: Xin Zhao, McGill University, Québec
Collaborators: Grant Tomita, Hawaii Department of Agriculture; Brian Talbot, Université de Sherbrooke; Pierre Lacasse, Agriculture and Agri-Food Canada; Andrew Potter, University of Saskatchewan; Daniel Scholl, Université de Montréal

Vaccines against coliform mastitis are available on the market but require multiple injections to provide the desired protection against severe clinical mastitis. This project is focused on the development of a single injection vaccine to avoid the multiple injections and the frequent handling of animals. Microencapsulation is a process in which vaccine antigens are enclosed in tiny biodegradable polymer particles. The polymer acts as a vector for the slow controlled release of vaccine antigens, which results in an extended production of antibodies by the cow. The use of a microencapsulated vaccine could prove to be a promising alternative to multiple injections.

- In 2008, vaccination trails were conducted on 36 heifers to demonstrate the variation in immune response contingent on the vaccine used and the number of doses administered. In 2009, the results from those trials were analyzed. The heifers that received a single injection of the microencapsulated vaccine had an antibody production level comparable to that of heifers that received several injections of a commercial vaccine. These results indicate that the microencapsulated vaccine has strong potential to replace multiple injection products.

- An invention disclosure has been filed. The Office of Technology Transfer of McGill University has initiated a patentability study. Discussions have been held with a partner from the biomedical sector.

**Deliverables:**

1. Microencapsulation process for the formulation of a single-injection vaccine

   **Target users:** Dairy producers through the biomedical industry

   **Transfer horizon to the biomedical industry:** 2 years
Vaccination strategies to enhance immunity against *Staphylococcus aureus*

Lead Scientist: Andrew Potter, Vaccine and Infectious Disease Organization, University of Saskatchewan, Saskatchewan
Collaborators: Jose Perez-Casal and Philip Griebel, University of Saskatchewan
Duration: 2006-2010. (Budget 2006-2010: $279,115)

Developing vaccines capable of providing global protection against *S. aureus* requires not only the identification of antigens produced by the different strains, but also an appropriate formulation and delivery systems to maximize the immune response. The scientists working on this project want to develop better methods to increase the immune response of the mammary gland against *S. aureus* mastitis.

- According to results obtained in 2009, the production of molecules, called cytokines, by leukocytes would vary depending on the type of *S. aureus* strains involved.

**Cytokines** are produced in response to leukocyte contact with microbial antigens. Antigens stimulate cells that are responsible for the immune response. Understanding how immune cells and antigens interact is essential to finding out how to optimize mammary defence against pathogens.

**Deliverables:**

1. Increased knowledge of the immune response of the mammary gland to various strains of *S. aureus*
   - **Target users:** Canadian and international scientists
   - **Transfer horizon:** 2010

2. Innovative vaccine formulation against intramammary infections caused by *S. aureus*
   - **Target users:** Biomedical industry
   - **Transfer horizon:** 5 years

**Additional funding:** $32,000 for the support of a graduate student
Validation of on-farm mastitis pathogen identification systems

Lead Scientist: Greg Keefe, University of Prince Edward Island, Prince Edward Island

Collaborators: Ian Dohoo, University of Prince Edward Island; Herman Barkema, University of Calgary; Jean-Philippe Roy and Luc Descôteaux, Université de Montréal; Ken Leslie and David Kelton, University of Guelph

Duration: 2006-2011. (Budget for 2006-2010: $434,150)

The administration of antibiotics to treat clinical mastitis may not always be justified. This is in light of the high rate of spontaneous recovery of certain types of mastitis and the poor performance of treatments against certain bacteria such as E. coli. The aim of this project is to determine if the use of rapid diagnostic tools for the identification of mastitis bacteria would foster therapeutic decisions favouring a reduction in antibiotic use without jeopardizing mammary gland health in the short, medium or long term.

- 54 Cohort farms from 7 Canadian provinces participated in this project. For each case of clinical mastitis, the producer had to randomly choose between a milk culture with the Petrifilm™ or an immediate antibiotic treatment with Cefa-Lak®. If the Petrifilm™ test results indicated growth of Gram-positive bacteria, cows would begin antibiotic treatment 24 hours later. A total of 997 cases of clinical mastitis were recorded.

- Performing the on-farm Petrifilm™ test required training and a certain skill level from the person interpreting the results. For each Petrifilm™ test performed on-farm, another Petrifilm™ test was performed in laboratory using the same milk sample to verify if there were interpretation discrepancies. It would appear that farms where the Petrifilm™ test was used more than 1/4 times during the trial period (about once a month) gained more experience in interpreting the test results. Petrifilm™ test result discrepancies between on-farm and laboratory interpretations are undergoing closer analysis.

- Preliminary results indicate that the level of reduction in the use of antibiotics depends on pathogen profiles on each farm. On average, participating farms reported a reduction of nearly 40% in the use of antibiotics without any short-term negative effect on mammary gland health.

- Other analyses on medium and long-term effects are ongoing. Economic analysis models will be developed in order to assess the cost-benefit ratio of providing antibiotic treatment according to on-farm culture results.

- A prototype on-farm milk culture kit was developed by Maritime Quality Milk in cooperation with 3M and the CBMRN.

