ANALYSIS OF THE PROVISION OF MOLECULAR GENETIC TESTING FOR LONG QT SYNDROME BY THE BC MOLECULAR GENETICS LABORATORY

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ABSTRACT

This report was conducted in response to a request by Dr. Brett Casey, Program Director of the BC Molecular Genetics Laboratory (MGL), to examine the feasibility of offering a test for Long QT syndrome (LQTS). LQTS is a cardiac disease affecting approximately 1/2500 people. Presently, the MGL is facing a number of budgetary, administrative, and operational challenges. In addition to the importance of providing this test to the patients within BC, it is Dr. Casey’s hope that by providing this test as a service the revenue could be used to fund some of the challenges facing the MGL. Currently, genetic testing for LQTS is only available through a private corporation in the United States. The authors establish the clinical case for LQTS testing, confirm the MGL’s ability to offer the service, and consider whether providing the testing as a service is appropriate or possible in a broader environmental context.

Keywords: Long QT Syndrome; molecular genetic testing
EXECUTIVE SUMMARY

Project Overview & Aim

This report was commissioned by Dr. Brett Casey, the Program Director of the BC Molecular Genetics Laboratory (MGL) at BC Children’s & Women’s Hospital as a first step towards potentially providing a genetic test for the Long QT syndrome to patients in British Columbia. The MGL provides all non-cancer related molecular genetic testing for the British Columbia health care system. The MGL also provides some testing to outside clients on a fee for service basis. This initiative was prompted by several interested parties contacting Dr. Casey regarding the Laboratory’s ability to offer testing for the Long QT Syndrome (LQTS).

Additionally, the MGL is facing a number of budgetary, administrative, and operational challenges. Adding the Long QT Syndrome test as an additional for-profit service is seen by Dr. Casey as a potential way to help alleviate these problems and therefore improve British Columbians’ access to care as well as offsetting the cost of the provision of laboratory services. To provide this, this project evaluates the clinical case for LQTS testing, assesses the MGL’s ability to offer the testing, and considers the likelihood of the MGL’s succeeding at providing this service in light of external as well as internal factors.

Conclusions

The clinical case for LQTS testing is conclusive: access to LQTS genetic testing should be available to British Columbians. Internal analysis suggests that the MGL has the ability to deliver the LQTS Test, though the MGL is clearly facing substantial funding and infrastructure issues. The delivery of this test is appropriate according to the strategic objectives of all major stakeholders, those being, the Ministry of Health, the Provincial Health Services Authority (PHSA) and PHSA Cardiac Services. The PHSA is a critical stakeholder, and further development of the MGL’s relationship with the PHSA at a senior level is recommended.
Broader systemic issues have come to light through the analysis completed by this report. It is the authors' opinion that addressing LQTS testing in particular, and a rapid review of genetic testing in general, is essential to ensure patients in British Columbia have access to the greatest level of care possible as the usefulness and relevance of molecular genetics in medicine is rapidly increasing in importance.

Recommendations

A number of recommendations are put forward in response to the opportunity created by the LQTS service and the risks faced by the MGL. It is recommended that the MGL: (1) proceed forward with the completion of the business case for LQTS testing; (2) aim to establish a comprehensive portfolio-based approach and process around the procurement and assessment of specific rare genetic disease tests; (3) position itself to become a centre of excellence in Canada and provide a service to other provinces; (4) establish a formal network linking the Centre for Translational and Applied Genomics (CTAG), the molecular genetics lab at BC Cancer and the MGL; (5) establish a committee specifically related to molecular genetic testing in order to better coordinate testing within Canada; and (6) connect with the key decision-makers in various stakeholders and other provincial ministries of health involved in the procurement of rare genetic disease testing.

Next Steps

To move forward with the LQTS proposal, it is necessary for the MGL to build a complete a business case. This will include details of how the service will be offered and a full financial analysis.
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1 PROJECT OVERVIEW

1.1 Project Context

The BC Molecular Genetics Laboratory ("MGL") is run by the Laboratory Genetics division of The Department of Pathology & Laboratory Medicine at Children’s & Women’s Health Centre of British Columbia (Provincial Health Services Authority, 2007). The Department of Pathology & Laboratory Medicine’s goal is to:

provide critical tertiary-care diagnostic consultation and services on which vital decisions are made in the care of patients. It is also dedicated to research and teaching in paediatric and obstetric laboratory medicine through the application of specialized consultative expertise in diagnosis, screening and monitoring. (Medicine, Department of Pathology & Laboratory, 2007)

The MGL has been subject to a number of challenges throughout its history. In 1987, the Provincial Health Services Authority (PHSA) signed a 5-year contract for the provision of genetic testing with the laboratory. Under this contract some work was done on a fee-per-service basis and billed back through the Medical Services Plan (MSP), while the cost of other forms of testing was done on a lump sum basis. Upon the expiry of this contract in 1992, the payment structure was eliminated so that payments came directly into the hospital. Genetic testing in British Columbia has been operating with financial challenges since this time, while also facing a significant increase in the number of samples tested, a dramatic rise in operating costs, increased complexity of testing requirements, growing patient expectations and changing technological conditions. Going forward, these problems are expected to increase in severity based on continuing and significant medical breakthroughs in the genetic basis of disease.
A 2003 report commissioned by the Provincial Laboratory Coordinating Office (PLCO) found that BC’s lab costs are the highest in the country and that BC has the highest lab services utilization rates of any province (Bayne, 2003). In addition, the report found that lab services were fragmented, unsustainable, not accountable for quality or cost, and not patient-centred. In order to address some of these issues, the PLCO adopted a new strategy for renewing BC’s laboratory system in June 2005. The MGI was bundled in as part of this initiative. Part of this new strategy involves the restructuring of individual PHSA laboratories, including the Department of Pathology & Laboratory Medicine at Children’s & Women’s Health Centre of British Columbia, into a single entity (Medicine, Department of Pathology & Laboratory, 2007). The underlying assumption of this strategy is that the restructuring will produce an emphasis on high quality provision of service, more support of innovation, increased accuracy of results and an assurance that the medical decisions resulting from testing are appropriate.

In response to these budgetary, administrative, and operational challenges, Dr. Brett Casey, the MGI, Program Director, looked at ways of using genetic testing to generate revenue and bring the testing of various rare diseases in-house. He saw the testing of rare genetic diseases on a fee-for-service basis as a possible solution. He selected a disease he had some familiarity with and set up a testing service for regions outside of BC. This venture was successful. Whereas previously, detection of this disease was a financial liability for the province, Dr. Casey’s venture turned it into a profitable activity. This test case suggests that it is possible to both increase the quality of care offered to British Columbians and offset the cost of the provision of laboratory services.

Recently, several interested parties have contacted Dr. Casey regarding the Laboratory’s ability to offer testing for the Long QT Syndrome. These parties include stakeholders from within British Columbia as well as an individual from another province’s Ministry of Health.
concerned with the rising costs associated with outsourcing Long QT testing to a US based for-profit lab.

As a result of these synergies, Dr. Casey commissioned the production of this report.

1.2 Project Aim

The purpose of this project is twofold. Firstly, we will evaluate the clinical case for Long QT Testing. Secondly, we will assess the ability, appropriateness, effectiveness and likelihood of the MGI to be able to deliver this test as a service to the BC health care system and potentially beyond.

1.3 Project Scope

This project is limited to items related to the above project aim. This project is time and resource limited; the examination of the items listed in the project aim is at a level of detail that can be achieved within these constraints.

The case for Long QT Testing is built through a discussion of the clinical need for the service across Canada and in British Columbia in particular. This discussion includes the health economies behind the syndrome, the health burden on those affected, and the clinical implications of having testing available (chapter 2). Subsequently, the ability of the MGI to deliver a Long QT testing service and the effects of going forward with the service is examined through an internal analysis (chapter 3). The internal analysis looks at the strengths and weaknesses of the Laboratory, as well as the opportunities available to it. The appropriateness of the MGI’s proceeding with this service is analyzed by looking at the broader strategic fit of providing Long QT testing as well as looking at possible alternatives (chapters 4 and 5). The effectiveness of the MGI is examined by conducting a high level review and benchmarking of molecular testing being provided globally (chapter 6). Finally, information about the likelihood of the MGI being
able to move forward is gathered by examining the stakeholders involved (chapter 7). Based on these facets, we provide recommendations on how to proceed forward (chapter 8). If the MGI does make the decision to move forward and examine the case for providing the testing of other rare diseases as a service in the future, there should be no need for another detailed analysis of the MGI itself. Instead the focus would be on the clinical and business case for the testing.

The project does not go into detail regarding the ethical or legal implications of genetic testing. Nor does it make the full business case for the offering of Long QT testing as a service. It is expected that this would be built as a subsequent step to this initial document. Lastly, a detailed analysis of the 'market' for genetic testing is not made within this project, though it is assumed that a market does indeed exist.
2 CLINICAL CASE FOR LONG QT GENETIC TESTING

There must be a solid clinical case for LQTS testing before the MGI decides to allocate its limited resources to such a service. This chapter examines the ‘market’ by reviewing the effects of the Long QT Syndrome, the clinical need for a test, the impact on care, the health burden on the target population and finally the expected health and business gains.

2.1 What is Long QT Syndrome?

Long QT Syndrome (LQTS) refers to a group of disorders that can lead to severe cardiac events, putting young and otherwise healthy people at risk of sudden cardiac death (SCD). Patients with LQTS have hearts that exhibit normal mechanical function but abnormal ion channel function that can cause irregular and potentially fatal electrical problems. Patients with LQTS can present with symptoms ranging from seizures to heart palpitations. “QT” refers to the QT interval of the heartbeat, a measure of the time required for depolarization and repolarization. In LQTS, the duration of repolarization is longer than normal, putting patients at risk of life-threatening arrhythmias. There is a high potential of LQTS causing lethal cardiac events, with a 13% incidence of cardiac arrest or sudden death among untreated patients (Priori S. c., 2003).

There are 8 LQTS genotypes, which are commonly referred to as LQTS 1, LQTS 2 etc., according to the location (or locus) of the mutation causing the disease. LQTS 1, 2, and 3 account for over 90% of LQTS occurrences (Modell, The Long QT Syndrome Family of Cardiac Ion Channelopathies: A HuGI Review, 2006). Risk of a first cardiac event, including syncope (fainting), cardiac arrest, or sudden death can be stratified using genotype, sex and the QT interval corrected for heart rate (Priori S. c., 2003). Priori found that a patient’s risk of a first
cardiac event before treatment and before the age of 40 was 46% for those with a LQTS2 genotype, 42% for LQTS 3 genotype patients, and 30% for LQTS 1 patients. More significantly, these same patients’ risk of a first cardiac event, including sudden death, varied as much as 30% for LQTS 1 patients to 56% and 60% for LQTS 3 and 2 patients respectively, making a patient’s risk assessment dependent upon their specific genotype. Priori concluded that the locus of the causative mutation affects the clinical course of the long QT syndrome and modulates the effects of the QTc and sex on clinical manifestations (Priori S. e., 2003).

Essentially, genotype matters. Not only does genotype influence the degree of severity of the QT prolongation, it correlates strongly with the likelihood of cardiac events.

2.2 Clinical Need

The existence of different LQTS genotypes and their impact on outcomes implies that the mere diagnosis of an irregular QT interval alone is not sufficient for proper management of LQTS. Genetic testing is required to identify the specific genotype. Proper diagnosis and treatment are vital for the management of this inherited disease. Testing provides knowledge of the location of the LQTS mutation which may assist cardiologists in stratifying their patients into risk categories, assessing the need for long term therapy in patients who are asymptomatic, and deciding for whom to choose prophylactic treatment.

The study by Priori brought attention to the risks to family members with clinically normal QT intervals, particularly for the families of patients with a LQTS 1 genotype (Priori S. e., 2003). Approximately 10% to 12% of all patients with LQTS may show a normal QT-interval on their ECG, highlighting the need for more sophisticated diagnostic capabilities (Fondazione Salvatore Maugeri, 2007). Further complicating the diagnosis of LQTS, 2.5% of the healthy population has a prolonged QT interval, indicating that more genetic testing may prevent the false diagnosis of healthy individuals (http://www.answers.com/topic/long-qt-syndrome). Furthermore it has been found in practice that even serial ECG testing can miss the “longest” QT interval and result
in a missed diagnosis. Failing to properly diagnose a LQTS patient who displays a seemingly normal QT interval is dangerous, because such a patient will not receive prophylactic treatment (e.g., beta blockers). will be unaware of passing the genotype on to children, and will not be aware of the need to avoid environmental risks such as strenuous exercise, QT-prolonging drugs, or stress (Napolitano, 2005).

Currently, cardiologists faced with patients and families in need of genetic testing for LQTS must outsource this testing to a private corporation in the United States. Testing is subject to case-by-case approval by individual provincial Ministries of Health (Hamilton, 2006). Interviews with cardiologists at the BC Children’s and Women’s Hospital indicate that testing for the LQTS is an under-met need in British Columbia, and they are desirous of increased access to this service. Specific information regarding the number of LQTS genetic tests conducted for Canadian families, the current spending on LQTS drugs, and how many families go without testing because of the expense and effort is difficult, if not impossible to find. Statistics regarding LQTS specific deaths or cardiac events have also proved a stumbling block in data collection, as investigation of disease databases and Canadian health statistics yield little to no information. Section 2.4.1 includes a discussion of the prevalence of LQTS within the BC population. A positive spin-off of genetic LQTS testing is that the service will provide a clearer picture of the true incidence of LQTS in the population and a greater understanding of the treatment that is currently undertaken.

2.3 Impact of Genetic Testing for LQTS on Clinical Care

The previous section clarified why there is a need for genetic testing of LQTS for British Columbian patients. Patients are currently misdiagnosed or undiagnosed; family members of LQTS patients may not be aware they are at risk; genetic testing makes the appropriate management of LQTS possible; testing leads to a confirmed diagnosis and increased patient
compliance with lifestyle changes and treatment regimes; LQTS is a possible cause of SIHD; and LQTS may further put patients at risk due to dangerous drug interaction.

