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Ageism and London’s Hospitals: A long-overdue and insufficient remedy

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The term “ageism” was coined in 1969 by Robert Butler, who likened it to other forms of bigotry such as racism and sexism, defining it as a process of systematic stereotyping and discrimination against people because they are at or beyond a certain age.¹ Ageist attitudes are perpetuated in many ways. Institutions perpetuate ageism and reinforce ageist stereotypes by not hiring or promoting older workers and through mandatory retirement. Ultimately, stereotypes are dehumanizing and promote one-dimensional thinking about others. Elders are not seen as human beings but as depersonalized objects who, therefore, can be more easily denied opportunities and rights, leading to cruel and inhumane treatment. Ageism, as manifested by mandatory retirement, is based on fallacious thinking and untenable policies. Chronological age is a poor predictor of the competence of the older adult.² Furthermore there is far more variation of productivity, ability and intelligence within than across age groups.³

The Ontario Government’s Bill 211, which is now in effect, should force London Health Science Centre’s (LHSC) and St. Joseph’s Health Centre’s (SJHC) to amend their by-laws that gave an absolute cut-off for hospital-based, OHIP or LHSC/SJHC-funded remunerative work to individuals over 70 years of age. However, the plan not to reinstate those recently terminated before December 2007/January 2008 will unjustly curtail the careers of several capable, internationally renowned academic clinicians. Thus, this arbitrary decision perpetuates the injustice that existed here before Bill 211.

Why should we persist in discriminating against individuals who are otherwise well qualified? If we cut off physicians’ livelihood, i.e., the ability to be remunerated for clinical work, they cannot viably continue their academic pursuits, even if the university position remains. Mandatory, age-dependent retirement has been abolished in most Canadian universities and hospitals. The policy is, above all, inhumane: “The deprivation of the opportunity to work has been the most widespread disadvantage imposed on people because of old age.”⁴ At a time of physician shortages, we are losing good people who could still make valuable contributions in research, teaching and patient care. Within the academic medical centre the academic milieu is damaged. There are aspects of collegiality, best demonstrated in academic rounds and collaborative research projects, that would be compromised if these individuals were forced to retire.

We need not look far for examples of the damaging effects of mandatory retirement. We have lost a number of internationally famous individuals, who have moved to other institutions, e.g., Mayo Clinic, when they could no longer work at LHSC and SJHC. In the past two years several prominent, active, productive faculty members have lost even their outpatient privileges and their ability to carry on their needed activities in established units at the LHSC and SJHC, because of ageist bylaws of convenience. This makes no sense if they want to work and if they are needed.

Why must this persist, when LHSC and SJHC are otherwise so progressive and prominent in research, teaching and patient care? Within medical and surgical departments, mandatory retirement was a convenient means for department heads to be freed from the responsibility of passing judgment on the
comprehendence of competent departmental members, some of whom were the mentors or professors of current department heads or service chiefs. It also allows the system to eventually free itself of incompetent and non-productive members. Mandatory retirement is one of the few methods by which positions are created to hire new departmental members. However, if the senior member is still active and capable (often such individuals are in their prime at age 65, 70 years or beyond), this cannot be justified. Why should they be sacrificed? From an ethical perspective it is wrong: the ends do not justify the means. Also, at a time of physician shortages in almost all branches of medicine, forcing out our most productive, competent and prestigious colleagues is both wasteful and unwise.

Reform is the best approach to counteracting ageism within institutions. The object is to have quality members in the department, regardless of age. To do this we need a better model. Although it will be a challenge to design and implement a workable, fair system, it is the right thing to do. Departments have Appointments and Promotion Committees that have the duty of assessing the performance of departmental members and recommending their continuation, promotion, demotion or discontinuation. Surely these committees should function as they were intended and allow for yearly, fair, merit-based assessments of each Departmental member. The committee should be empowered to make decisions about appointments, promotion as well as the dismissal of individuals based upon agreed-upon qualifications and record of research, teaching and service in the “stream” appropriate for each member. This would take the onus off the divisional chairs to make such decisions in isolation. Other models for the operation of hospital and university departments can be formulated that allow continuation of the best and hiring of the brightest: the Faculty could derive another system for physician assessment with appropriate oversight, principles of function, accountability and authority with checks and balances. Individuals should be maintained on our staff while they continue to make meaningful contributions to the missions of the university, hospital and departments. Mandatory retirement from LHSC/SJHC, with respect to admitting, consultation and billing privileges should be abolished. It is shameful at a time when we need capable and knowledgeable academic clinicians for them to be effectively dismissed.