### Deliverables:

1. Development of a treatment protocol for on-farm milk culture
2. An on-farm culture kit for 10 cows

**Target users:** Veterinarians and dairy producers  
**Transfer horizon:** 2010-2011

**Additional funding:** $330,000 for research activities
Investigating the association between antimicrobial treatment and resistance in mastitis pathogens

Lead Scientist: Herman Barkema, University of Calgary, Alberta
Collaborators: J McClure, University of Prince Edward Island; Patrick Boerlin, University of Guelph; David Léger, Public Health Agency of Canada; Serge Messier, Université de Montréal

The general assumption is that antimicrobial resistance acquired by bacteria is associated with the rate of antimicrobial use. Would that assumption apply to antibiotics used against mastitis pathogens? In order to find answers to this question, this project is designed to identify the most frequently used antibiotics on Canadian dairy farms along with the quantities used in the treatment of mastitis. This data will be used to determine the antimicrobial resistance profile of certain bacteria that cause mastitis and to figure out the resistance dynamics in relation to different variables.

- The collection of empty medication containers and recording of information about treatments administered on Cohort farms have resulted in the gathering of data related to the amount and use of antibiotics on Canadian dairy farms.

Distribution of the route of administration of antibiotics (intramammary, systemic, others) on Cohort farms

![Distribution of the route of administration of antibiotics](image_url)
Cephalosporins (Cefal-Lak®, Cefal-Dri®, Excenel® and others) and penicillins are the two classes of antibiotics that are most often used on Cohort farms.

- Antimicrobial resistance profiles and genetic analysis for certain virulence and antimicrobial resistance genes have been conducted on 1,694 isolates of *S. aureus*, 398 isolates of *E. coli* and 138 isolates of Klebsiella spp. So far, 9% of the *S. aureus* isolates tested are resistant to penicillin and 7% resistant to trimethoprim-sulfa; only one isolate has proven to be resistant to methicillin. Two *E. coli* isolates and one *Klebsiella* spp. isolate have been found to be resistant to ceftriaxone.

- Over the next year, the team will determine the impact of the use of antibiotics at drying-off and for the treatment of clinical mastitis on changes in antimicrobial resistance patterns of various mastitis pathogens.

**Deliverables:**

1. Knowledge of the level of antimicrobial resistance of mastitis bacteria and of the correlation between that resistance and the use of antibiotics

   **Target users:** Veterinarians
   **Transfer horizon:** 2011

2. Guidelines for the appropriate use of antibiotics on the dairy farm

   **Target users:** Veterinarians and dairy industry
   **Transfer horizon:** 2011
New Research Projects

In 2009, an internal call for proposals was launched as a result of a budgetary surplus due to the conclusion of the Core Research Platform and of a research project. Network members were invited to submit proposals and after a review process, four projects were selected. Two of those are the continuation of existing projects while the other two are new projects. They all commenced in January 2010.

1. Improving udder health in automatic milking systems through feed bunk management and design

   Lead Scientist: Trevor DeVries, University of Guelph, Ontario
   Collaborators: Ken Leslie, University of Guelph; Herman Barkema, University of Calgary; Jack Rodenburg, DairyLogix Consulting; Guy Séguin, Dairy Farmers of Ontario

   Providing feed at various times of the day could prompt cows to remain standing after being milked. Such a practice would not only be beneficial to udder health, but it would also promote cow movement in the barn. This would increase the milking frequency, make intervals between milking more regular and reduce the number of cows waiting to be milked.

   The objective of this project is to describe the lying patterns of dairy cows milked in barns equipped with automatic milking systems, and if there is a relationship between those patterns and mammary gland health. In addition, the research team will determine the effects of feed bunk access and feed distribution frequency on animal behaviour.

2. Novel treatment for *Staphylococcus aureus* IMI: Demonstration of efficacy in cows

   Lead Scientist: François Malouin, Université de Sherbrooke, Québec
   Collaborators: Pierre Lacasse, Agriculture and Agri-Food Canada; Brian Talbot, Université de Sherbrooke

   This project is a continuation of the project entitled "Identification of the genes that enable *S. aureus* to cause chronic intramammary infections". In that project, a particular gene of *S. aureus* was identified as being strongly expressed in intramammary infections. A new antibiotic specifically targeting that particular gene was developed. Preliminary experiments with mice yielded very promising results in which the antibiotic effectively killed *S. aureus*. It was also noted that this antibiotic might also act on staphylococci other than *S. aureus*. The team is now ready to test this new antibiotic in cows.
**RESEARCH ACHIEVEMENTS**

### An assessment of behavioural changes and discomfort associated with the naturally occurring mastitis, induced mastitis and drying-off event

**Lead Scientist:** Ken Leslie, University of Guelph, Ontario  
**Collaborators:** David Kelton and Trevor Devries, University of Guelph; Greg Keefe, University of Prince Edward Island; Cristina Petersson-Wolfe, Virginia Tech; Steve Oliver, University of Tennessee

Monitoring various dairy cow behaviours over a long period of time could be quite useful in predicting and identifying quickly health and welfare problems. Recent innovations in tools and methods available to observe and measure animal behaviour could facilitate the design of programs intended to improve animal welfare and prevent disease. The research team will observe cow behaviour and determine if it is related to the occurrence of different types of clinical mastitis. Behavioural comparisons will be made between naturally occurring clinical mastitis and experimentally induced infections. In addition, the project will serve to assess if changes in the frequency and duration of standing and lying might be good indicators of discomfort and of increased risk of mastitis after drying-off.

### Mastitis Open Linked Data

**Lead Scientist:** Ian Dohoo, University of Prince Edward Island, Prince Edward Island  
**Collaborators:** Greg Keefe and Crawford Revie, University of Prince Edward Island; Daniel Scholl, Université de Montréal

Since the creation of the CBMRN, several projects, and especially the Cohort project, have generated vast amounts of data that have been stored in various computer databases. This project will optimize access to and use of the data collected by the Platform for the benefit of present and future scientists.