Currently, cardiologists screen for LQTS in three different ways aside from genetic testing. The first, the resting electrocardiogram, can be inadequate in that it can show a normal QT period even in individuals with LQTS. The second, the exercising electrocardiogram, can help to clarify a diagnosis for those who are suspected of having LQTS but whose QT intervals are normal or borderline. Lastly, cardiologists may use the epinephrine challenge to clarify normal or borderline QT patients. Epinephrine is infused in a controlled and monitored environment, as the QT interval may become slightly more abnormal upon infusion, similar to the exercising ECG.

Importantly, there is evidence suggesting “most physicians, including many cardiologists, cannot accurately calculate a QTc and cannot correctly identify a long QT” (Viskin, 2005). Current diagnosis of LQTS is based on a “diagnostic score” developed through ECG readings and the clinical observations of a patient’s cardiologist. Patients may then be risk stratified; we have included a sample risk stratification from the American College of Cardiology in Appendix.

Genetic testing is required because the Schwartz and Keating standard diagnostic criteria widely used to diagnose LQTS, may dramatically under-diagnose LQTS 1-3 patients (Hofman, 2006). In addition, “the specific type of long QT syndrome can be helpful in guiding restrictions and modifications to lifestyle, and predicting prognosis and response to interventions such as beta-blockers and pacing” (Hamilton, 2006). While once the broad use of beta blockers for all LQTS genotypes may have been standard, there is now research that suggests a patient’s genotype can lead a clinician to more specific treatment options. For instance, beta blockers are more frequently effective at suppressing syncope or sudden cardiac death in LQTS 1 patients than in LQTS 2 or 3 patients (Tan, 2006). In fact, the recurrence rate is higher in LQTS 2 patients than in LQTS 1 patients, at times creating the need for conjunctive therapy, while beta blockers are not as protective and may even be harmful for LQTS 3 patients (Shimizu, 2005). Finally,
there is thought that people who have been positively identified by genotype will be more likely to follow their medical treatment as it removes all uncertainty.

Genetic testing for LQTS is most important in cases where a LQTS proband (the family member who draws medical attention to a family) has been identified and their family members are uncertain about their LQTS status. Knowing which family members are affected will allow preventative medical monitoring and perhaps preventative beta blockers to be put in place. Implantable cardioverter-defibrillators (ICD) may even be necessary for patients who have experienced a severe cardiac event, and genotyping may be useful in identifying those patients requiring such aggressive treatment (Priori S. e., 2004). ICDs confer a significant health cost burden, making the prevention of any cardiac event that creates the need for an ICD a clear economic benefit (Gollob, 2006).

A diagnosis of LQTS will invariably impact an individual’s quality of life. The type of LQTS diagnosed through genetic testing will more specifically identify necessary lifestyle changes because different types of LQTS put individuals at risk during different activities. For example, swimming is a common trigger for cardiac events in LQTS 1 patients, while LQTS 3 patients are most at risk during sleep and at rest, and LQTS 2 patients are at risk during exercise, sleep or as a reaction to a sudden auditory stimulus, such as an alarm clock or telephone (Shimizu, 2005).

Long QT Syndrome has long been suspected as a possible cause or factor in Sudden Infant Death Syndrome (Schwartz PJ, 1998). Due to this, genetic testing for the LQTS genotype may be of interest to physicians interested in Sudden Infant Death Syndrome (SIDS) or in families with a history of multiple cases of SIDS in conjunction with other cardiac events. SIDS is the leading cause of mortality in the first year of life. Most recently, a genetic post-mortem study of 201 infants who died of SIDS found that 9.5% of these cases were carrying the genes
associated with LQTS (Austad, 2007). It was suggested by the authors that early detection of LQTS in these infants may have reduced the number of fatalities. In addition, the authors also put forward that identification of the genes could lead to other affected family members.

Further, it is now believed that post-mortem genetic analysis should become a standard part of a clinician’s tool kit when dealing with sudden cardiac death in the young (Ingles J., 2007). A recent genetic molecular study performed at the Mayo Clinic found that 20% of autopsy negative sudden unexplained death cases were carrying the genes for Long QT Syndrome (Tester D., 2007). The authors of this study noted that their data suggested that many cases of autopsy-negative SID may be preventable. Although sudden death was the sentinel event in the majority of mutation positive cases, many had a positive family history of cardiac events, yet no family members carried the diagnosis of LQTS.

A literature review by Tester and Ackerman found that their results matched similar studies and in addition some of these studies had found matching identifiable cardiac channelopathy in first degree relatives.

A confirmed diagnosis of Long QT also has significant impacts on the treatment options given to the patient in regards to other health issues. For example, women with Long QT giving birth have a greater risk of a cardiac event and will require greater monitoring. In addition, patients with confirmed Long QT will be required to avoid the many drugs that have the side effect of further prolonging Long QT. Some of the drugs included in this category include common antibiotics, antidepressants and heartburn medication. A complete list of these drugs is available at www.QTDrugs.org.

Genetic testing is not a panacea, as a LQTS-negative test does not necessarily rule out LQTS. Up to 30% of LQTS patients may in fact turn up a negative genetic test due to our still incomplete understanding of the disease (Hamilton, 2006). While approximately 30% of
clinically-positive LQTS patients will turn up a negative LQTS genotype, genetic testing is still of vital importance given that an individual’s genotype affects not only their diagnosis, but their treatment options and the lifestyle changes necessary for that patient (Napolitano, 2005).

2.4 Target Population & Health Burden

2.4.1 Target Population

Section 2.2 discussed the clinical need for a LQTS testing service. What is largely unknown is a precise number of current LQTS cases in BC, the number of tests being outsourced to the US, and the number of patients currently underserved due to a lack of access to testing. This section aims to estimate the number of LQTS patients in BC, thereby providing guidance as to the health burden in BC. The target population for this LQTS service will include patients who present with symptoms of LQTS, known as LQTS probands, and their families as identified by cardiologists in BC. Various estimates of the incident rate have been produced for LQTS. These incidence estimates range from 1/2500, 1/5000 to 1/10000 (Quaglini S, 2006), (Tester, 2006), (Ackerman, 2005), (Schwartz, 2003). It is estimated that 2,000-3,000 children and young adults die each year in the United States due to LQTS, though comparable figures for Canada are as yet unknown (Phillips, 2005). The current population of BC is estimated to be 4.3 million (Stats, 2006), (Demography Division, 2006). If the high end estimate (1/2,500) is applied, it can be roughly estimated that there are 1720 individuals in BC with LQTS. The low end estimate (1/10,000) indicates that there are approximately 430 individuals in BC with LQTS. Of the 4.3 million people in BC, approximately 970,000 individuals are 19 years of age or under (Demography Division, 2006). The prevalence range indicates that of these 970,000 children and adolescents in BC, between 97 and 388 may suffer from LQTS. Given that LQTS has the potential to strike a young person down without warning, these numbers indicate that an unacceptable number of BC children and adolescents are at risk and may be significantly under-diagnosed.
Since Long QT syndrome is an inherited genetic condition, “pyramids” of cases have been observed. According to a cardiologist at BC Children’s and Women’s hospital, one small community in British Columbia has a disproportionate number of Long QT cases due to a founder passing the genotype onto multiple children. The most recent research has shown that the gene is passed along at a higher rate than what would be expected under “classic Mendelian inheritance ratios” (Imboden M., 2006). In his study of 1534 descendants of individuals identified with Long QT it was found that 57% of offspring carried the gene and that the alleles for the Long-QT syndrome are more often transmitted to daughters than to sons. This speaks to the need to identify the gene within families so risk reduction and genetic counseling can take place.

2.5 Health Gains

The potential health gains of initiating a LQTS genetic testing service at the MGL include increased accuracy of clinical diagnosis and a higher level of care offered to individual British Columbians. As has been made clear in chapter 2.3, a more sophisticated diagnosis of the subtype of LQTS can be crucial in determining the appropriate approach to treatment for each individual presenting with symptoms of LQTS. Importantly, genetic testing can also serve as an “early warning system for at-risk families” (Modell, The Long QT Syndrome Family of Cardiac Ion Channelopathies: A HoGE Review, 2006). This early warning system can help limit the impact of the disease on families by identifying family members who suffer from LQTS. Without genetic testing, family members identified as at-risk may otherwise have been subject to preventative treatment with beta blockers. For those testing negative for LQTS, these preventative measures can be avoided. An appropriate treatment regimen can instead be initiated, helping to reduce the risk of sudden death (Ching, 2006). Further positive outcomes of testing include reduced uncertainty, greater patient compliance with treatment regimes and activity restrictions.
2.6 Business Gains

The primary business gain of instituting a LQTS genetic testing program is the creation of a means of cost recovery while clearly establishing a standard of care for British Columbians that recognizes and capitalizes on the most recent research and technology. Currently, physicians looking to have their patients tested for LQTS must outsource the testing to a company in the United States at a cost of $5,400 USD for the first family member suspected to have Long QT, and $900 USD for each additional family member (Cardiac Arrhythmias Research and Education Foundation, 2007). Authorization of this testing requires multiple levels of approval, resulting in delays and differing levels of care.

A detailed health economic analysis of familial genetic testing for LQTS was carried out by Philips in 2005. This study focused on the incremental cost-effectiveness of molecular genetic testing versus a standard clinical approach without the benefit of this test. The authors noted that genetic testing is more cost effective than not testing at a cost per year of life saved of $2500. The cost per year of life saved is well below the standard threshold of $50,000 per life-year saved, which often is used to define a cost-effective intervention (Phillips, 2005).

To provide further comparison, this is well below the cost per year of life saved of other more complicated cardiac procedures that positive assessment could prevent. For example, an assessment of a study from 2001 found implantable cardioverter-defibrillators (ICD) as having a cost of $39,764 dollars per year saved (Zipcs, 2001).
2.7 Clinical Case Conclusion

The clinical case and need for a molecular genetic test for the Long QT Syndrome is clear. The conclusive diagnosis that is provided in 70%+ of cases is of benefit to the patient, their family, the clinician and the health care system as a whole. It is interesting to note that as research has progressed in the Long QT Syndrome and a conclusive test has been made available within some healthcare systems, the estimated prevalence of Long QT has steadily increased from a long held estimate of 1/10000 to the most recent 1/2500. The clinical implications of this increased prevalence are presently being debated. Some practitioners have suggested widespread ECGs should be provided as part of an infant screening program and some areas of Italy have moved forward with this (Quaglini S, 2006). Others contend that the detection rates of the ECG and the associated costs do not make sense. Either way, it is clear that this disease affects a larger portion of the population than was previously recognized and that this will have clinical implications (Border W, 2007).

Pam Husband, Executive Director of the Canadian Sudden Arrhythmia Death Syndromes (SADS) Foundation, has stressed that the most important feature of LQTS testing in Canada is that it be diagnostically accurate, cost-effective, and timely. The most compelling reason for the genetic testing of LQTS is that the worst case scenario of LQTS (sudden cardiac death in a young person) is largely preventable (Husband, 2007). Unlike other diseases, including various forms of cancer where a genetic diagnosis may only provide an indication of a patient’s susceptibility, a genetic LQTS diagnosis can directly prevent fatalities through the prophylactic use of treatment. As research into the genotype-phenotype relationship has progressed, it is increasingly clear that increased knowledge of an individual’s genotype can in many cases directly impact the level of and approach to clinical care.

It would be useful to have access to accurate population data, including BC-specific incidence and prevalence rates and the economic impact of LQTS on the health care system, to
create a more precise picture of the financial, social and health burden that IQTS places on BC society and the medical system. Lamentably, this information is not readily available for our region so one is forced to rely on anecdotal evidence from physicians in British Columbia.

Analysis of best practices in genetic testing, a comparison of alternative solutions and an internal analysis of the MGL will help demonstrate whether this genetic test is better offered locally or accessed via outsourcing.
3 INTERNAL ANALYSIS

Having established that there is a clear clinical need for a Long QT Syndrome test, this chapter addresses the question of whether the MGI is capable of delivering the test and if changes wrought by the delivery will be beneficial. Initially, we examine the background and funding history of the MGI and the challenges it faces in that regard. We then move on to develop an understanding of the MGI’s strengths and weaknesses, as well as the opportunities and threats (SWOT) it faces. The SWOT analysis is undertaken from the point of view of the MGI’s current state, as well as a hypothetical state in which LQTS testing has been initiated. In its totality this structure answers the posed question: “Does the MGI have the ability to provide Long QT Testing as a service?”

All information in the internal analysis has been supplied by the MGI, unless otherwise stated.

3.1 BC Molecular Genetics Laboratory Background & Vital Statistics

The BC Molecular Genetics Laboratory (“MGL”), has been in operation at BC Children’s and Women’s Hospital since the mid-90’s. Since the MGL’s establishment, tremendous scientific and clinical advances have been made in the field of medical genetics. In 2003 the human genome was mapped, creating boundless opportunities to identify the genetic basis of disease. The mapping of the human genome was said to have ushered in a “new era of molecular medicine characterized less by treating symptoms and more by looking to the most fundamental causes of disease” (Human Genome Project, 2006). The number of single-gene disorders now exceeds 6000, opening what amounts to a Pandora’s Box for medical researchers and many new potential tests for the MGI. As of 2006, more than 900 genetic tests have been introduced to
diagnostic practice (Human Genome Project, 2006). At present the MGI’s capabilities are limited to testing for 37 diseases on a routine basis.

Since 2003, the sample volume handled by the MGI has increased by over 400% to approximately 4000 annually. With new discoveries in medical genetics, such as the recently identified genetic basis of autism, the demand for the MGI’s services will only increase. In addition to increasing the number and type of tests demanded by patients and physicians, advances in medical genetics have altered the expectations of patients and physicians. During this time of increased demand, the MGI’s budget has not kept pace.