This would be a very good time for LHSC and SJHC to abolish mandatory retirement as well as the “no re-entry” policy for the unjustly retired. We need to develop other models for dealing with competence and productivity, so that the incompetent and non-productive can be jettisoned from and the good retained in academic medical centres.

References

A Royal Pain: The Porphyria Disorders

Badrinath Narayan, BSc, Medicine 2009
Stephen Chihrin, BSc, Medicine 2008

One of the first and most popular examples of historical diagnosis is provided by an examination of King George III and the records of his significant illness. Plagued with acute attacks of intense abdominal pain, curiously-coloured urine, and a constellation of neuropsychiatric symptoms, historians were at a loss for an explanation for nearly two centuries. It is now generally accepted that King George suffered from some form of porphyria, likely acute intermittent porphyria (AIP) or variegate porphyria (VP). Porphyria diseases are at their root a variety of disorders of heme synthesis. Symptoms are believed to result from the accumulation of biosynthetic intermediates. It is the intent of this paper to outline AIP and VP and their association with many influential people from the past. Maintaining a high index of suspicion for these entities you will not only undoubtedly impress your senior resident – you may also find yourself in royal company for your efforts.

Introduction

One cannot discuss the history of rare diseases without mention of King George III. Ruler of the British Empire from 1760 to 1820, he presided over a considerable time span marked by great achievements and questionable decisions alike. Britain’s navy had proven itself as the undisputed world leader, defeating Napoleonic France and strengthening King George’s influence across the world. On the other hand, mismanagement of the American colonies led to the Boston Tea Party, and ultimately, the Declaration of Independence. The establishment of Australia as a penal colony, also controversial, was also conducted during his reign. These events left somewhat of a shadow over the legacy of King George III, “The King Who Lost America”. Subtle and not-so-subtle indications of Parliament’s hesitancy with King George’s rule stemmed from his periodic bouts of madness – bouts that while well documented would not receive a diagnosis for nearly 200 years.

While evidence suggests minor episodes began much earlier, it was in October of 1788 that King George experienced his most prolonged bout of intense, totally debilitating madness, leaving England largely without a ruler until February of 1789 – a period often now referred to as The Regency Crisis. Royal physicians Dr. Richard Warren and Sir George Baker meticulously recorded symptoms of tachycardia, fever, periodic jaundice or bloodshot eyes, abdominal colic, constipation, lower leg cramps, pain, and weakness. They also noted bullous eruptions along the arms, hoarseness, and port-wine coloured urine, as well as a variety of psychiatric manifestations including bouts of vivid multi-sensory hallucinations, delusions, and rambling which often degenerated into incoherent strings of obscenities.

Initially assumed to be a chiefly psychiatric disease, intriguing reports by royal attendants of urine that “leaves a pale blue ring upon the glass near the upper surface” left historians and physicians alike looking for a better answer. In the 1960’s Ida Macalpine and Richard Hunter first proposed that King George III was afflicted with acute intermittent porphyria (AIP), and with the permission of the royal family collected urine samples from his descendants, many of whom displayed elevated porphyrin levels. The subsequent discussion they sparked is perhaps unmatched in the field of medical history, and the mystery has spawned countless books and even an Oscar winning feature film. More recent proposals have integrated the observation of vesicular lesions to suggest instead a diagnosis of variegate porphyria (VP), though VP does not as commonly present with psychiatric manifestations, and rarely ever has it produced symptomology as severe as observed...
in King George III. As this topic remains controversial, it is the intent of this article to address both AIP and VP.

Epidemiology and Pathogenesis
AIP results from an autosomal dominant mutation in the Porphobilinogen (PBG) deaminase gene. While mutation rates for this gene are relatively high, and more than 400 mutants have been identified, gene penetrance is low resulting in a disease prevalence of 1-2 per 100,000. VP, resulting from an autosomal dominant mutation in protoporphyrinogen oxidase (PPOX), is just as heterogeneous in its mutations, and while one subtype occurs at a frequency of 1 per 300 in South Africa, global frequency is considerably lower. Furthermore, incidence of subtypes displaying associated psychiatric disease is rarer still leaving estimates as simply “less than AIP”. Both genes are involved in the biochemical cascade required for the synthesis of protoporphyrin, the integral iron-bound component of hemoglobin. Defects in either of these two genes results in accumulation of both PBG and delta-aminolaevulinic acid (ALA).