A pilot computer system will be created in order to make it possible to integrate, share and query a large variety of information from the database. This system will provide links between demographic, epidemiological and bacteriological data stored in the Platform. These links will facilitate information queries by various researchers and will create an environment that will provide answers to a wide variety of scientific questions related to mammary gland health and milk quality. The system will be designed to allow the addition of new data generated by CBMRN research and by external collaborations.
The CBMRN puts considerable emphasis on external collaborations in order to foster the use of the data from the Core Research Platform and also to increase research activities in mastitis in Canada. At the present time, there are five collaborative projects in progress.

**Relationship between lying pattern and udder health in lactating dairy cows**

Lead Scientist: Trevor DeVries, University of Guelph, Ontario  
Collaborating CBMRN Scientist: Daniel Scholl, Université de Montréal, Québec  
Duration: 2008-2009

Cows usually lie down after milking. It is known that the teat opening remains dilated for a certain amount of time after milking. There is a belief that keeping cows standing after milking would help in avoiding mastitis since it prevents the open teat from coming into contact with the ground where environmental pathogens are present. The project was designed to assess how the feeding schedule might influence how long cows remain standing after milking and to determine if that duration might be linked to the intramammary infection rate. Six Cohort tie-stall farms in Ontario participated in this project. Milk culture results were also obtained from the Cohort.

**Results**

Providing feed 30 minutes before milking to 60 minutes after milking resulted in the longest periods in the standing position. Feeding outside of this time span had different effects on periods in the standing position. The standing periods were influenced by the cows' motivation to begin a new meal or by the anticipation of receiving fresh feed.

Cows that lied down in the first 40 minutes following milking ran a higher risk of intramammary infection than cows that lied down between 40 to 60 minutes after milking. However, when periods in the standing position exceeded 60 minutes after milking, there was an increase risk of contracting a new intramammary infection.

**Conclusion**

Despite the fact that it is possible to control the standing periods by providing fresh feed at various times around milking, the use of such a feeding strategy in tie-stall barns does not seem realistic as a strategy for prevention of new intramammary infections.
Characterization of pathogenic *Escherichia coli* mastitis

Lead Scientist: Julie-Hélène Fairbrother, Université de Montréal, Québec
Collaborating CBMRN Scientist: Serge Messier, Université de Montréal, Québec
Duration: 2009-2010

Typically, *E. coli* mastitis is of short duration or sporadic, but persistent infections may occur. This study will investigate the relationship between strains of *E. coli* that causes persistent infections and sporadic infections by characterizing *E. coli* virulence factors. In addition, the presence of antibiotic resistance will also be determined to establish if there is a difference between persistent strains and sporadic strains.

- A first group of 22 cows with recurring mastitis in the same quarter was selected from Cohort samples. A second group of 16 cows with persistent mastitis in different quarters was also selected.

- It was possible to compare isolates with the use of a DNA typing technique. Among the 22 cows in the first group, 18 had identical strains, thereby confirming a persistent infection. Among the 16 cows in the second group, 2 cows had identical strains, suggesting the possibility that *E. coli* would have a communicable potential.

- Comparing antibiotic sensitivity profiles can at times help to assess the similarity between bacterial isolates. In general, isolates from persistent mastitis showed more resistance to antibiotics than isolates from sporadic mastitis cases. However, total proportions of resistant isolates were low. Unfortunately, the use of antibiotic sensitivity profiles as a differentiation method between persistent isolates and sporadic isolates does not seem very effective.

Prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) and extended spectrum-β-lactamase (ESBL) *Escherichia coli*

Lead Scientist: J McClure, University of Prince Edward Island, Prince Edward Island
Collaborating CBMRN Scientist: Herman Barkema, University of Calgary, Alberta
Duration: 2008-2010

Antibiotics are frequently used to treat mastitis. It seems that their prolonged use could lead to the development of antimicrobial resistance that could potentially be transmitted to bacteria that cause infection in humans. Methicillin-resistant *Staphylococcus aureus* (MRSA) and extended spectrum-β-lactamase (ESBL) *Escherichia coli* are two bacteria that may cause serious infections in humans as a result of their strong resistance to antibiotics. In Canada, there is very little information on the presence of these two bacteria in animals that are part of the food chain. Combined with the project that is investigating the association between antibiotic treatment and resistance of mastitis bacteria, this study will determine the proportion of MRSA and ESBL *E. coli* isolates among mastitis cases reported in Canadian dairy cows. This project will also identify risk factors among herds found to have MRSA and ESBL *E. coli*, classify the various strains of MRSA and compare them to strains found in humans. Different strains of ESBL *E. coli* will be classified and their genetic resistance profile will also be determined.

- Approximately 2,000 *S. aureus* isolates and 1,000 *E. coli* isolates from the Mastitis Pathogen Culture Collection were selected to be tested for MRSA and ESBL, respectively.