Budgetary constraints have faced the MGI since its inception and have directly affected its ability to meet its mandate of “consistent, high-quality and timely service to British Columbians”. Frankly, the history of MGI funding provides a bleak picture. The MGI’s original 5-year contract with the Ministry of Health set the tone for what would prove to be more than a decade of chronic underfunding. Under this first contract, the MGI had an initial estimated shortfall of $65,000-75,000. In fiscal 2004 the MGI saw a further shortfall of over $24,000. This was followed up in 2005 by an actual funding decrease of $24,000. Fiscal 2007 shows no improvement. This year’s budgetary “increase” is in reality expected to consist of revenue generated by the centre’s external service efforts. The projection of an increase by the budgetary authority does not take into consideration the cost of supplies required to generate that revenue. This is compounded by a direct $12,000 decrease in the supplies budget provided to the centre. It is difficult to generate revenue without the materials required to do so. In summary, in the five years from fiscal 2002 – 2007, the total budget has increased by just 13%, while labour costs have increased 34% (without any increase in personnel). Advancements in technology and medical science have not remained static, indicating that at current funding levels, the MGI is incapable of maintaining a high quality standard of care for British Columbians.
The following table provides a high-level summary of the resources available to the MGL.

In summary, the budgeted resources available to the MGL under-serve the needs of the laboratory to provide adequate infrastructural capabilities and appropriate human resource levels. It may be noted that the MGL’s leadership believes the laboratory’s recruitment, retention and training or skill developments to be appropriate, indicating that in terms of human resources, the MGL may be very capable of successfully implementing this service.

Table 3.1 Resource Summary for the BC Molecular Genetic Lab

<table>
<thead>
<tr>
<th>Category</th>
<th>Under-met</th>
<th>Appropriate</th>
<th>Over-met</th>
<th>Details/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial: Budgetary resources</td>
<td>X</td>
<td></td>
<td></td>
<td>Current level of funding renders the MGL incapable of offering higher levels of service.</td>
</tr>
<tr>
<td>Infrastructure: Facilities</td>
<td></td>
<td></td>
<td>X</td>
<td>MGL may use CTAG’s offsite equipment for LQTS testing, though in-house equipment is more appropriate.</td>
</tr>
<tr>
<td>Infrastructure: Equipment</td>
<td></td>
<td></td>
<td>X</td>
<td>MGL proposes the hiring of a full-time Genetic Counsellor. Current staffing level is under threat from PHSA budget deficit.</td>
</tr>
<tr>
<td>Human Resources: Number of Staff</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Human Resources: Recruitment</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Resources: Retention</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Human Resources: Training/Skill Development</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

18
3.2 Strengths Weaknesses Opportunities Threats (SWOT)

The financial picture of the MGL is poor, but it does not provide all of the information required to answer the question of whether the MGL can provide Long QT testing as a service. To complete this stage of our analysis we apply a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis to the MGL.

A SWOT analysis summarizes the key issues from the business environment and the strategic capabilities of an organization that are most likely to impact on strategy development. This can be useful as a basis against which to judge future strategic choices (Johnson, 2005).

This SWOT analysis encompasses both the current state of the MGL, and a hypothetical state of affairs in which the MGL provides the proposed QTS service.

3.2.1 SWOT Current Status

3.2.1.1 Strengths

- Qualified leadership committed to improving the MGL’s service.
- Invested, dedicated, intelligent and experienced staff are eager to expand their knowledge and technical skills.
- Leadership driven to improve the quality of service of the laboratory.
- Scientific and clinical relationships with leading cardiologists and interested stakeholders, including for example cardiologists in the Department of Pediatrics - Division of Cardiology and the Children and Family Research Institute.
- Core equipment and facilities necessary to undertake a broad range of testing in a timely manner and to a degree of quality demanded by clinicians.
- High-functioning laboratory for standard molecular-diagnostic procedures such as PCR, Southern blot, gene-tracking utilizing polymorphic markers, fragment sizing, MLPA and Sanger sequencing.
- Small structure (8 staff total) allowing for effective organizational communication and planning.
- Staff capable of learning and conducting new tests

3.2.1.2 Weaknesses

- Inadequate infrastructure – the MGL currently relies on agreements with related institutions such as CTAG for access to assay development. The MGL has a need for further advanced equipment to pursue developments in molecular genetics, including fluid robotics, a chip resequencing suite, and high-speed PCR instruments.
- Lack of experience with some techniques, including non-Sanger sequencing, quantitative PCR, and xMAP.
- Subordinate position with respect to various stakeholders and low visibility within the PHSA.
- Inadequate funding leading to reduced access to appropriate human resources and technology.
- Difficulty meeting increasing demand for testing without appropriate resources.
- Human resources – MGL requires at least two more technologists and one genetic counselor. The MGL is particularly understaffed with respect to the development of new assays.
- Uncertain political influence and a poor understanding of process and politics around funding new initiatives while competing for limited resources.
- Limited ability to successfully lobby for increased funding.

3.2.1.3 Opportunities

- New technologies offer enhanced ability to test for newly genotyped diseases, i.e. the sequencing technology required for LOF as well as other diseases. New technology -
shared across diseases - also allows for the testing of disease in faster, more accurate and more cost-effective ways. Synergies across genetic disorder testing will reduce per test costs across all disorders.

- Continuous scientific discoveries regarding the genetic basis of disease and the effects of genomics on drug effectiveness (pharmacogenomics) will continue to provide the MGI with more potential genetic tests to improve the standard of care for British Columbians.

- Unmet needs in the healthcare system can be viewed positively, as areas for advancement and improvement.

- Availability of platforms at CTAG for assay development i.e. Affymetrix for non-Sanger sequencing and Luminex for xMAP.

- No leadership with regards to LQTS testing within Canada presents an opportunity for the MGI to fill a niche need and expand capabilities.

3.2.1.4 Threats

- Budgetary constraints threaten the ability of the MGI to serve British Columbians with appropriate levels and standards of care. The present PHSA budget deficit threatens the current staffing level and the MGI is incapable of upgrading current equipment and/or obtain new equipment as technology advances.

- Increasing demands from the public and medical community threatens the MGI’s reputation and could start a vicious cycle by further reducing the ability of the MGI to lobby for funding.

- Lack of political influence and knowledge of stakeholder intentions creates risk of alienating or conflicting with important stakeholders.

- Risk of moving too slowly on the LQTS initiative will allow other hospitals/research labs to initiate LQTS testing causing a loss of the classic first-mover advantage and reducing the potential market within Canada.
3.2.2 SWOT Status with LQTS Service in Place

3.2.2.1 Strengths

- Strong relationships with supportive stakeholders, created through fulfillment of mutual and complementary goals.
- Instructive organizational learning with respect to systems/processes, “organizational competence and confidence” and capabilities.
- Increased political credibility, connectivity and stature.
- Increased revenue.
- Increased diagnostic ability for LQTS patients and SIDS victims.
- Enhanced ability to serve British Columbians.
- Further support of the academic mission of the Children’s and Women’s Hospital.
- Ability to assist in the tracking of LQTS epidemiological information on a province-wide basis.

3.2.2.2 Weaknesses

- Possible loss of focus on primary mandate.
- The MGI’s resources could be stretched too thin to be successful in offering the LQTS service, potentially affecting services that previously ran well.
• Increased expectations from stakeholders involved in supporting the IQTS testing service.

3.2.2.3 Opportunities

• The process of gaining approval and dealing with various stakeholders will strengthen the MGI’s position with respect to its political position, potentially creating further opportunities through this exposure.

• Success in developing the IQTS testing service should create a positive feedback loop whereby the MGI may find it easier to initiate other new services.

• Increased national and international recognition as a centre of excellence for IQTS – possibly bringing rewards in the form of increased funding, enhanced recruitment profile, inclusion in multi-centre studies.

• Revenues from fees

3.2.2.4 Threats

• Competition from private stakeholders currently offering IQTS service – i.e. price wars, efforts to steal market share. The MGI, as a public institution, may be ill-prepared to compete with a market-driven laboratory.

• Competition from other provinces’ Ministries of Health services.

• Alienation of important stakeholders, depending upon how the process to gain approval for the IQTS service was conducted.

• Possibility of the MGI disappointing clients and supporters (with increased service come increased expectations)
possibility of the public mistrusting a public institution entering a “commercial” space should the MGI venture into for-profit testing for out-of-province patients.

- Need for clear ethical guidelines and clinical gatekeeping. Inadequate preparation for this may jeopardize the success of the LQTS testing service.

- Dedication of specific assets for an as-yet unknown quantity of samples.

- Possible limiting of the MGI’s ability to seek funding for other projects.

3.2.3 SWOT Summary

The SWOT analysis has created a picture of genetic testing in British Columbia that can alternately be viewed as discouraging or hopeful. Because there continues to be technological developments in molecular genetics, MGI’s basic infrastructure and resources create the opportunity for continual improvement of service. With committed and trained staff, appropriate levels of infrastructure and an effort to keep pace with technological innovations, the MGI is in an exceptional position to improve British Columbians’ access to the very best diagnostic standard of care. Opportunities can only be viewed positively for so long however. Should PHSA and the Ministry of Health delay too long before adequately addressing the MGI’s funding and staffing levels, genetic testing in BC may fall so far behind as to be virtually incapable of catching up without significant investment and effort.

The hypothetical SWOT analysis suggests that the provision of testing for LQTS could impact the MGI in a positive way. It is clear that there are risks involved in the addition of an LQTS service, however. To succeed, the MGI must look to utilizing its strengths and capitalizing on its opportunities while overcoming its weaknesses and mitigating the threats it faces. The question is- how will LQTS testing allow the MGI to do this? A successful LQTS
service marketed across Canada could prove to be a valuable revenue generator and a powerful example of how innovative solutions can be found to counteract seemingly hopeless funding challenges.

The actual process of lobbying for a new service and initiating testing will provide the MGI with many valuable lessons and experiences. These lessons will include an increased understanding of working with influential stakeholders and knowledge gained with respect to the process the MGI must undergo in order to be recognized at higher levels and across the country. What is clearly an important weakness for the MGI, the lack of understanding of its political position and an inability to create positive change for itself, would be mitigated with the successful navigation of the current stakeholder environment. The MGI has been plagued by an inability to effect change in its budgetary situation. Addressing these stakeholder challenges will be crucial to the success of the MGI, with or without a LQTS testing service.

3.3 Internal Analysis Conclusion

The goal of the internal analysis is to answer the question of whether the MGI has the resources necessary to provide Long QT testing as a service. Our answer is a tentative yes. The MGI is however, clearly facing substantial funding and infrastructure issues. The effort of lobbying for LQTS testing and the initiation of the service may prove to be a strain on the MGI’s existing resources, and there may be a gap between the current and future resource scenario that will be difficult to bridge. It is our feeling that at present those issues are balanced out by the strong human resources present. Although there are not enough people present, the individuals working at the lab are dedicated and skilled. Basically, the quality of the human resources is presently overcoming the lack of quantity. This situation might not remain true into the future. The under funding will cause strain on the staff and could potentially undermine these going forward. Importantly, examining the proposed SWOT after the implementation of the test
suggests that implementing LQTS testing could in fact provide solutions to the issues presently facing the MQL.
4 STRATEGIC ANALYSIS

Now that we know that there is a clinical case for Long QT testing and that the MGI is capable of delivering it, it is necessary to examine the appropriateness of doing so in a broader sense. This is done by conducting a strategic analysis of the molecular genetic testing for Long QT syndrome by the MGI, in terms of strategic fit and alignment. Strategic fit looks at how the provision of this testing aligns with the strategic direction of the affected health care agencies. For organizations to function efficiently it is important the sub organizational units direct their efforts and resources towards activities that link with the overall strategic direction. Fundamentally, you want everyone rowing in the same direction.

The MGI and the potential Long QT Test falls within the environment and influence of three bodies. These are the British Columbia Ministry of Health, the Provincial Health Services Agency and the Provincial Cardiac unit. In 2006 these organizations published documents outlining their strategic directions and objectives and we will use these as the basis for our analysis.

4.1 Ministry of Health

The BC Ministry of Health is empowered by the government with the following mandate:

The Ministry of Health is responsible for British Columbia’s health system, with a mandate to guide and enhance the province’s health services to ensure British Columbians are supported in their efforts to maintain and improve their health.

The BC Ministry of Health publishes its service plan on a yearly basis. This year’s plan identified the following key strategic objectives into which the establishment of a molecular
genetic Long QT Syndrome test falls (British Columbia Ministry of Health, 2006). In the following section we relate these objectives to the MGI initiative.

4.1.1 Ministry of Health Objective 1.2: Protection of the public from preventable disease, illness and injury

The second major approach to keeping people healthy is through providing effective public health services to prevent illness and disability. The ministry and its partners play an important role in monitoring and protecting the health of the population. Injury prevention and control measures also help to improve population health, prevent illness and reduce health care costs (British Columbia Ministry of Health, 2006).

As set out in Chapter 2 of this document, the molecular testing of Long QT syndrome allows for the identification of at-risk individuals and family members through their genotype and will therefore ensure that those individuals will receive the intervention necessary to protect them from an adverse cardiac event. This in turn will directly prevent illness and reduce costs, provided that a service offered by the MGI is less expensive than outsourcing.

4.1.2 Ministry of Health Objective 2.2: Patient-centred care tailored to meet the specific health needs of patients

B.C.’s health system is committed to providing top quality care and services. When people use the system we must ensure the care they receive is centred on their needs, safe, evidence-based and will lead to the best health outcomes. Since one size does not fit all in health service delivery, the ministry is working with health authorities, physicians and other providers to design and deliver customized care that addresses the unique needs of patients or specific patient groups, such as those with chronic diseases. Implementing a quality focused, patient-centred approach can improve quality of life and health outcomes for patients and provide better use of health services (British Columbia Ministry of Health, 2006).