Interestingly, both of these compounds are colourless in the isolated state but develop a yellow, red, or purple pigment when left to react non-enzymatically in the urine. Under normal circumstances the accumulation of biosynthetic intermediates is insufficient to produce symptoms of porphyria. However, under conditions of hematologic stress, most notably infection, blood loss, or Cytochrome P450 induction resulting from smoking, excess alcohol intake, fasting, fever, or pharmacologic interactions, porphyrin precursors accumulate to dangerous levels. While both ALA and PBG are implicated in triggering the neuropsychiatric aspects of porphyria, research has indicated that it is predominantly ALA that is responsible, by competitively inhibiting normal GABA receptor binding.

It has also been proposed that the extreme symptoms experienced by King George III may have been magnified by accidental, or perhaps iatrogenic arsenic exposure. It is well established that arsenic in its trivalent state can disrupt a number of the enzymes responsible for hemoglobin synthesis. Analysis of hair samples from King George III found arsenic traces

<table>
<thead>
<tr>
<th>Stage</th>
<th>Signs and Symptoms</th>
</tr>
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<tbody>
<tr>
<td>Early through late (Abdominal)</td>
<td>Severe colicky abdominal pain (often epigastric lasting days) Constipation Nausea and vomiting</td>
</tr>
<tr>
<td>Mid through late (Psychiatric)*</td>
<td>Depression common Mania Psychosis</td>
</tr>
<tr>
<td>Late only (Neurologic)</td>
<td>Areflexia common Motor weakness, usually in lower limb Diffuse pain, usually in upper limb Autonomic neuropathy (hypertension, postural hypotension, tachycardia are common) Delirium, coma, cortical blindness also reported</td>
</tr>
<tr>
<td>Skin**</td>
<td>Photosensitive lesions, bulla or furrowing (most severe in children) Lesions often friable Hypertrichosis Sclerodermoid changes</td>
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</tbody>
</table>
Much debate exists as to whether these symptoms have a pathogenic mechanism in VP. Observation of the South African cohort, where roughly 1 in 300 people have the gene for VP, suggests not. Skin manifestations only present in VP.

throughout the length of each hair, suggesting chronic exposure to low dose arsenic. It has been proposed that this exposure may have resulted from contamination of his antimonial emetic tartar, which at one point he was receiving at a rate of 120mg q6h. Treatments involving elemental compounds were quite popular at the time, and Dr. John Willis, head of Dunston House, London’s premier asylum of the time, was quite fond of arsenic therapies. However, direct therapy using arsenic is not recorded in the logs of King George’s physicians. The observation of a bluish layer precipitating to the surface of collected urine has also recently been explained. It has been observed that prolonged constipation can affect levels of bacterial sulphatase in the gastrointestinal tract, and in the presence of excess tryptophan, can lead to excessive production of indoxyl sulphate (indican). This substance is then processed in the liver and excreted via the kidneys. Barely soluble, it falls out of solution as urine temperature drops outside of the body. While this mechanism is largely believed, what is not understood is why this phenomenon is observed with greater frequency in patients suffering from an acute episode of porphyria.

Diagnosis
Diagnosis relies on a high index of suspicion given the signs and symptoms of both AIP and VP (see Table 1). It should be noted that symptom groups generally progress as overlapping groups, with initial manifestation limited to the abdomen, followed by psychiatric symptoms, and finally peripheral neuropathy. Ultimately, early morning or 24-hour urine collection should be conducted, ideally during an acute attack of the disease, and assessed for ALA and PBG accumulation. While levels will be substantially elevated during an acute attack, levels of both ALA and PBG, particularly PBG, remain elevated, often for years following the last acute attack.

Urine levels of ALA and PBG may be misleading if urine samples are left too long before analysis, particularly if exposed to light, or if collected from a patient with chronic renal failure. In this circumstance measuring direct ALA and PBG serum levels is indicated. Measurement of protoporphyrin and coproporphyrin in the stool may also assist in these circumstances, but is of low sensitivity. Recently, experts have also suggested that directly assessing PBG deaminase activity may be warranted as it unequivocally detects the defect associated with AIP.

Differential
The differential diagnosis of acute porphyria is potentially enormous, thus diagnosis rests on successful identification of hemoglobin precursors in the urine, blood, or stool. The abdominal symptoms present in AIP are similar to many acute GI disorders. Neuropsychiatric manifestations are most closely approximated by heavy metal poisoning. The skin lesions observed in cases of VP share similarities with a number of dermatological conditions, the most important to rule out include drug-induced photosensitivity reactions and porphyria cutanea tarda.

Management
Successful management of acute attacks of porphyria rest on decreasing heme synthesis, in turn decreasing production and accumulation of heme precursors. Administration of high-dose glucose has been observed moderately curtail heme synthesis, if given in doses of at least 400g per day. More severe attacks have been well managed with the use of hematin, a heme derivative, at a dosing of 4mg/kg/day for at least 4 days.