- So far, 1,094 *S. aureus* isolates and 347 *E. coli* isolates were analyzed. Among those, one *S. aureus* isolate was found to be MRSA positive. This had never been reported in Canada until now. Furthermore, a wide diversity in antibiotic resistance genes was observed in ESBL *E. coli* strains.
Influence of different Staphylococcal species on severity and chronicity of mammary gland inflammation

Lead Scientist: John R. Middleton, University of Missouri, USA.
Collaborating CBMRN Scientist: Daniel Scholl, Université de Montréal, Québec
Duration: 2008-2011

Coagulase-negative staphylococcus bacteria (CNS) represent a collection of several bacterial species that have historically been considered to be minor pathogens. Recent research suggests that various species of CNS induce different levels of mammary gland inflammation and that such infections might persist in the udder over long periods of time. The objective of this project is to find out if there are differences in the pathogenicity and the chronicity of intramammary infections caused by different CNS species and among strains from the same species.

One thousand five hundred CNS isolates from the Mastitis Pathogen Culture Collection are presently being analyzed to identify the specific species and strain. So far, the bacterial species found in 950 isolates is known and 17 different CNS species have been identified. The species found the most often are *S. chromogenes*, *S. simulans* and *S. xylosus*. Preliminary data also show some differences in the degree of SCC elevation caused by certain species.

Here are some results:

<table>
<thead>
<tr>
<th>Species</th>
<th>Lactation Median SCC x 1,000</th>
<th>Pre-drying off Median SCC x 1,000</th>
<th>Post-calving Median SCC x 1,000</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. chromogenes</em></td>
<td>105</td>
<td>132</td>
<td>470</td>
</tr>
<tr>
<td><em>S. simulans</em></td>
<td>62</td>
<td>460</td>
<td>1,555</td>
</tr>
<tr>
<td><em>S. xylosus</em></td>
<td>161</td>
<td>119</td>
<td>107</td>
</tr>
<tr>
<td><em>S. haemolyticus</em></td>
<td>211</td>
<td>330</td>
<td>531</td>
</tr>
<tr>
<td><em>S. cohnii</em></td>
<td>21</td>
<td>30</td>
<td>61</td>
</tr>
<tr>
<td><em>S. hyicus</em></td>
<td>-</td>
<td>1,575</td>
<td>27</td>
</tr>
</tbody>
</table>

The data generated by this study will eventually be integrated into the CBMRN database. Future studies will have access to the various demographic and epidemiological data from the CBMRN in conjunction with the data from this study in order to conduct analyses of the risk factors associated with mastitis caused by specific CNS species or strains.
Immunological monitoring of parasites in dairy cattle

Lead Scientist: Ian Dohoo, University of Prince Edward Island, Prince Edward Island
Collaborating CBMRN Scientist: Greg Keefe, University of Prince Edward Island, Prince Edward Island
Duration: 2008-2010

*Ostertagia ostertagi* is a gastrointestinal parasite that can have a severe impact on the performance of dairy cows. Research has shown that an ELISA test based on *Ostertagia ostertagi* antigens had the potential to predict which cows or which herds needed to be dewormed. However, there is not enough data to develop adequate guidelines on the use of that test. This study was conducted using Cohort dairy herds that had at least one cow or one heifer with access to pasture at some point during the year.

- A commercial ELISA test (Svanovir®) was used to test milk samples from approximately 2,500 cows from 38 herds distributed across 6 Canadian provinces. At calving, these cows either received a vermifuge or a placebo. Milk production data were collected for the first 200 days in milk. Results are pending.
- A modified ELISA protocol that requires less time and reagents was also evaluated in laboratory. This protocol appears to be as effective as the standard procedure recommended by the manufacturer.
- Analysis showed that ELISA results are not affected by multiple stresses such as freezing and thawing of milk samples.
Impact through farm-level implementation of practical measures stemming from research

• 7 out of 13 CBMRN projects are involved with applied research, including 3 new projects
• 3 external collaboration projects are involved with applied research
• 44% of research expenses were allocated to applied research
• Investments by the dairy industry in applied research have increased by a factor of 8.1 (applied research expenses / industry funds dedicated to applied research)
• Knowledge/results disseminated through the publication of a scientific article as well as 9 posters and 16 presentations during various provincial, national and international conferences
• Additional funding of $517,500 secured

Impact of fundamental research: mastitis monitoring and control technologies

• 6 out of 13 CBMRN projects are involved with fundamental research
• 2 external collaboration projects are involved with fundamental research
• 56% of research expenses were allocated to fundamental research
• Investments by the dairy industry in fundamental research have increased by a factor of 2.6 (fundamental research expenses / industry funds dedicated to fundamental research)
• An invention disclosure for the microencapsulated vaccine
• Two patent requests for genetic markers associated with mastitis susceptibility
• Two provisional patents for the discovery of a new antibiotic with a novel mechanism of action
• Knowledge/results disseminated through the publication of 3 scientific articles as well as 4 posters and 8 presentations during various provincial, national and international conferences
• Additional funding of $171,000 secured
After research, disseminating knowledge is at the very core of the CBMRN’s mission. Numerous strategies are implemented to make the most out of the new knowledge coming out of the research program for the benefit of various stakeholders.

www.mastitisnetwork.org

Our loyal Internet users know that our site www.mastitisnetwork.org is chockfull of useful tools and references to assist them in their fight against mastitis. This year alone, nearly 150 new documents were published in the Mastitis Online Resources section.

The site has recorded almost 8,000 visits with an average of 5.64 page requests per visit. That represents an increase of 25% in viewed pages when compared with last year. We have also noted that the duration of visits has increased from 3:30 minutes to 4:46 minutes, which means that visits are 36% longer. That can only mean that visitors have more material to sink their teeth into!