Molecular genetic Long QT testing is an enabling service that allows cardiac specialists to provide top quality care. It is a service that directly addresses the needs of the patient group and their families who are either affected or potentially affected with Long QT Syndrome. This testing service will tailor the clinical intervention more to the individual and will improve the quality of life of those who now can be either definitively identified as carriers of the genotype.
4.1.3 Ministry of Health Objective 3.4: Sound business practices to manage within the available budget while meeting the priority needs of the population

The ministry is committed to working with its partners to manage the health system efficiently to ensure resources are spent where they will have the best outcome (British Columbia Ministry of Health, 2006).

Genetic testing of individuals with either confirmed or suspected Long QT Syndrome allows for budgetary savings and focus of treatment dollars while also making the care more effective. Instituting the fee-for-service component will make the LQTS testing self-funding and therefore, consistent with this objective.

4.2 PHSA

The Provincial Healthcare Services Authority (PHSA) “plans, manages and evaluates specialty and province-wide health care services across BC.” It is one of the sub-organizations managed by the BC Ministry of Health. The molecular genetic lab (MGL) is part of this organization. Providing molecular genetic testing for Long QT syndrome falls into all four strategic directions identified by the PHSA’s strategic plan for 2007 (Provincial Health Services Authority, 2006). In addition the PHSA recognized the pressures faced by the molecular genetic facilities in their annual report:

The explosion of scientific knowledge will have an impact on the work we do and the way we do it. For example, the rapid developments in genetics research will put pressure on our clinical genetics program to advise both the system and our patients about these advances, at the same time as presenting ethical and economic challenges as new treatment modalities become available. (Provincial Health Services Authority, 2006)

The PHSA’s strategic report also noted its move towards utilizing a portfolio approach to access opportunities and a balanced scorecard to measure the results.
4.2.1 Operational Excellence

PHSA’s management sees operational excellence as “[i]nproving our ability to achieve the goals of the health system through redesign, evaluation and evidence-based decisions” (Provincial Health Services Authority, 2006). The Long QT Syndrome testing brings together resources from children’s and families’ molecular genetic testing unit and leverages them to provide evidence to support the decisions of frontline clinical staff as well as the staff responsible for planning at the provincial cardiac unit.

4.2.2 Knowledge and Innovation

The PHSA recognizes the importance of knowledge transfer and innovation. This is reflected in its stated goal of “Increasing research and education and enabling the transfer of knowledge into practice improvements” (Provincial Health Services Authority, 2006). The infrastructure for Long QT testing will enable genetic related health research in British Columbia. It is also a direct example of knowledge transfer from basic research into an innovative service that has a direct positive impact on the health of British Columbians.

4.2.3 System-Wide Improvements

The PHSA is unique in that it has a province-wide mandate and acts as a centralized coordinating body. The rest of the province is split into geographic-based health authorities that are focused on providing patient care only in their physical area. The PHSA’s role as a coordinator is reflected in its strategic direction, which it characterizes as “[u]sing our provincial role and mandate to achieve system wide changes and maintain access to specialized health services” (Provincial Health Services Authority, 2006). This role of coordinator is of special importance in Canada since health care is a provincial responsibility. At present the resources of
the MGI are unable to provide the specialized services necessary for Long QT genetic testing. By funding this plan, the PHSA will be fulfilling its stated strategic direction.

4.2.4  Prevention, Promotion, Protection

The PHSA’s final strategic direction is “[c]ollaborating with partners to shift the focus of the health system ‘upstream’ to reduce the incidence and impact of disease” (Provincial Health Services Authority, 2006). As outlined in Chapter 2, testing for Long QT reduces the burden of disease by allowing for more effective prevention and protection of those affected. Due to the genetic hereditary nature of this disease this impact extends out to the effects on the extended family.

4.3  Provincial Cardiac Unit

The provincial cardiac unit falls within the jurisdiction of the PHSA “Cardiac Services was created to improve the planning, coordination and evaluation of cardiac services in British Columbia” (PHSA Cardiac Services, 2006). The quality of the clinical services offered by the provincial cardiac unit will be directly affected by the availability of the Long QT genetic testing service and this is reflected in its support of the following self identified strategic directions.

4.3.1  Improved Accessibility

Cardiac Services sees a key aspect of accessibility as the improvement of “provincial access to the range of services offered from diagnostics through to interventional/surgical services” (PHSA Cardiac Services, 2006). Genotype testing for Long QT syndrome directly impacts this in two ways. First, there is a direct effect by providing improved diagnostic capability to clinicians. Second, it will improve accessibility by removing “grey area” potential Long QT cases from the present case load in the system.
4.3.2 Enhancing Quality and Effectiveness of Service

Testing for Long QT Syndrome will improve the quality and effectiveness of the cardiac services in BC by providing an exact identification for an estimated 70-75% of Long QT Syndrome cases.

4.3.3 Develop, maintain and strengthen partnerships and collaboration

At present the Cardiac Services organization recognizes the need for cross functional partnerships and collaborations. As one of its strategic directions it is directly seeking to improve this area. The implementation of this service will require a partnership to be directly developed between the molecular genetic laboratory and Cardiac Services. This relationship will only become more important as the genetic basis of heart disease is further refined. In addition, as data is collected this relationship will be extended into research organizations both internal to the province, Canada-wide and, potentially, internationally.

4.4 Strategic Alignment Conclusion

The MGI, providing Long QT testing is a strong strategic fit at all levels of government and the respective organizational units that will be initially impacted by the decision to move forward. Furthermore, Long QT Testing represents a test of the improved systems and processes that have been put in place since the reorganization of health care in British Columbia. With the PHSA’s leadership focusing on using strategic drivers and a portfolio approach to managing resources and projects, the structure should enable the rapid identification and funding of an innovative cross functional clinical service like this one.
5 ALTERNATIVES CONSIDERED

It is only appropriate for the MGI to offer Long QT Testing as a service if it provides clear advantages over the alternative ways forward. To determine whether this is the case, we look at the pros and cons of the two valid alternatives: maintaining the status quo, which involves few families accessing genetic testing for LQTS, and increasing access to an externally sourced test.

Table 5-1 Summary of Alternatives Considered

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Pro</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Quo</td>
<td>No Immediate Cost</td>
<td>Clinical Cardiac Resources will not have access to a critical diagnostic tool</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The standard of care for British Columbia will fall behind the rest of the world</td>
</tr>
<tr>
<td>External Sourcing</td>
<td>No Immediate Cost</td>
<td>High incremental cost per test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No access to research data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Builds reliance on outside supplier</td>
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<tr>
<td></td>
<td></td>
<td>Failure to build local expertise</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No direct control over quality or timeliness of results</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BC Healthcare dollars used to build external infrastructure</td>
</tr>
</tbody>
</table>

5.1 Status Quo

The first alternative to the development of Long QT testing in British Columbia is to “do nothing”. If this test was not made more widely available to the health care system in British Columbia there would be a clinical and perhaps political impact.
The clinical case for Long QT testing was made in detail in Chapter 2. In summary, greater Long QT testing could potentially impact children’s death rates, the costs of health care through better use of resources, and provide a direct health benefit to British Columbia by revealing previously undetectable carriers of Long QT syndrome. In addition, the health economics of family-based genetic testing are compelling (Phillips K A., 2005).

Besides the clinical impact there also could be a direct political impact. Since the clinical data is so compelling it is expected that Long QT testing will become the standard of care elsewhere in the world. If it is not available here the public perception and confidence in our health care system will be reduced. The next time a preventable death happens in a young athlete the media will be sure to highlight the deficiency in testing.

Staying with the status quo would eliminate the need for funding of a local test operation and the money and time could be allocated elsewhere.

5.2 External Sourcing

It is possible to conduct Long QT testing using external laboratories. There are two possible sources for this testing, Gendina or PGxI Health. Both are for-profit companies but they have very different strategies. Gendina acts primarily as a middleman and does a limited amount of its own testing. Instead it actually outsources the actual testing to third party organizations. In contrast PGxI Health does all of its own testing utilizing patented probes and technology.

The approach of external sourcing of testing has the following weaknesses:

- High testing costs. The PGxI Health test, Familion, is $5400 US. The testing through Gendina is $550 Euros for a single genotype. Based on the exchange rates of February 2007, that would make the cost $6294 or $2831 Cdn respectively.
• No control for quality or timeliness of results. If the testing is outsourced, there will be no way to ensure that the laboratories meet any accepted standards of privacy, accuracy, or procedures. It is worth noting that for these reasons that the UK Genetic Testing Network, the UK’s system of molecular genetic labs, only uses labs located within the UK and have gone through a certification process.

• Builds reliance on a supplier. There are a limited number of external agencies presently able to supply Long QT testing. As this moves to becoming the standard of care, the demand for this service will increase. Under standard economic principles, it would be expected that this constraint in supply will result in an increase in cost. It is also a risky approach in that the ability to provide clinical services will be tied to an organization that may or may not exist going forward.

• Opportunity cost: Loss of infrastructure. The health care money spent outside the country could have been used to build up the local biotech and healthcare infrastructure and cluster. The testing equipment purchased for Long QT testing could have also been used to test for other diseases and provide information to researchers. BC will have lost an opportunity to invest in an industry that directly supports the knowledge-based economy and the related innovations that are seen as the future of our economy. These effects have been observed in Ireland (as per the annual report from the Irish molecular genetic testing facility) (Lynch, 2006).

The advantages to outsourcing are, again, that the money that would not be used towards the initial capital expenditures involved in setting up the lab could go elsewhere. In addition, some of the risks involved in this approach could be mitigated. Long term contracts setting the
costs of the tests and service levels could be negotiated. The Ministry of Health could arrange for independent certification of the quality of the laboratories involved in the testing.

5.3 Alternatives Conclusion

The available alternatives have many negative aspects. Their potential benefits do not outweigh the advantages provided by the MGI offering testing for the Long QT Syndrome as a service. Importantly, by passing up on the opportunity to increase the service offered by the MGI, a range of economic, social, and educational opportunities will have been ignored. British Columbia could strengthen the province’s technological infrastructure and further develop the province’s cluster of healthcare expertise. This conclusion provides the last piece of information necessary to draw the overall conclusion -- that it is in fact appropriate for the MGI to offer Long QT Testing. The next logical step is to examine the most effective way this can be done.
6 MGL LQTS TESTING SERVICE IMPLEMENTATION: BEST PRACTICE

We use benchmarking to provide guidance as to the most effective way for the MGI to offer Long QT Testing as a service. Benchmarking is a process by which organizations compare how their processes and outcomes compare to those in the industry. Benchmarking is usually done by looking at industry norms within a sector as well as seeking out the highest performers or the best in class (Johnson G, 2002). Benchmarking has its weaknesses: “Taking ideas from other companies can be valuable, but it can also mislead and distract. It can prevent managers from focusing on what is unique to their situation” (Campbell, 1999). We avoid this by taking into account the unique environment and situation the MGL is in when examining the benchmarked agencies. Benchmarking within clinical organizations is seen as an effective practice: “Benchmarking can benefit healthcare organizations most when it attempts to determine best actual practices, not just lowest overall costs. Benchmarking that focuses on best practices can provide managers with an impetus for change based on ideas and practices that have been proven successful elsewhere” (Senn, 1998). For our benchmarking we examine global organizations, country based healthcare systems and private laboratories. To paint a complete picture we not only examine the organizations who have the best practices but also those whose systems are experiencing difficulties.

The Organisation for Economic Co-operation and Development (OECD) is one of the global organizations attempting to bring together the approaches taken by its member countries in an attempt to harmonize the global efforts. Most recently it has produced a report reviewing the molecular genetic testing within 18 countries (OECD Working Party on Biotechnology, 2005). This report looked at how genetic testing is procured and funded and the various quality
assurance methodologies. This study surveyed 827 laboratories during 2003. Based on this survey it presented a series of recommendations on molecular genetic services. The specific recommendations relevant to this project are:

Those national and international barriers to accessing genetic testing for rare diseases should be examined and addressed and that the role of cooperation between national and international networks for improving access to genetic testing for rare diseases should be explored.

That the ways in which analytic and clinical validity and clinical utility of genetic tests are currently assessed across different jurisdictions should be explored, particularly for newly-developed tests and tests for rare disease. (OECD Working Party on Biotechnology, 2005)

These recommendations support the approach of benchmarking and looking at what is happening and has happened in other jurisdictions.

6.1 Other Countries and Regions

A variety of different molecular testing strategies and facilities exist in individual countries. These strategies are generally set up utilizing a network model. In a network model some sort of central agency exists that coordinates, and in some cases gate-keeps, access to testing. The testing itself then takes place at individual labs within the network. This model has developed to respond to the commonly held belief that it is inefficient for any individual lab to be set up to test for all diseases. There are some diseases / tests that are complementary in terms of required resources. This coordination also prevents needless duplication. The government of Australia recently sponsored a comprehensive review of these networks across a variety of nations in an effort to jump start their own system (Maxwell & Edkins, 2006). Using their review as guidance, we have identified and researched some typical and leading representative countries.
6.1.1 National Centre for Medical Genetics – Ireland

The population of Ireland is presently reported as 4.2 million, approximately the same as that of British Columbia. Its molecular genetic testing is coordinated through the National Centre for Medical Genetics. Their mandate is to provide “a comprehensive service for all patients and families in the Republic of Ireland affected by or at risk of a genetic disorder” (National Centre for Medical Genetics, 2007). This organization consists of three organizational units that function as a comprehensive whole: a Clinical Genetics service, a Cytogenetics laboratory; and a Molecular Genetics laboratory. The information derived from the service is used for research purposes and the Centre maintains ties to several University-based research facilities. At present the Centre does not provide a service for the genetic screening for Long QT although meetings have been started to consider it.