150
new documents

25%
Increase in viewed pages when compared with last year

4:46 minutes
Duration of visits

Mastitis-Flash

Mastitis-Flash now has 1,260 subscribers. Over 285 Internet users have registered since last year, that’s an increase of 25%! Mastitis-Flash attracts subscribers from everywhere: dairy producers, veterinarians, teachers, students, on-farm advisors, and more.

The Mastitis-Flash is emailed to subscribers and posted on the CBMRN Web site every month (except during the summer break). After every issue, the number of daily visits to the site increases significantly in the following days. The publication of Mastitis-Flash definitely attracts a lot of interest from subscribers and prompts them to visit and consult available resources.

1,260
Mastitis-Flash subscribers

285
new users

After every issue, the number of daily visits to the site increases significantly in the following days
The Toolbox

The Toolbox offers a vast array of practical tools that can be used to implement an udder health management program at the farm.

Illustrated factsheets

Simple, practical and easy to use, a series of 9 illustrated factsheets is now available on the CBMRN Web site. Internet users can download the factsheets and print them as they please. They are:

- Administration technique of intramammary treatment in dairy cows
- Cow cleanliness assessment
- Injection technique for dairy cattle
- Milk sample collection technique for bacterial testing
- Step-by-step milking procedure
- The California Mastitis Test (CMT)
- Observation of mammary system conformation
- Teat abnormalities
- Teat condition evaluation table

Testimony about the factsheets:

"These sheets will act as a wonderful visual reference tool to our existing staff but more importantly to any new staff that are unfamiliar with identifying and treating mastitis. These fact sheets will be added to our "Mastitis Protocol" binder so that all employees can reference the sheets at any time. Thank you again."

Fred Doberstein, Dairy Farmer, Daldas Farms Ltd., British Columbia

"I have used the laminated factsheets to explain or initiate discussions about the CMT, the administration technique of intramammary treatment and collecting milk samples, for example. These educational tools seem to be very well done. Their visual nature makes it easier to interact with the producer. Being able to revisit topics that have often already been covered gives us an opportunity to upgrade knowledge and make sure the concepts are well understood."

Dr. Jean-Yves Perreault, DMV
Clinique vétérinaire Centre du Québec, Notre-Dame-du-Bon-Conseil, Québec

Martin Gosselin, agronomist and teacher in dairy production at the Saint-Hyacinthe campus of the Institut de technologie agroalimentaire. Mr. Gosselin, uses the CMT factsheet and video to complement his students’ training. All of his students subscribe to Mastitis-Flash and they had better read it because there will be an exam question on it! “Among the tools they can use for their term papers, they must use the Cow Cleanliness Assessment and the Teat Condition Evaluation Table factsheets. Those sheets are an excellent way of integrating theoretical concepts and practice. In addition, the students can use the CBMRN Web site to learn more about the production of quality milk.”
The Toolbox
Calculation tool

The Teat Condition Calculator

- Assessment of the most common teat abnormalities (hyperkeratosis, congestion, lesions)
- Compilation of individual and herd results
- Full analysis per quarter, per cow and per type of abnormality

This computerized calculation tool (Excel spreadsheet) can be used to complement or replace the Teat Condition Evaluation Table. Users simply enter the data in the appropriate cells on the spreadsheet and all calculations are performed automatically. You can get figures for the main abnormalities observed and compared them with NMC standards.

The Toolbox
Videos

CMT: A Simple and Effective Tool

The video of few minutes is now available from our online Toolbox. It shows the steps involved in performing a California Mastitis Test for the quick detection of mastitis. This very interesting educational tool can be used for training students and farm employees, or used as a refresher for those who might have left their CMT paddle collecting dust for too long in the back of a cupboard in the milkhouse!

The ABC of Milk Sampling for Bacterial Testing

You will know everything you need to know about collecting and storing a sterile milk sample after viewing this video. Properly collected samples make it worth the cost and fits right into any anti-mastitis intervention strategy.

The Toolbox
Veterinary Investigation Guide on Mammary Gland Health

This guide is invaluable when dealing with a milk quality crisis on the farm. It is designed to allow for drawing a true picture of udder health management and identify critical issues accurately. It is a must have for any practitioner called in to troubleshoot a situation for a client dealing with penalties. The Guide proposes 5 steps for a visit conducted during milking and contains several useful references.
The Veterinary Kit 
TACTIC Udder Health

Veterinary practitioners can now rely on a new weapon in their fight against mastitis. The Veterinary Kit TACTIC Udder Health was developed by the CBMRN in cooperation with many partners. It offers a 5-point structured approach to standardize the support provided to dairy producers and promote cooperation with other on-farm stakeholders. Inspired by the national udder health improvement program established in The Netherlands, this initiative is a first in Canada.

The French version of the Kit is already available through the Association des médecins vétérinaires praticiens du Québec (AMVPQ) while an English adaptation is close to completion. Veterinarians from different English speaking provinces have generously contributed to its review. It should be finalized very soon. There have even been some discussions in certain provinces about initiating training in udder health for dairy producers, veterinarians and other on-farm stakeholders.

Mastitis Column

Once again this year, some 20,000 subscribers to Le producteur de lait québécois and The Milk Producer magazines were able to read about results of research activities conducted by the CBMRN because of the regular publication of our Mastitis Column. The Column is written by our transfer team with the assistance of CBMRN scientists. In addition, the CBMRN contributed to the production of a full report on mastitis which was published in Le producteur de lait québécois magazine. This launched Québec’s strategy for udder health improvement. Visit the Mastitis Column section on our Web site to get a list of published articles.

The newspaper
"What’s New? In the World of Mastitis Research”

This year, our usual transfer brochure took the form of a newspaper! Illustrated and bursting with information in an easy to read format, the newspaper reported on several of our ongoing research projects.

Over a 1,000 copies have been distributed to our partners, veterinarians and stakeholders across Canada. Considering this enthusiastic response and by the recommendation of the Transfer Committee, 13,500 additional copies were printed! Every farm in Canada will receive a copy of the newspaper during the spring of 2010, thanks to the invaluable cooperation of provincial dairy producer associations. An electronic version of the paper is available in both languages on our Web site.
Dairy Farmers of Canada (DFC) publications

DFC publications provide a valuable forum to the CBMRN to present advancements made in mastitis research at the national level. In 2009-2010, ten articles were published in Action-Fax. The CBMRN also enjoyed the privileged place in the Fall 2009 and Spring 2010 Action + activity reports.

Mastitis Capsules

Several provincial dairy organizations publish regular newsletters to keep in touch with their membership. Throughout the year, the CBMRN has submitted 10 information capsules on udder health for inclusion in such publications. These capsules can be consulted on our Web site, under the Mastitis Capsule tab.

The Display

It is always a pleasure for the transfer team to travel across the country to meet with CBMRN users and share with them available resources. With our display in tow, we were welcomed at several events:

- Fédération des producteurs de lait du Québec (FPLQ) (Québec, QC, April 2009);
- Dairy Farmers of Canada (Saskatchewan, SK, July 2009);
- Association des médecins vétérinaires praticiens du Québec (Lévis, QC, September 2009);
- British Columbia Dairy Industry Conference 2009 (Vancouver, BC, November 2009);
- Training in udder health for practitioners of the AMVPQ (Drummondville, Saint-Hyacinthe and Sainte-Foy, QC, November 2009);
- Seminar on the health of dairy herds (Drummondville, QC, December 2009);
- Training in udder health for dairy sector stakeholders (Drummondville, QC, December 2009);
- Ontario Dairy Days (Kemptville and Maxville, ON, February 2010).

Visitors who stopped at our display received various handout materials about mastitis including the CBMRN newspaper and the factsheets. They were also invited to subscribe to Mastitis-Flash.
CBMRN Transfer Workshop

On October 26, 2009, as part of the Annual Scientific Meeting, about forty dairy producers, veterinarians, stakeholders and partners attended the first CBMRN transfer workshop. The day began with a corporate session organized by Pfizer, a corporate sponsor of the CBMRN. During the afternoon, the transfer team went all-in and presented six lectures on the most recent developments in CBMRN research and transfer tools. A first that is bound to be repeated!

Conferences

As experts in matters of udder health, CBMRN students and scientists are invaluable collaborators for disseminating knowledge among users and the scientific community. Throughout the year, our scientists and students have participated in a host of events to present their research results and spread the word about good udder health management practices. During the past year, CBMRN experts gave lectures and presentations all over the country and even beyond our borders. See page 45 for a list of topics presented and all events attended.

The tools and resources of the CBMRN contribute to the fight against mastitis in Québec

Several Québec organizations have pooled their resources to implement a provincial udder health strategy. This ambitious undertaking is intended to improve the mastitis situation in Québec. Training sessions were scheduled for veterinarians and stakeholders in the fall of 2009. Mastitis prevention training sessions for producers were held across the province during the winter of 2010.

The Network has contributed enthusiastically to this province-wide initiative. The CBMRN team has participated in the drafting of a full report on mastitis that was published in the November 2009 issue of Le producteur de lait québécois magazine. As a result of the financial contribution of the FPLQ obtained through Valacta, the 9 illustrated factsheets were distributed to all producers and stakeholders attending training sessions. Veterinarians have received the binder and the USB key of the Veterinary Kit TACTIC Udder Health through AMVPQ training sessions.

Team members also had the opportunity to address Valacta advisors to inform them about resources that are available in the CBMRN Toolbox and Web site.
Evolution of the knowledge transfer program

Continuation of staffing for the development and execution of new transfer activities:
• One transfer manager and two part-time project transfer managers

New collaborations for transfer to veterinary practitioners, stakeholders and dairy producers:
• Collaboration with the AMVPQ for distribution of the French version of Veterinary Kit TACTIC Udder Health to veterinarians at training sessions and by request from their office
• Collaboration with English-speaking Canadian veterinarians for the validation of the English version of Veterinary Kit TACTIC Udder Health
• Collaboration with FPLQ, AMVPQ, the Faculté de médecine vétérinaire (Université de Montréal) and Valacta for drafting a full report on mastitis which was published in Le producteur de lait québécois magazine
• Collaboration with Valacta for the presentation of lectures and the distribution of factsheets during 3 training sessions for their advisors during the fall of 2009
• Collaboration with Valacta for the printing and distribution of illustrated factsheets to the 2,800 producers who attended the training sessions held during the winter of 2010

New transfer activities initiated over the last year:
• Creation of the newspaper “What’s new? In the World of Mastitis Research”
• Production of two videos for the Toolbox
• Adaptation of one calculation tool
• Organization of the first transfer workshop during the CBMRN Annual Scientific Meeting
• Organization of a workshop on the use of a mastitis treatment decision support tool during a dairy herd health colloquium in Quebec

Active maintenance of CBMRN Web site
• Regular and frequent addition of new documents
• Monthly publication of Mastitis-Flash
• Planning of Web site overhaul for optimal browsing and easy updating