The most recent report on the state of medical genetics in Ireland was the annual report for 2005 which was issued in July 2006. As of November 2005 the molecular genetic facility had 16.5 FTE’s and was finding itself struggling to meet the demands placed upon it. It had seen an increase of 133% in sample numbers since 1999 with an increase of 16% during 2005. In 2001 and 2002 the laboratory was no longer able to meet the demand placed upon it and had to reduce the repertoire of tests offered by a third. In 2005, 893 samples were sent for testing in labs outside the country (Lynch, 2006).

The lab director noted the impact of this in the report: “It is certain that these tests could be performed more cheaply in-house, if the money was used to hire staff instead of paying for testing abroad...leading to a loss of hard-won expertise from the Laboratory” (Lynch, 2006).

6.1.2 National Health Service – UK

The UK National Health Service has shown clear leadership in the field of molecular genetic testing. In 2002 it established the National Genetics Reference Laboratories. The goal of
thcsc labs was to act as leaders and provide support and standards for the NIHS and its other labs. Specifically their mandate includes:

- Horizon Scanning and Technology Assessment
- Developing new Quality Assessment Systems
- Developing reference and control reagents
- Developing information systems for genetics
- Providing advice to government and other bodies

The NIC also established the UK Genetic Testing Network in 2003 (What is the UKGTN, 2005). This organization was initially set up, funded and given its mandate as part of a white paper published by the UK Department of Health in June of 2003 entitled Our inheritance, our future: realising the potential of genetics in the UK. The funding made available was in the amount of 50 million pounds over three years. The UKGTN’s mandate is

The UKGTN aims to provide equal access to high quality molecular genetic testing services for patients from across the whole of the UK. It is a network of laboratories that offer tests for inherited single gene germ line disorders. All UKGTN laboratories adhere to quality criteria and standards and work within clinical governance arrangements. In addition the tests offered on the network undergo a rigorous process of evaluation to ensure scientific validity and clinical utility. The robust entry requirements and test evaluation procedures ensure an efficient and effective quality service that meets the needs of both patients and clinicians. (What is the UKGTN, 2005)

This mandate and the progress made towards the goals laid out in the white paper are presently under review with an updated report expected by the end of quarter 1, 2007. In regard to Long QT testing, the UK government put forward 1.5 million pounds to fund the development of six “knowledge parks”. One of these parks, the Oxford Genetics Knowledge Park, is presently engaged in a pilot study focused on Sudden Cardiac Death including those caused by Long QT. This program was described in the Oxford GKP Midterm Report released in September 2004 as:

The aim of WPI is to assess whether genetic testing and cascade screening for the Sudden Cardiac Death Syndromes (SCD), which include hypertrophic cardiomyopathy (HCM), dilated cardiomyopathy (DCM) and long QT (LQT), is worthwhile and desirable. The programme evaluates the technical feasibility of offering this as a routine service by the NHs Clinical Genetics labs and the clinical utility of such genetic test information. In addition we are exploring the
cost-effectiveness of such testing and the psycho-social and ethical issues which are raised by it. This proactive multi-disciplinary assessment of a new genetic test is the first of its kind in the UK and provides a model for future service development at the interface of genetics and medicine. (NHS Oxford Radcliffe Hospitals, 2004)

As part of this study the specific health economics of testing for LOTS are being examined: “Detailed costing of the laboratory procedures has been undertaken, giving a price per mutation. A model which evaluates the cost of integrating genetic and clinical approaches to SCD management has been built and the mutation information incorporated in a preliminary analysis. The model also factors in costs saved by discharging individuals who are not carriers from annual screening” (NHS Oxford Radcliffe Hospitals, 2004). As of February 2007 these preliminary results have not have been published. As of December 31, 2006 further entry into this trial was closed due to having enrolled their maximum number of families and Long QT testing is now only available through the regular UK GTN system.

6.1.3 National Services Division – Molecular Genetics – Scotland

Within Scottish National Services, a group of four laboratories operate together as the Scottish Molecular Genetic Consortium (SMGC). This group, which was established in 1985, provides testing for rare genetic diseases as well as providing specific programs for more common diseases such as Cystic fibrosis, Huntington’s disease, Fragile X syndrome, chromosomal microdeletion syndromes and breast, ovarian and colorectal cancers (Maxwell F., 2004).

The present population of Scotland is 5 million, slightly more than British Columbia. Its health care system is comparable to British Columbia’s in the sense that it falls within the jurisdiction of the Scottish Parliament even though Scotland itself is part of the UK (Scottish Executive, 2006).
In 2006 a report was commissioned to examine the impact of genetics on healthcare in Scotland. The mandate of this report was:

To review NHS genetic services in ... and to assess how the current quality of such services in Scotland can be maintained and the potential from present developments in genetics harnessed for the enhanced wellbeing of the people of Scotland, and to benefit academia, the life sciences industry and the NHS in Scotland. (Scottish Executive, 2006)

The Review Group of the network model of the molecular genetic labs of the SMGC were “confident that the model . . . worked well, providing an effective, cost efficient and equitable service for Scotland” and concluded that there had been “clear advantages in such a fast moving field to have central funding and coordination.” The study noted that the main challenges confronting the SMGC were:

- Space constraints
- Rapid obsolescence of equipment
- Under capacity for large scale genotyping to deal with backlogs as well as current demands for mutation analysis in large genes.
- Expensive rapidly developing technology

The study also found that the demands facing the SMGC had been underestimated. Initially it was thought that the demands on the centre would plateau as the backlog of individuals with conditions was identified. Instead the rapid advance and identification of the genetic basis of disease had put strains on the centre’s resources. Specifically,

The situation has been greatly exacerbated by the introduction of rapid testing for chromosomal anomalies by QF-PCR, into the pregnancy screening service. These tests significantly contribute to the 350% increase in prenatal tests done by the laboratories in the last 3 years. However, this huge year upon year increase in activity in molecular genetics has been accompanied by a lesser increase in resources. Over the last 3 years alone, Consortium funding has increased by 24% (including inflation) while over the same period, DNA analyses have risen by 49% and patient reports by 42% (this on top of considerable efficiency gains from 1997 – 2000).

(Scottish Executive, 2006)

In response, the report recommended an immediate rolling capital budget increase of 300 thousand pounds to the SMGC. This recommendation was approved in August of this year.
The following is a table outlining the number of staff and the amounts spent on the molecular genetic testing facility in Scotland:

### Table 6-1 National Services Division SMGC Expenditure and Staff 2003-06

<table>
<thead>
<tr>
<th>Years</th>
<th>Whole-Time Equivalent (Laboratory Staff Including Clerical)</th>
<th>Payments Sheet Total (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yorkshire Lothian Tayside Grampian</td>
<td>Yorkshire</td>
</tr>
<tr>
<td>2003-04</td>
<td>11.75 9.5 6.4</td>
<td>7</td>
</tr>
<tr>
<td>2004-05</td>
<td>14.25 11.9 7.9</td>
<td>7</td>
</tr>
<tr>
<td>2005-06</td>
<td>15.25 11.9 7.8</td>
<td>8.53</td>
</tr>
</tbody>
</table>

Data Source: National Statistics Division of Scotland.

### Table 6-2 Total Number of Patient Reports Issued by SMGC

<table>
<thead>
<tr>
<th>Years</th>
<th>Total Number of Patient Reports Issued by SMGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-04</td>
<td>9,758</td>
</tr>
<tr>
<td>2004-05</td>
<td>11,902</td>
</tr>
<tr>
<td>2005-06</td>
<td>14,200</td>
</tr>
</tbody>
</table>

(Scottish Executive, 2006)

Although it was not in our mandate to do a comprehensive qualitative review of the relative molecular genetic laboratories, upon reviewing the high level numbers retrieved during the course of our report, we felt we would be remiss if we did not share our findings. We feel this is especially critical given the fact that the numbers paint such a different picture than the one given by the document that started the strategic initiative resulting in the PI.CO.
Table 6-3  Funding and Staffing Across Surveyed Molecular Genetic Labs

<table>
<thead>
<tr>
<th>Region</th>
<th>Samples</th>
<th>Staffing</th>
<th>Samples per Staff</th>
<th>Funding per Sample</th>
<th>Dollars per Sample</th>
<th>Funding per Capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGL</td>
<td>4000</td>
<td>8</td>
<td>500</td>
<td>$806,554.45</td>
<td>$201.64</td>
<td>$0.19</td>
</tr>
<tr>
<td>Scotland</td>
<td>12018</td>
<td>41</td>
<td>293</td>
<td>$6,304,305.35</td>
<td>$524.57</td>
<td>$1.26</td>
</tr>
<tr>
<td>Ireland</td>
<td>5327</td>
<td>16.5</td>
<td>323</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 6-1  Samples Processed per FTE

This graph shows that at present the MGL is processing considerable more samples per FTE than either Ireland or Scotland. This is especially impressive given the Scottish system’s reputation for efficiency (Scottish Executive, 2006).
Although the report issued by Bayne (2001) notes the dangers of comparing molecular genetic labs in terms of funding per capita, the overall analysis of that report uses that methodology when comparing the labs in BC vs. other provinces. In order to allow for a comparison we will use the same method. The findings of Bayne’s report suggested that in terms of funding per capita the lab system within BC was inefficient when compared to other provinces.

The above graph separates out the MGI, and compares it in relative terms to the world class Scottish labs.

The above two graphs suggest that the MGI is extremely efficient and is in fact underfunded compared to Scotland’s laboratories. As noted in our overview of the Scottish system, a recent review of that system found it was underfunded. As a result the Scottish parliament increased its budget by adding an additional amount of 300 thousand pounds to its budget per year. This increase represents a number close to the entire existing budget of the MGI.
6.2 Private Laboratories

6.2.1 Genônia - Belgium

This network is a for-profit group of laboratories centrally coordinated through the main facility located in Antwerp. These labs are located not only in Belgium but also in Australia, Canada, the USA and other countries in Europe. All samples are sent to a central lab which in turn sends them out to the appropriate “expert” lab that specializes in the particular test. Genônia presents the advantages of this approach as increased access to a wider array of tests than would normally be available to a single provider, lower costs due to increased volumes brought in by its international scope and independent quality assurance activities. None of these claims are backed up by qualitative metrics. At present Genônia does offer several different forms of Long QT testing. Testing of KCNQ1 and HERG is priced at 850 Euros while a more complete test for KCNQ1, HERG, SCN5A, KCNE1 and KCNE2 would be 1850 Euros (Genônia, 2007). The MGI at Children’s Hospital has worked with Genônia in the past.

6.2.2 PGxHealth

PGxHealth is a for-profit laboratory owned by the publicly traded corporation Clinical Data. PGxHealth is focused on developing patent protected molecular genetic tests and providing them on a fee-for-service basis. At present it markets a test called FAMILIION which is targeted at detecting cardiac channelopathies including Long QT Syndrome. At present the cost for this test is $5400 US for the first member of a family to be tested and $900 US for each additional member. In addition to this test PGxHealth is active in pharmacogenomics. It offers several tests designed to screen for adverse reactions or drug efficacy based on a patient’s genotype (Clinical Data, 2006).
6.3 Canada

At present there is no central body within Canada to coordinate molecular genetic testing. This is most likely a result of health care being under the jurisdiction of the provinces with no centralized coordinating body. In 1991 the Science Council of Canada (since disbanded) put forward a paper entitled *Genetics in Canadian Health Care*. In regard to molecular genetic testing it found that there was a uniform lack of funding and lack of planning with respect to the anticipated increased demand on genetic testing services across the nation (Science Counsel of Canada, 1991).

Ontario has examined the effects of molecular genetic testing on health care. In 2001 a report was delivered to the Ontario Ministry of Health entitled *Genetic Services in Ontario: Mapping the Future*. This report called for the Ministry to provide for equitable timely access to genetic testing services. It also suggested that

[In some cases, the rarity of some genetic disorders requires that specimen samples be sent out of the province. Meanwhile other jurisdictions will send specimens for other rare tests to Ontario. Consideration should be given to the development of a policy that permits the use of laboratories in other jurisdictions (Ontario Ministry of Health, 2001).]

As a follow up to this report Ontario delivered a subsequent examination of this issue on a Canada-wide basis to the Premiers. This report was entitled *Ontario Report to Premiers: Genetics, Testing & Gene Patenting: Charting New Territory in Healthcare*. A key recommendation of this report was to “gradually evolve regional centres specializing in certain forms of testing” while coordinating these regional efforts on a Canada-wide basis (Ontario Ministry of Health, 2002). As of the writing of this report no apparent progress had been made on implementing this recommendation.

Presently three bodies exist at a federal level with a mandate in genetics. These are the Institute of Genetics, the Canadian Genetic Disease Network and Genome Canada. The Institute
of Genetics' strategic plan lists its mandate as "to support research on the human and model genomes and on all aspects of genetics, basic biochemistry and cell biology related to health and disease, including the translation of knowledge into health policy and practice, and the societal implications of genetic discoveries" (Institute of Genetics, 2004). In practice, this organization is focused on providing funding for research and does not provide any centralized coordination.

The remaining two organizations have similar mandates and are also focused on providing funding for research rather than any sort of coordination around clinical based testing.

6.4 Analysis of Benchmarks

For our analysis of the selected benchmarks we utilize the strategic lens of experience, design and ideas (Johnson G, 2002). The lens of experience weighs what has happened in the past for an organization and encompasses the fact that strategic direction tends to be evolutionary and adaptive to its environment. Design looks at how the benchmarked systems have used analytics, structure and direction to achieve their goals. The ideas lens considers how the laboratories have managed to support the emergence of order and innovation from the environment of variety and diversity that surrounds genetic testing in a clinical setting.

By examining these benchmarks through the three lenses we hope to provide insights toward how to move forward.

6.4.1.1 Experience

The successful experience of the UK Genetic Testing Network (UK GTN) shows that a holistic system-wide approach to molecular testing is effective. Through its centralized and rational approach the UK GTN has managed to put in place a system that has enhanced health care while also providing an enabling environment for research and its related economic spin-offs. This can be directly seen in the increased number of tests available for use by clinicians. When the UK GTN started offering genetic tests, it had tests available for 253 diseases through labs
based in the UK (UK National Health Service, 2003). As of January 1st, 2007 its directory includes tests for 361 diseases, with 6 more tagged for test development (UK National Health Service, 2007). Its network approach was based on the leadership of the Scottish Molecular Genetic Consortium which was started in 1985. This shows the evolution of the strategy that today is providing effective and efficient care.