Availability of mastitis information to the Canadian dairy industry

• 150 new documents in the Mastitis: Online Resources section of the Web site
• 10 Mastitis-Flash and 3 CBMRN Bulletins sent to subscribers and posted on the Web site
• 9 illustrated factsheets dealing with various udder health issues posted on the Web site and available in laminated color print
• 1 calculation tool
• 2 videos
• 7 mastitis columns published in French and 5 in English
• 1 transfer newspaper “What’s new? In the World of Mastitis Research”
• 2 reports published in the Fall 2009 and Spring 2010 issues of Action+ by the Dairy Farmers of Canada
• 10 articles published in Action-Fax by the Dairy Farmers of Canada
• 10 mastitis capsules sent to 34 contacts for publication in membership bulletins of provincial dairy associations and other targeted media
• 1 Veterinary Kit in French intended for veterinarians reviewed and approved by experts; 220 printed copies
Visibility of knowledge transfer strategies

- Over 1,260 subscribers on the mailing list (an increase of 285 over the last year) who receive Mastitis-Flash and the CBMRN Bulletin
- *Le Producteur de lait québécois* has a circulation of 10,871 copies, including 7,600 copies to dairy producers
- The Milk Producer has a circulation of 10,000 copies distributed across the country, including 7,000 copies to dairy producers
- 13,500 copies of the newspaper were printed and distributed to each and every dairy producer in Canada
- 1,000 copies of the newspaper were distributed to veterinary practitioners, stakeholders, schools, visitors to the CBMRN display and more
- Nearly 3,800 illustrated factsheets were distributed to CBMRN users, mainly dairy producers
- Nearly 20,000 people received Action + from Dairy Farmers of Canada twice this year, which included CBMRN reports
- The Action-Fax in which we published an article were sent to 300 contacts
- Roughly 1,700 people attended events where we set up our information display
- 200 copies of the 2008-2009 Annual Report were distributed

Interest in knowledge transfer activities

- Approximately 8,000 visits of our Web site
- 72% of those visits were made by Canadian users
- A total of 45,000 Web site pages consulted
- 36% of users revisited the Web site more than once
- The average duration of Web site visits was 4:46 minutes
- The number of visitors increased for several days after each publication of Mastitis-Flash
- 285 Internet users have subscribed to our publications (compared to 130 the year before)
- 185 veterinary practitioners attended a training program to which we have contributed
- 300 stakeholders from the dairy sector attended a training program to which we have contributed
- 40 people attended the Transfer Workshop organized by the CBMRN during our Annual Scientific Meeting
- 30 people attended a workshop organized by the CBMRN during a dairy herd health colloquium
- Over 400 people stopped by our information display and picked up a documentation kit
CBMRN students are the future hands and minds in laboratories, universities and in the field. We have the duty to provide them with a multidisciplinary understanding of bovine mastitis. During 2009-2010, ten undergraduate students, twenty four graduate students, six postdoctoral researchers and fourteen technicians and research professionals have contributed to the Network’s research activities. Four other graduate students participated in collaborative projects. Overall, one third of the annual budget was allocated to students, postdoctoral researchers and their training activities. In addition, several students obtained grants from external sources (Maritime Quality Milk, Atlantic Veterinary College, NSERC, Ontario Veterinary College, Canadian Dairy Commission in cooperation with Novalait inc. and Bigland Foundation). Numerous activities and opportunities were offered to them to foster their interest and increase their knowledge in mastitis research.

**Multidisciplinary networking**

The Annual Scientific Meeting was held on October 26, 27 and 28, 2009 in Montreal. Seventeen (62%) students and postdoctoral researchers and two research professionals were in attendance. They attended sessions on the progress of the Network’s research activities, presentations from guest speakers and a strategic planning workshop. Their participation in this Meeting gave them the opportunity to talk to one another and to other participants, to gain experience in presenting their research results and to gain access to knowledge from participants in other fields of expertise.

**A stimulating display**

Students had the opportunity to present their most recent research results to dairy producers, researchers and other industry stakeholders in the friendly confines of a poster session. This year, 18 scientific posters were presented, including 14 (82% of participants) by Network graduate students, postdoctoral researchers and professionals. As in years passed, the best posters earned a $500 award and five were granted to students and postdoctoral researchers. These awards will be used to present their results at an international scientific conference.
A rewarding workshop

Fifteen people attended the training workshop on basic principles of epidemiology held on October 26, 2009. Organized by four graduate students from the University of Prince Edward Island, this interactive workshop gave an overview of epidemiology while focusing on practical examples and actual cases. Training workshops are intended to offer basic training in a specific field of expertise and foster interdisciplinary education. Judging from the feedback, the workshop was a complete success.

A window on the world

As part of the International Meeting Participation Grants program, six graduate students received awards as a result of their participation in a pair of contests held by the Network in June and November 2009. Out of the six students, five went on to represent the Network at the 5th International Dairy Federation Mastitis Conference held in March 2010 in New Zealand. The grants had been increased to $1,500 for this particular event. Such awards are intended to enhance international networking activities of students in order to create new cooperation opportunities, acquire new skills and enhance personal experiences.

An Inter-Laboratory Exchange Grant enabled Kamal Said, a doctoral candidate at McGill University, to visit the J. Craig Venter Institute in Maryland, USA. Kamal underwent intensive training in the application of DNA chip technology and the different approaches of this new technology. This grant program enables recipients to benefit from the expertise and experience of students and postdoctoral researchers from other research groups.