In the past this approach was seen within Canada as having merit and reports providing recommendations were put forward in 1991 and again in 2002. None of the efforts to date seems to have produced sustained measurable results within Canada. That the case for molecular genetic testing was put forward convincingly in these papers suggests that at some point we can expect to run into one or more systemic issues that derailed the previous efforts and that we need to proactively formulate strategies to deal with them. Fully identifying these issues is beyond the scope of this project since we are focused on Long QT testing within British Columbia. Even so, it is apparent that the most obvious difference between the National Health Service and healthcare in Canada is an environmental one. Canada, unlike the UK, lacks a strong centralized body with a mandate to set and enforce health care policy in the form of the NHS. The lack of this centralized organization in Canada could have a strong environmental effect that could result in similar initiatives failing. By constraining our project to the province of British Columbia we will be somewhat mitigating the environmental effects of this. Scotland, with similar size, has managed to build a world-class molecular genetic testing centre that is handling the rapid growth in this area in medicine.

Ireland contrasts with Scotland. Its lab seems to have no clear strategic direction and is receiving an inadequate amount of funding, although slightly more than the MGI in British Columbia. As a result it is having trouble with staff retention and, by sending out the majority of its work, it is in effect funding the increased effectiveness of its neighbour’s health care system.
6.4.1.2 Design

The strategic approach taken by our leading benchmarked health care organizations is design driven. The UK, Scotland and Australia to some degree are all clearly following the logical rational analytic path that is characteristic of strategic design. In addition, they are making full use of analytic and evaluative tools to make sense of the complexity of issues around molecular genetic testing. The most successful programs (i.e. the UK GTN) have the most structured design driven approach and are actively revisiting the analytics to ensure that they are continuing to meet their mandate and improve with time.

For molecular testing in British Columbia, this suggests that any eventual program should also take a strong analytically driven design perspective. Furthermore, it lends credence to putting in place metrics to measure the success of Long QT testing in order to enable an analytic approach.

The OECD suggested in its recommendations that networks be built at an international level to improve accessibility to genetic testing. Certain countries are taking a design related approach and setting up internal networks. Within the European Union these networks are starting to be extended between countries. In Canada this was also studied and recommended even though no action has taken place.

This suggests, for our specific situation in British Columbia, that we design and set up our processes around Long QT testing to be able to fit into a potentially larger network. It also provides background and context for British Columbia taking a leadership position within Canada for either molecular genetic testing as a whole or to at least rare disease molecular genetic testing within an eventually overall designed network. More specifically, it clearly shows that molecular genetic testing belongs in the design of the PHSA with its mandate to provide central services to the health authorities.
6.4.1.3 Ideas

Our benchmarked organizations are putting processes and linkages in place that enable innovation. The UK GTN in particular has recognized that the science in this area is rapidly progressing. It has created defined pathways for research to move from academia into direct clinical contexts that will benefit patients. It has also put in place clear lab certification requirements that allow the private sector to provide some tests (UK Genetic Testing Network, 2006). This allows for innovations in molecular testing and processes that might not have come from a purely public approach. This approach also allows for an increase in capacity while maintaining the standards and regulations of the overall system. It also encourages private organizations to base their research centres in the country and assist in building up the UK as a pharmacetical cluster.

6.4.1.4 Lessons Learned from Benchmarking

The analysis of the benchmarks through the lens of ideas, experience and design brings the differences in the benchmarked countries into sharper focus. It highlights how the three are really related and require each other. Ireland has a similar design but its weaknesses and lack of linkage in ideas and experience is making the network design ineffective and as a result the system as a whole is struggling.

6.5 External Benchmarks Conclusion

Our analysis so far focuses on benchmarks, strategic alignment and possible alternatives. Taken as a whole these areas show emergent properties. The benchmarking suggests that the most effective and efficient model for molecular genetic testing is to establish a holistic system that is responsible not only for molecular genetic testing but also for its clinical use, provision of new tests, transition of research into practice and genetic counselling at a national level. Past experiences suggest that extending such a network across Canada through design will not be
possible. The establishment of a Long QT test within BC clearly fits within the strategic direction of the PHSA and Ministry of Health. The available alternatives (external sourcing and the status quo) have many negative aspects. This conclusion is reinforced by the fact that one of our benchmarked countries establishes that external sourcing can lead to a vicious feedback loop in which the public system becomes weaker and weaker, leading to a decline in clinical performance, research and the economic spin-offs. Taken together these facts suggest that a possible way forward would be to establish a Genetic Network similar to Scotland’s within the PHSA while using Long QT as a test case. The question still remains as to whether the MGL will be able to move forward given the stakeholders that will be required to become involved in order to have the test successfully implemented.
7 STAKEHOLDER ANALYSIS

The goal of stakeholder analysis is to evaluate and understand the characteristics of organizations, individuals and groups likely to influence or be affected by a policy or project (Brugha R, 2000). For the purposes of this report we look to this analysis to provide us with information regarding the likelihood of the LQTS testing initiative being successful given the specific context of the MGI. To do this we focus on the characteristics of interest (present awareness of the project), influence (over other stakeholders), resources (to potentially contribute to project), and support of molecular testing for the Long QT syndrome. We also express the uncertainty within each rating. Ultimately it would be desirable to have little to no uncertainty, however, scope and time constraints have made it impossible to have the degree of engagement with each individual stakeholder this would require. To provide insights into the stakeholders, we analyze these by using a series of graphs making visible the most important stakeholders. In order to orient the MGI within this web of stakeholders, it is important to note that the MGI reports to the Site Director at the BC Children’s and Women’s Hospital, then to the Executive Medical Director of PIISA Laboratories, and ultimately, to the CEO of the PHSA.

7.1 The Provincial Health Services Authority (PHSA)

PHSA has responsibility over all centrally delivered health care for the province. Their interest in a single initiative like this will be low given how large their size and mandate is. However this is mitigated by the fact that their annual report specifically mentions the ongoing pressure in regard to clinical genetics. The organization has direct authority over this area of health spending so their influence and resources are high. Included within this section are all divisions that are part of the PHSA and qualify as stakeholders.
7.1.1 Department of Paediatrics – Division of Cardiology

The Children’s and Women’s Hospital (C&W) is one of the entities within the PHSA. Its department of Paediatrics has a specialty cardiac unit and a representative of that unit is one of the members of our steering committee for this initial part of the project. Their interest in this project is high as Long QT testing as a direct impact on clinical care for their department.

7.1.2 BC Provincial Medical Genetics Program

The provincial medical genetics program is located at C&W. The services offered include: “assessment, diagnosis, and genetic counselling for birth defects and genetic diseases; prenatal genetic evaluation; and counselling. The program offers both inpatient and outpatient consultations.” (BC Women’s Hospital & Health Centre, 2007). Long QT testing would have a direct positive impact on the services offered by the MGL. As the mandated provincial centre for genetics they should have a strong interest and influence.

7.1.3 Provincial Laboratory Coordination Office (PLCO)

The PLCO is presently transforming how laboratories are managed in British Columbia. To date most of their work seems to be focused on pathology labs rather than the molecular genetics lab. The procurement of a new test and related capital expenditures might be of high interest to them. Anecdotally, we have heard from unrelated parties that the PLCO is mired in political problems as well as change management issues. The political status and issues with this initiative make these suppositions relatively uncertain.

7.1.4 The Centre for Translational & Applied Genomics (CTAG)

CTAG is a genomics and molecular pathology laboratory primarily based at the BC Cancer Agency and BC Centre for Disease Control. Its mission is “to develop novel laboratory tests to improve the management of a diverse spectrum of disorders including cancer, infectious
diseases, and inherited syndromes” (BC Women’s Hospital & Health Centre, 2007). At present
CTAG offers its services to both the public health system and private companies. The centre’s
interest and influence in regard to developing a test for Long QT will be high. At present their
level of support is unclear.

7.1.5 PHSA Cardiac Services

PHSA’s Cardiac Services division’s mandate is to support cardiac care in BC. Long QT
testing will directly impact cardiac care province-wide and their interest has been confirmed.
They have considerable resources and this test could be the first of many to support their
mandate.

7.2 BC Patients

Long QT testing itself only affects a small segment of the population. However, for those
patients it obviously is a major issue. The influence of the patients would normally be low but it
is multiplied by the political effects of the media and historically Long QT has received press
coverage.

7.3 BC Research Programs Affected

BC does have significant research programs that would be impacted by the provision of
Long QT testing.

7.3.1 Children and Family Research Institute

The Children and Family Research Institute is focused on women and children’s health
and is partnered with Women’s and Children’s Hospital. Genetics is recognized as one of its
cross functional “themes”. Laura Arbour is one of the researchers in this area and presently
working on a project to examine Long QT syndrome in BC First Nations population (The Child
& Family Research Institute, 2006). Accordingly, interest will be high.
7.3.2 icapture Centre

The icapture Centre is “[d]iscovering the links between genetics and the environment that will lead to better treatments for cardio-pulmonary diseases” (iCAPTURE Centre, 2007). It has a focus on analyzing the genotype and phenotypes associated with cardiovascular disease. At present none of its research is tied to Long QT syndrome but it does have an interest in molecular genetic testing in relation to cardiovascular disease.

7.4 British Columbia Ministry of Health

The BC Ministry of Health has two key motivations. The first is to supply cost effective solutions to patients of BC. The second is political in nature. This project has the potential to positively affect both. However, because the Ministry of Health is the “top of the pyramid” supplier of the budget for the Molecular Testing Lab and in terms of its overall mandate the Long QT test itself is a very small component, the interest at this level will be low.

7.5 Other Province Ministries of Health

The ministries of health of the other provinces represent both potential clients and competitors. At present they are sending their Long QT testing out of country or relying on one-off testing done at research focused facilities. If the Long QT test is offered at a price and quality better than that of the competing labs their support for this initiative will be high. One province has already contacted the lab to inquire about the availability of Long QT testing. On the other hand the provinces compete with each other on an economic basis. Many see knowledge industries such as the life sciences as critical for their economies and could see this initiative as a threat. The fragmented nature of health care and lack of coordination in Canada acts a limiting factor to their influence.
7.5.1 Public Out of Province Molecular Genetic Labs

Out of province molecular genetic testing labs have an interesting relationship with this project. The labs themselves are competing for resources and research grants. They are also potentially clients and would have influence on the ministries of health in their respective provinces. Some of the major labs that would fall into this category include The Centre for Applied Genomics at Toronto Sick Kids, the Canadian Cardiovascular Genetics Centre at the Ottawa Heart Institute and the Molecular Genetic Laboratory at Children’s Hospital of Eastern Ontario.

7.6 For Profit Labs

There are two for profit labs whose business model could be affected by BC offering a test for Long QT testing. These are PGxHealth and Gendia. Both of these were discussed in Chapter 2.1. Of the two of these, PGxHealth would be a direct competitor as the Familion test is one of its only streams of revenue and it is presently servicing the Canadian market. Gendia could end up being a potential source of revenue rather than a competitor. At the present time the MGI has an existing relationship with Gendia and offers a test for another genome through them. This existing relationship could be leveraged to increase the potential market size for the LQTS.

7.7 Public Genetic Research Organizations

There are several agencies focused on genetic research in Canada with surprisingly similar mandates to that of the MGI. These include Genome Canada (and its subsidiary Genome British Columbia), the Canadian Genetic Disease Network and the Institute of Genetics. These organizations represent potential sources of funding. They provide grant-based funding supplied through competitions.
7.8 Canadian Non Profit Organizations

There are two Canadian Non-Profit Organizations that would be stakeholders in a genetic test for Long QT syndrome. These are the Canadian SADS Foundation and the Heart and Stroke Foundation. The SADS Foundation has a particular focus on Long QT syndrome as its mandate is "to save the lives and support the families of children and young adults who are genetically predisposed to sudden death due to heart rhythm disorders" (The Canadian SADS Foundation, 2007). Both represent potential sources of funding for the test as well as ways to market the test through their influence.

Table 7.4 Stakeholder Rating

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Interest</th>
<th>Influence</th>
<th>Resources</th>
<th>Support</th>
<th>Uncertainty</th>
</tr>
</thead>
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<tr>
<td>PHS4</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Paediatric Cardiology</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
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<tr>
<td>BC Provincial Medical Genetics Program</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Provincial Laboratory Coordination Office</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
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<tr>
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<td>4</td>
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<tr>
<td>PHS4 Cardiac Services</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>BC Patients with Long QT</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Children and Family Research Institute</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>ICapture Centre</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>BC Ministry of Health</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Other Ministries of Health</td>
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<td>2</td>
<td>5</td>
<td>3</td>
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<td>Out of Province Genetic Labs</td>
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<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Gendia</td>
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<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PGxHealth</td>
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<td>1</td>
<td>1</td>
<td>1</td>
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<td>Public Genetic Research Organizations</td>
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<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Non Profit Organizations</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

(Note: 5 high 1 low)
7.9 Stakeholder Analysis

All projects have a limited amount of resources and time. As a result, project leadership ought to focus efforts towards stakeholder management on those stakeholders most critical to success. Which stakeholders are the most critical is shown below:

7.9.1 Targeted Stakeholders

Figure 7.1 Targeted Stakeholders' position on influence and support

The graph shows Influence vs. Support with the goal of illustrating the most significant stakeholders that should be targeted with additional attention. The size of the bubbles shows the level of resources available and the colour indicates how confident we are in the information.
provided based on the limited scope of this report. The most critical stakeholders are: CTAG, PLCO, Cardiac Services, PHSA, BC Ministry of Health, Other Ministries of Health, Out of Province Laboratories, and PGx Health.

For this project to be successful there needs to be targeted efforts towards these key stakeholders in three different ways. Firstly, the organizations highlighted in red need to have formal contact established and potentially be brought in on the project. This will eliminate the uncertainty of the positioning of these critical organizations. Organizations in this category include the Provincial Lab Coordination Office, PHSA and CTAG.

Secondly, any organizations located below the middle support line either need to have their level of support increased or conversely their impact minimized by reducing their influence. Ultimately it would be more desirable to have buy-in from every stakeholder but this will most likely not be possible due to conflicting goals. PGxHealth is a good example of this sort of stakeholder. The offering of a Long QT test is an automatic conflict so their influence should be minimized. Due to the competition between provinces, other Ministries of Health have been placed below the neutral line of support. By engaging with them and demonstrating economic advantages to sending their tests to the Molecular Testing Lab, it should be possible to gain support and move them up the graph.

Finally, organizations to the far right have the greatest influence on the project. They should receive a disproportionate amount of resources devoted to meeting their needs going forward in order to move them firmly into the upper right quadrant of the graph.
This graph shows all of the stakeholders with a support level of 4 or 5. This represents the potential core support for the project. The size of the bubbles represents their current level of interest/engagement with the project. The stakeholders with a current interest level of 1 are highlighted in red while those with 2 are highlighted in yellow, and those in green are interest levels of 3 or more. In addition, the stakeholders have been placed in terms of their influence and resources. When taken together this graph illustrates two ways forward in terms of stakeholder management. Firstly, the upper right quadrant contains the stakeholders that have the potential of contributing the most towards the success of the project if their interest is raised. These therefore represent the first priority of any stakeholder management activities. Secondly, this graph should...
be renewed periodically since it functions as an effective scorecard for successful stakeholder management. Successful stakeholder management will result in the number of organizations and size of bubbles on this graph increasing with time.

7.10 Stakeholder Analysis Conclusion

At the present time the analysis identifies the PHSA as a critical stakeholder. Immediate attempts should be made to engage senior PHSA management and gain their support. It is also logical to establish contacts with the PLCO and CTAG to remove any uncertainty and raise their levels of support. Finally, we would suggest formalizing the initial contacts made with outside Ministries of Health in order to start to position them as potential clients. Stakeholders are not static. Who is and is not a stakeholder will change over the course of any project or initiative. In addition, the characteristics of the stakeholders will change over time. This analysis captures a single point in time and should be repeated at each logical juncture of the project. This exercise guides the use of the limited time available for stakeholder management activities.

Overall, it is clear that there exists a complex web of stakeholders that will prove to be crucial to (a) lobbying for funding for the LQTS testing service; (b) the establishment of this service; and (c) the success of the venture. The importance of the stakeholder web in which the MGL operates cannot be overstated. Support from the ‘right’ stakeholders for the MGL’s LQTS initiative, and conversely, opposition to the initiative, have the ability to make or break the MGL’s chances of success. Stakeholder management must be proactive and constant. The inertia observed at the national Ministries of Health level suggests that the challenge is considerable, but it also suggests that a champion may be the necessary spark required.
8 RECOMMENDATIONS

Through the course of this report it has become clear that the clinical case for Long QT Testing is conclusive, the MGI has the ability to deliver the Long QT Test, and the delivery of this test is appropriate. Although we do foresee challenges, there is a strong likelihood of the MGI succeeding if it moves forward with a project to deliver this test as a service to the British Columbia health care system and beyond.

The analysis also has revealed some systemic issues. The unaddressed nature of LQTS testing in BC is merely a symptom of a wider problem that can only worsen as the use and relevance of molecular genetics in medicine increases in importance. It is important to emphasize that if further tests are considered, they should not require the same level or degree of rigorous analysis around the MGI, and its situation. Further evaluations for the testing for other diseases should focus on the clinical and business case.

The more specific recommendations that follow are divided into sections that address LQTS specific recommendations (8.1), recommendations specific to the MGI (8.2), system-wide recommendations (8.3), what success will look like as well as how to measure it (8.4), risks inherent in the project (8.5), lessons learned during the process of investigating this problem (8.6), and the next steps required for LQTS testing to become a reality for BC families (8.7).

8.1 Long QT Test Recommendation

We recommend completing the business case for Long QT testing. The case for providing a test for the Long QT genotype is clear both in clinical and health economics terms. The provision of a Long QT test is good strategic fit at all levels of the organization. The external
analysis supports the Molecular Genetic Testing Laboratory at Children’s and Women’s delivering this test as a service inside the province and beyond. Further steps are required before full funding and offering of Long QT as a service should proceed as a project. These include the production of a full business case with complete financials. Section 8.6 lays out the next steps forward in more detail.

The goal of the LQTS project should be to not only increase the level of care offered to British Columbians, but to benefit from some cost recovery. The project has the potential for the MG1, to earn revenue for testing of out-of-province patients. Given the present financial state of the MG1, this revenue is sorely needed.

The LQTS proposes meets the goal of the Department of Pathology & Laboratory Medicine, which is to “provide critical tertiary-care diagnostic consultation and services on which vital decisions are made in the care of patients. It is also dedicated to research and teaching in paediatric and obstetric laboratory medicine through the application of specialized consultative expertise in diagnosis, screening and monitoring” (Medicine, Department of Pathology & Laboratory, 2007). The establishment of a LQTS testing capability at the MG1 will address these goals in a variety of ways.

With the successful implementation of the LQTS test, the laboratory will achieve benefits linked to organizational learning. As the MG1’s staff becomes more familiar with the new test, the associated technology and the management of the LQTS program, the added skill and expertise will benefit all other testing within the laboratory.

It is also hoped that conducting cutting edge research and offering the latest standard of care will attract talented researchers, therefore increasing the expertise in the laboratory and beyond. Academic cardiologists may be attracted to Children’s and Women’s Hospital by the
advanced diagnostic support and research capabilities of the genetic laboratory. Similarly, the infrastructure and expertise gained would make the MGL more attractive to large international multi-centre studies, enhancing the profile of researchers in British Columbia. The LQTS testing program is also expected to support the academic mission of the hospital by creating the opportunity for staff to publish a greater number of high quality papers due to the production of sophisticated laboratory data. As highlighted earlier, there is limited data available regarding the incidence and prevalence of LQTS and related cases of SIDS or unexplained sudden cardiac death. The establishment of a LQTS testing would create a more cost-effective means to begin to rectify this scarcity of information. Lastly, the successful implementation of a LQTS testing service within British Columbia will enhance the MGL’s track record for out-of-province testing, thereby building the first step to having a portfolio of tests that enable the MGL to engage in further cost recovery.

Initially this service will be available to all BC residents as selected by cardiologists and other appropriate clinical gatekeepers. The details of how this selection will be conducted, and who will do the selecting is beyond the scope of this project. However these details will be essential in determining the logistics and feasibility of the service. Upon the successful initiation of the service, the MGL will open the service to all Canadian provinces on a fee-for-service basis. The MGL is reasonably confident that Ministries of Health from other provinces would make use of the service as long as the fees were less than the commercial alternative in the United States.

8.2 Molecular Genetic Laboratory Recommendations

We suggest that the Molecular Genetic Laboratory undergo an immediate funding review.
This funding review could be conducted by either doing a detailed and comprehensive benchmarking exercise or more quickly by using the standards set by one or more of the leading systems in Europe.

8.3 System Wide Recommendations

There clearly is a need for a comprehensive country-wide approach to rare genetic disease testing. This is not unique to Canada as we saw in the review of other nations. Due to the nature of the start-up capital expenditure, the most economically effective rare disease testing will service the largest possible population. This was noted in the document Report to Premiers: Genetics, Testing & Gene Patenting: Charting New Territory in Healthcare and is further validated by similar research done by the UK and Australia (Maxwell & Edkins, 2006) (UK Department of Health, 2003). More specifically within British Columbia, this approach was also validated by the Lab Services review, wherein it was observed that programs “offered through Health Authorities, are not amenable to funding by population-based formulae since program costs are significant and fixed” (Boyne, 2003).

From the perspective of British Columbia, even in a compelling case such as Long QT Syndrome, the smaller populations associated with rare diseases make it difficult to put in a cost effective infrastructure and supply the tests to the province’s population alone. However, experience suggests that a coordinated Canada wide approach is not likely to happen given the competitive nature of the provinces, the de-evolved nature of the present health care system and the lack of any body with a mandate or authority to put this in place at a Canada wide level. Doing nothing is not an option since the demand for molecular testing is increasing within BC. Nor is this demand unique to British Columbia. It is validated by similar numbers globally (Lynch, 2006) (Scottish Executive, 2006). A solution needs to be put in place that addresses and recognizes the unique nature and demand of molecular genetic testing in comparison to the rest.
of the laboratory system. If this is not done, the pressure on our provincial system will continue to worsen, likely resulting in both poor health and political outcomes.

Based on this supposition, an opportunity is presenting itself for the British Columbia health care system and the Molecular Genetic Testing Lab in particular. It is our suggestion that the lab leverages the initial opportunity presented by the Long QT syndrome testing to position itself to become a centre of excellence for rare genetic testing for Canada. This would be done by taking a market driven approach and actively seeking out testing revenue derived from other provinces. Additional revenue could be derived on a global basis with limited effort through leveraging the MGL’s established relationship with Gendia. Although it is beyond the scope of this report to flesh out this in detail, initial suggested actions include the following:

1) Establish a formal network linking CTAG, the molecular genetics lab at BC Cancer and the lab at Children’s and Women’s. These would remain independent entities but increase their level of communication and coordination. Molecular genetic labs face unique challenges and should be considered outside of the regular laboratory services. Again, this is not unique but based on the benchmarks.

2) Collect a portfolio of potential rare diseases that have no testing in place in Canada. A simple and clear process for doing this should be put in place and communicated outward to potential clients.

3) Provide a set of clear metrics that will be used to measure the testing of rare diseases in order to be able to weigh them against each other. These metrics could include such things as the cost per life year, population affected, etc. This will allow to MGL to properly focus limited resources. Basing the decision making on clear metrics will also forestall any charges of favouritism. This could be rapidly done by co-opting the methodology and metrics presently used in by the UKGTN.
process could be enabled by an off the shelf software tool such as Microsoft Portfolio Server, therefore lowering start up costs.

4) Establish a committee specifically related to molecular genetic testing. This group should be empowered with the necessary authority to provide funding and approval for moving forward with tests that meet the agreed upon criteria. Alternatively, this committee may make recommendations to the Ministry of Health or spearhead a committee within the Ministry of Health budget group. A sub goal of this committee would be to coordinate the resources necessary to successfully integrate a new test into the British Columbia health care system. This would include but not be limited to genetic counselling, clinical resources, laboratory services, training and communication. The network established by item 1 would be a clear first step towards this. The importance of this system based approach cannot be emphasized enough. Research has shown that the positive diagnosis of Long QT Syndrome has a measurable psychological impact on the affected individual and the family (Hendriks K., 2005) (Varnoworth M., 2005) and our health care approach must take this into account.

5) Establish the systems and processes necessary to collect metrics related to genetic testing in order to measure success in a quantifiable fashion. This is more specifically addressed in Chapter 8.3.

6) Connect with the key decision makers in other provincial ministries of health involved in the procurement of rare genetic disease testing. The goal of this would be to establish master standing agreements for any specific tests developed by the centre for a period of multiple years. This would allow for reduced risk and a clear predictable cash flow.
7) Formalize and extend the existing relationship with Gendia to bring in additional revenue.

8) Measure performance of molecular genetic testing in BC against applicable organizations globally and make adjustments. At this time no province in Canada is a leader and therefore if benchmarking is conducted against the approach of other provinces to molecular genetic testing, BC runs the risk of mirroring an ineffective system. Most other countries have taken a network approach to their molecular testing so it would make more sense to compare the network within BC against rather than the MGI.

The establishment of this centre would enable world class care for British Columbians. It also would have economic spin offs related to attracting and retaining better staff, providing the infrastructure for research and giving additional support for the growth within the local biotech cluster.

8.4 Measuring Success

The PHSA and its agencies use balanced scorecards to measure the success of their strategic initiatives (Provincial Health Services Authority, 2006). Balanced Scorecards measure success in terms of Financial, Customer, Process and Learning and Growth. The idea behind this approach is that the successful implementation of the right strategy will show demonstrated change in a key related metric or measure (Kaplan & S, 1992). The Financial perspective typically looks at items like cash flow, return on investment, revenue, etc. The Customer perspective consists of metrics related to the satisfaction and impact on customers of the goods and services produced by the organization. Typically this includes such things as delivery time of
a product, its quality and performance. Business Process focuses on measuring the performance of the key business processes directly related to meeting the customers needs and satisfaction -- for example, a measurement of the number of defects (quality) in the goods produced using a new process. Finally, the Learning, Growth and Innovation part of the scorecard looks at metrics related to how the organization is learning and changing. For example, the length of time required to produce each new product or the number of employees certified in using a new machine.

More recently Kaplan and Norton (2006) in their article *How to Implement a New Strategy Without Disrupting Your Organization* have emphasized that strategy set at the corporate level needs to take into account the different operational challenges and environments across their business units. Scorecards from one unit will not magically “roll up” and match those from another. Any attempt to do so will cause disruptions and inefficiencies. A molecular genetics lab is different than a pure research lab or one focused on blood samples for example. The solution offered by Kaplan and Norton is to take the corporate strategy system based around the balanced scorecard and to integrate in business unit priorities and realities. Put more simply, the strategy and actions pursued by the individual unit should be one that is tailored to their unique situation while directly contributing to the strategic direction of the overall organization. The suggested methodology for this is to integrate, action, theme and measurement at the business unit level (Kaplan R, 2006).