A committee for the next generation

A training committee composed of Herman Barkema (Calgary), Ian Dohoo (Prince Edward Island), Brian Talbot (Sherbrooke) and Annik L’Espérance (CBMRN) determines training activities that will be held during the course of the year. The main goal is to give students the opportunity to acquire as much knowledge as possible in various fields of expertise by offering challenging activities and possibilities.

Testimony from a student about her experience within the Network:

“Being involved in the CBMRN has taught me a great deal in an applied setting, as well as allowed me to connect with a wide array of researchers and gain a perspective of the broad panorama of epidemiology and mastitis research worldwide. I have been fortunate to be able to present an overview of the Core Research Platform and to generate interest in the superb and epidemiologically-relevant dataset we have amassed and made available to collaborators worldwide. In my mind, and the minds of many others, we have laid down the gauntlet in mastitis research, and I look forward to seeing what collaborations stem from our data, allowing them to be used to the fullest!”

Kristen Reyher, Ph.D. student
University of Prince Edward Island
Networking is the key element of success and a major asset for the implementation of the second phase of the CBMRN. The Network has contributed to strengthening existing relationships and creating new ones while generating novel research ideas. Many networking activities are planned and scheduled throughout the year to promote discussions and yet, numerous collaborations between scientists and students often come from random encounters.

**Internal networking**

The Annual Scientific Meeting is the major networking event of the year. It was held on October 26, 27 and 28, 2009 at the Crowne Plaza Montreal Airport Hotel and was attended by 89 participants. Two workshops were held during Day One: a transfer workshop for users and partners and a training workshop for students. The transfer workshop was a splendid opportunity for the Network to bolster relationships with representatives from dairy associations and the industry. Day Two was devoted to scientific presentations. Our guest speaker, Dr. Stephen C. Nickerson from the University of Georgia, gave a presentation on future trends in the field of mastitis research. This was followed by CBMRN scientist presentations on developments of their own research over the past year. The day ended with a poster session and a banquet. During the banquet, Michael Hall, a dairy producer from Ontario, enlightened us with his vision of research as it applies to the reality of dairying in Canada. A session of strategic planning was organized during Day Three of the Meeting where scientists and students were invited to provide input on the emerging vision of the 2011-2016 phase of the Network. This session was led by consultants from SHI Consulting Inc.

An internal call for research proposals was conducted in the autumn of 2009 and four new projects were selected and brought on line in January 2010 (page 25). These projects are the result of existing collaborations within the Network.
External networking

This year, fifteen external collaborators participated in Network research activities; nine collaborators are from Canada, five are from the United States and one is from the European Union. Six of those collaborations are new and have led to the advancement of our projects or created new opportunities.

The Network was well represented by its scientists and students at several international conferences such as the 5th International Dairy Federation (IDF) Mastitis Conference. The IDF Mastitis Conference, which was held from March 21 to 24, 2010 in New Zealand, is the major international event on the calendar for 2010. Our scientists and students gave 13 presentations and displayed 6 scientific posters. The Director, Daniel Scholl, and the Control Theme Representative, Pierre Lacasse, from Agriculture and Agri-Food Canada, took advantage of their presence in New Zealand to meet with four of the most active organizations in dairy research in that country (Dairy NZ, AgResearch, Animal Health Centre and ViaLactia). Pierre Lacasse received a grant from the CBMRN “Networking Exploration Award” program to make this trip a reality.

This program also awarded a grant to Ken Leslie, from University of Guelph. This will give him the opportunity to meet researchers from the British Columbia Animal Welfare Program. The Networking Exploration Award program is designed to encourage Network researchers and researchers from international research groups to seek out and explore collaborations for research, transfer and training activities.

Impact on mastitis research capacity in Canada

- Network scientists collaborated with 9 Canadian researchers, 5 researchers from the United States and 1 researcher from the European Union
- 6 of these collaborations are new
- An additional amount of $8,600 was allocated to the “Networking Exploration Award” program as a result of a complementary grant from the NSERC Strategic Network Enhancement Initiative.
2009-2010
FINANCIAL REPORT

Cash Contributions

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSERC</td>
<td>$1,052,523</td>
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<tr>
<td>Partners</td>
<td>$224,400</td>
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<td>Year 3 Balance + Reserve</td>
<td>$1,132,466</td>
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Expenditures *(Amounts based on estimations)*

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<thead>
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<th>Category</th>
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<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>$548,090</td>
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<tr>
<td>Training</td>
<td>$453,512</td>
<td>29%</td>
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<tr>
<td>Networking – Transfer</td>
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<tr>
<td>Administrative Centre</td>
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<tr>
<td>Other activities</td>
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</tr>
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</table>

Total of contributions: $2,409,389
Total of expenditures: $1,540,415
Amount in reserve: $115,534
Balance: $753,442

Note: These figures include the Strategic Network Enhancement Initiative grant obtained from NSERC in October 2007.
CONFERENCES AND PUBLICATIONS

Scientific Conferences


Andersen, S., I. Dohoo, R. Olde Riekerink, H. Stryhn, and Mastitis Research Workers’ Conference. Evaluating expert opinions on the definition of intramammary infection using conjoint analysis...or steps towards a common vision. ISVEE XII. August 10-14, 2009. Durban, South Africa.

Andersen, S., I. Dohoo, and D. Kelton. Comparison of multiple versus single quarter milk samples for the identification of intramammary infections in lactating dairy cows “is two (or three) better than one?” ISVEE XII. August 10-14, 2009. Durban, South Africa.


Conferences to users


CONFERENCES AND PUBLICATIONS

Posters


Scientific Publications