In this case we will use the PIISA and its strategic directions as the umbrella organization for the MGL. This makes logical sense as the Molecular Genetics Laboratory is one of its business units. The PIISA’s stated overall goal is “Better Health for The People We Serve”. To fulfill this they have set four strategic directions which map to the “themes” approach suggested by Kaplan and Norton. Its strategic directions are defined as Operational Excellence, Knowledge and Innovation, System-Wide Improvements and “Prevention, Promotion and Protection”
8.4.1 Operational Excellence

The core operational activity of the Long QT Test will be the actual testing of the samples themselves. Improvement and optimization of this reasonably falls within the strategic theme of Operational Excellence. As the Long QT testing will be a new process, we are assuming that the design of the process itself will be scalable, of maximal efficiency and effective and the metrics should reflect this. Since the initial implementation of the process will really be a project rather than a process, we focus on the running of this process post implementation.

From a Learning and Growth perspective it would be advantageous to see increasing skills on the new systems among the MGL’s staff. This could be a result of learning on the job, formal external training and cross-training done by internal staff. A valid measurement of this would be the number of people qualified on the base equipment and related process.

As the staff skill levels improve we would expect corresponding improvements in process outcomes. We would expect to see a more optimal usage of the equipment and less waste in materials. These could be measured by chips used vs. tests performed on a monthly basis.

From the improvements in learning and process we would expect be able to measure decreased turn around time and accuracy of results. Both of these have been confirmed as being important and desired client outcomes from both patients and clinical customers.

Finally, from a financial perspective it makes sense to look at the cost per test performed. It is part of the PHSA’s strategy to provide cost effective health care and for this process to be judged a success it should be producing the test results at a cost below that of the Familion test from PGxHealth. Additionally, keeping the test cost at a low level will directly increase the profit resulting from a selling of the test to external agencies.
8.4.2 Knowledge and Innovation

The data collected during Long QT testing has the potential to support research within British Columbia. To ensure that this comes to pass it is necessary to establish connections with the appropriate research agencies (such as those identified in Chapter 3.4). Therefore, the increase in the number of agencies contacted should be considered as a metric for the Learning and Growth Scorecard. Different types of research will require additional information about the patients beyond that of the Long QT test result itself. It would make sense to put in place a knowledge management process for the appropriate information to be supplied to the researchers in a way that is efficient while also protecting privacy and meeting ethical standards rather than dealing with each research request in a one-off manner. If this process is working well, the data delivered to the researchers will be robust and complete. This could be measured by the number of times the data is requested as well as the number of papers published utilizing it. The number of papers published is a metric that is almost a type of desired financial outcome so it has been positioned in the border between the two scorecards. High number of published papers indicates high level of research which often turns into more funding. So finally, if this process is working overall we should see a direct financial result of more money being awarded to research based on or related to the Long QT test.

8.4.3 System Wide Improvements

The PIISA defines its role in “System Wide Improvements” as follows: “PIISA can provide leadership, facilitation and support to identify opportunities for system-wide improvement in the health system. Improvement will mean a more seamless, integrated system that provides continuity for our patients and providers” (Provincial Health Services Authority, 2006). As identified in our recommendations, the Long QT test is a specific opportunity for the PIISA directly related to this. Therefore, measuring the metrics related to setting up the
process/system integrating care related to the Long QT test falls under this theme even if it is somewhat out of the mandate of the MGL itself.

In terms of learning and growth, the completion of the initial plan to support this integrated approach is a logical binary metric. Directly following on the business process area would be the setting up of the process integrating the care around the test itself. Once the process was up and running it would make sense to measure a metric directly related to the process itself so that efficiency could be directly measured and improvements made.

From a patient perspective, the process around the Long QT test should provide a more complete set of services without the patients having to pursue them as individual non-related services. To measure this, one could capture the number of Long QT referrals provided through the process to the medical genetics group.

Finally, from a financial perspective we should see two different outcomes. The first is increased patient treatment efficiency. Long QT patients should have a clear path through the system. Initially a logical metric to judge this would simply be the number of Long QT patients utilizing the process as compared to those coming from elsewhere. As time progressed and historical data became available, efficiency could be measured by looking at time from first clinical contact to initial meeting with a medical geneticist. Over time we would expect to see a decrease in this length of time given similar system capacity and numbers. This information should help to tune the process itself—hence the two-way arrow linking this metric to the process itself. The second financial benefit should be related to direct reductions in the health burden related to Long QT syndrome. Conclusively identifying the genotype within a family and the specifically affected members allows for more targeted treatment and avoids treatment and diagnostic follow ups with “grey area” members. Tracking the number of successful tests executed by the lab reduces the health burden within those families.
8.4.4 Prevention, Promotion and Protection

At its heart, the Long QT test is about Prevention, Promotion and Protection. The conclusive identification of those at risk within a genotyped family allows for cost effective prevention and protection. The test itself only serves a purpose if its availability, limitations and benefits are understood by clinicians and patients alike. The actions based on this strategic theme are based on this assumption. Anecdotally, we have heard that awareness of the genetic test is low among patients in BC. (Husband, 2007) Affected patient and health practitioner awareness should be tracked via a survey as a measurement to track learning and growth. The creation and distribution of “marketing” materials for the test would provide one metric for the process scorecard. From the patient and health care professional’s perspective, tracking the number of appropriate uses of the test would show that the information was getting out to the target segments and was having an effect. Finally, if the test is being used effectively we should see demonstrated results in our true goal. There should be a reduction in the number of Sudden Cardiac Deaths and hospitalizations with Long QT Syndrome as the root cause.

8.5 Risks

Approval of the LQTS project is not an end unto itself. There are many potential risks faced by the MGI that may derail the implementation of the project or threaten its continued success. Risk refers to uncertainty about a project’s outcome, circumstances, or objectives. Project objectives may be based upon scope, time, cost, or a particular level of quality. For the MGI, project objectives may include a time specification for the return of completed testing with an appropriate level of quality or a cost per test. Logically, risk in a project context is most relevant in terms of the potential negative events or outcomes that may impede a project’s chance of success. The foremost goal of managing risk in a project setting is to prevent the risk from arising, or mitigate the impact of a risk should it be unavoidable. Risks may arise due to either internal or external sources, and may or may not be manageable. Risks may come about due to
increased complexity of a project, technological uncertainty, changes in the external environment, or altered stakeholder demands, interests or expectations. It is important to assess the likelihood and impact of a given risk in order to plan how to accept, prevent, transfer or mitigate that risk. In the following table, risks faced by the MGI are set out in order to identify those risks that the MGI is capable of mitigating. Avoiding or attempting to transfer the risk by passing it along to another stakeholder (i.e. via insurance) is not a viable option for the MGI, being that it operates in a public environment where many sources of risk are not under its control. The MGI is in a position to attempt to prevent potential risk through planning and to mitigate the impact of many risks should they occur. The table below uses a scale of ‘low’, ‘moderate’ to ‘high’ to illustrate the relative likelihood of a risk and the severity of its impact.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Likelihood</th>
<th>Impact</th>
<th>Mitigation Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Risks: Reliability of technology required for LQTS project</td>
<td>Low</td>
<td>Moderate</td>
<td>Use CTAG’s equipment should MGI’s equipment fail.</td>
</tr>
<tr>
<td>Business Risks: Funding &amp; resource shortfalls</td>
<td>High</td>
<td>High</td>
<td>Continue lobbying for support and increased funding.</td>
</tr>
<tr>
<td>Business Risks: Project Prioritization</td>
<td>Low</td>
<td>Low</td>
<td>Formally dedicate resources to LQTS project.</td>
</tr>
<tr>
<td>Internal Stakeholder Risks: Reduced commitment and/or ability or MGL staff to successfully complete/implement the LQTS project.</td>
<td>Low</td>
<td>High</td>
<td>Maintain internal commitment through regular meetings with relevant stakeholders.</td>
</tr>
<tr>
<td>External Stakeholder Risks: Direct opposition to LQTS project by allocated stakeholders.</td>
<td>Low-High</td>
<td>High</td>
<td>Engage stakeholders likely to support LQTS project. Engage and/or plan around those likely to oppose.</td>
</tr>
<tr>
<td>Risk</td>
<td>Likelihood</td>
<td>Impact</td>
<td>Mitigation Plan</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
<td>--------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>External Stakeholder Risks: Loss of support/enthusiasm for project due to competing demands or lack of momentum.</td>
<td>Low-High</td>
<td>High</td>
<td>Regular meetings with stakeholders to reinforce interest. Engage multiple stakeholders and locate a project supporter within organizations.</td>
</tr>
<tr>
<td>External Environment Risks: Competition from within Canada (public institution)</td>
<td>Moderate</td>
<td>High</td>
<td>Form agreements with parties known to be considering LQTS testing and Ministries of Health to ensure clientele.</td>
</tr>
<tr>
<td>External Environment Risks: Competition from outside Canada (private for-profit corporation or public institution) i.e., agreements with potential MGL clients &amp; price competition</td>
<td>High</td>
<td>High</td>
<td>Form agreements with potential clients (Ministries of Health) and set expectations for success beyond financial.</td>
</tr>
</tbody>
</table>

It is apparent that many risks faced by the MGL are out of its direct control. The majority of risks with potentially high severity arise out of differing stakeholder interest, influence and support for the LQTS project. It is therefore incredibly important to manage those stakeholders deemed most significant to the LQTS project and its success (Chapter 7).

This list of risks can in no way be exhaustive, so the continued identification of risks is essential. Risk management is an area of project management that includes the processes of measuring and assessing risk and developing strategies to manage it. It is an iterative process that cannot be adequately addressed in a single document. The MGL should continue to build upon this list in order to successfully manage and plan for risk. It might be advisable for the risk analysis to be repeated alongside the stakeholder analysis on a regular basis by a core team.
8.6 Lessons Learned

Included in the recommendation section are areas in which the MGI was previously inexperienced or unaware. Key among these recommendations was that the MGI should not only become more aware of its political and stakeholder environment, but it should learn to use stakeholders to achieve its ends. Most instructive has been the investigation into the political environment in which the MGI operates, as this has indicated who the key supporters for the LQTS initiative may be, as well as its key opponents.

It will also be important to manage expectations and determine how to determine what success will indeed look like. The discussion of the balanced scorecard gives an indication of how the MGI may better track its performance now and in the future.

8.7 Next Steps

The production of this document only represents the first step towards providing a molecular Long QT test as a service for British Columbia and external clients. Further steps are detailed below.

8.7.1 Building a Complete Business Case

This document only represents part of a complete business case for Long QT Testing. For a document to be complete according to generally accepted practice and, more importantly, the PHSA’s standards, it would need to include an analysis of the program, a feasibility study, and a financial analysis, as described below.

8.7.1.1 Program Analysis

A program analysis would detail how the service will be delivered. It would include a description of the Long QT Testing Service itself, a high level implementation plan, a
8.7.1.2 Feasibility

Although we have done an analysis of the MGI, and have confirmed that it could offer the test, the feasibility for the interfacing agencies has not been considered. The ethical considerations around offering this as a service also remain to be considered.

8.7.1.3 Financial Analysis

A financial analysis is a critical part of any business case. In this case the assessed service should be examined as if it were a potential business. This would involve consideration of initial and incremental costs of running the service, cash flow projections and sources of funding. It would also require a market analysis, a sensitivity analysis, and further detailing of risks to the project. Finally, a cost benefit analysis should be performed against outsourcing Long QT testing.

8.7.2 Long QT Group Stakeholders

As this initiative moves forward, membership in the stakeholder group should be expanded and potentially altered. Communication and stakeholder input are critical to the success of all projects. We suggest that membership in this group should potentially include members of CTAG, Cardiac Services, one or more clinical representatives and medical geneticists. A representative for the PILO may also be included, but anecdotal information indicates that at present, proceeding forward without the involvement of the PILO might also be prudent. To build support for the Long QT testing we would also suggest that this document be forwarded for review to the PIIISA project and portfolio group in order to ensure it meets the...
standards put in place. Finally, it would make sense to elicit an executive sponsor/champion for this project. Typically an executive sponsor is not someone who is involved in the day to day running of a project. Instead they are someone who, through direct authority, can exert influence to assist in problems that arise. Ideally they are as senior within the organization as possible and have access to budgetary resources. Due to the problem solving needs of the role the executive sponsor often needs to be able to exert pressure within the organisation to overcome resistance to the project. Kori Kingsbury, Provincial Executive Director – PHSA Cardiac Services, would make a logical executive sponsor since the availability of the test would have a positive direct impact on the Cardiac Services offered within the Province of British Columbia.

8.7.3 External Contacts

As it would be the intention of the lab to offer this as a service externally, the groundwork should be laid now. Contacts should be made or continued with possible clients. This would include other provinces, labs and Gendia.

8.8 Overall Conclusions

The purpose of this project was to evaluate the clinical case for Long QT Testing within the MGI and assess the MGI’s ability to deliver this test as a service to the British Columbian health care system and perhaps beyond. This project also considers the feasibility of the MGI offering the test. The clinical case for long QT Testing is strong. The MGI has the ability to deliver the Long QT Test and the delivery of this test is appropriate according to the strategic objectives of all major stakeholders. There is also a potential for a brighter future for the MGI if it moves forward with delivering this test as a service in British Columbia and beyond.

Throughout the course of the production of this report, issues specific to the MGI, as well as broader systemic issues have been identified. The unaddressed nature of LQTS testing in BC is a symptom of a wider problem that can only worsen as the use and relevance of molecular genetics
in medicine increases in importance. It is the authors’ opinion that addressing I/QTS testing in particular, and genetic testing in general, is essential to ensure Canadian patients have access to the greatest level of care possible.
Figure 9.1 Suggested Risk Stratification of Long QT Syndrome Patients

High Risk (≥50%)
- QTc > 500 msec
- Female Sex, QTc1
- Male Sex, QTc3

Intermediate Risk (30-49%)
- QTc < 500 msec
- Female Sex, QTc2
- Female Sex, QTc3
- Male Sex, QTc3

Low Risk (<30%)
- QTc < 500 msec
- Male Sex, QTc2

Source: Cardioweb ©2008 by the American College of Cardiology Foundation
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