Just as important as treating acute attacks, prevention of further attacks is a critical aspect of management, and one that is complicated by significant pharmacologic interactions. Well over 200 drugs have been found to exhibit properties that may predispose an individual to more
frequent bouts of porphyria. The classes felt to be most harmful include androgens, estrogens, progesterones, barbiturates, sulfonamides, hydantoins, griseofulvin, as well as ethanol. Due to the sheer volume of potential interactions, it is important to consult up to date, comprehensive lists when treating patients with AIP or any other porphyria.

Appropriate management must also include education and screening of family members. In asymptomatic individuals an assay for erythrocyte PGB deaminase has been found to be most sensitive in families with AIP. Similarly, assays for protoporphyrinogen oxidase have been used in assessing families with VP.

Conclusion
The acute porphyria diseases, despite being exceeding rare have captured a large portion of medical historians’ attention. In fact, it was King George and his regency crisis that many cite as one of the first and finest examples of ‘historical diagnosis’ to be discussed in the literature. Since the early papers on this topic a number of other historical figures have also been suggested to suffer from acute intermittent porphyria. As one would expect, many other British Royalty of King George’s bloodline have been afflicted, including Queen Anne, King James I, Queen Mary I of Scotland, and Frederic the Great of Germany. Other notable individuals often suggested to have had porphyria include Vincent van Gogh and King Nebuchadnezzar of Babylon.

References

Diabetes is a disease whose symptoms have been recorded in the annals of history ever since the earliest reports of polyuria in 1500 BC. However, it was only in the last hundred years that adequate treatment methods have been developed, initiated by Banting and Best’s discovery of insulin. Tracing the historical methods used to diagnose diabetes provides a perspective for current diagnostic and treatment strategies. Diagnostic tests have become increasingly quantitative evolving from the earliest diagnostic tests where urine was tasted to modern methods assaying the percentage of glycosylated hemoglobin. The basis of future diagnostic tools for diabetes will most certainly be based on past research findings and experiences.

The signs and symptoms of diabetes have been observed and recorded since the beginnings of civilization. The earliest descriptions were limited to changes in urine output and the fatal outcome of those inflicted with diabetes. Polyuria, as we now know, has many different etiologies, thus it is impossible to discern today whether the symptoms and treatments were correctly directed at diabetes mellitus. However, the early recognition of diabetes began with the examination of urine.

While the term “diabetes” was first introduced in the 1st or 2nd century BC by Demetrius of Apameia,1 descriptions of abnormal polyuria were recorded as early as 1500 BC in the Egyptian Papyrus Ebers, an ancient written document of medical knowledge.1-3 The term “diabetes” was based from the Ionic and Latin terms that meant to pass through or to siphon.1 It was coined by Areteus of Cappadocia (AD 30-90) “because the fluid does not remain in the body but uses the man’s body as a ladder whereby to leave it”.3 It was the prevailing belief that diabetics had large volumes of urine due to large volumes of ingested fluids, unchanged as it passes through the body, as if the patient was a siphon.1 In addition to coining the term diabetes, Areteus is credited with the first accurate clinical description of diabetes, likening it to “an affliction… melting down of the flesh and limbs into the urine”.1

The first test for diabetes was the urine taste test. While the Greek physician Claudius Galen (AD 129-200) believed diabetics’ urine was “unchanged drink” which may have accounted for a different aroma, early Egyptians, Indians, and Asians noted the sweet taste of urine.3 Chang Chung-Ching (AD 229) noted that the urine was so sweet that that dogs liked it.3 Indeed, animals and insects alike were attracted to the sweet urine.3,4 The Hindu medical textbooks from the 5th century described sweet, honey and sugarcane urine amongst 20 varieties of diseased flow of urine.1,3 Both Avicenna (AD 980-1037) and Paracelsus (AD 1493-1541) later recommended tasting the urine of diabetics.1,3

The source, however, of the sweet taste of diabetics’ urine remained unknown. Avicenna noted a sticky residue as sweet as honey remained after urine was left to stand in ambient air.1 Theophilos Protopatharios (630 AD) was the first to mention applying heat to urine as a diagnostic test.3 Paracelsus reported that boiling diabetic urine recovered “4 ounces of salt”.3 However, it was Thomas Willis (1621-1675) that first described the saccharine nature of urine, describing the sweet taste after evaporation “as if imbued with honey (quasi melle) and sugar”.1

In 1776, Matthew Dobson performed a diagnostics experiment that lead to the belief that diabetes was not just a disease of the kidneys, but rather a system disorder.1,5 Dobson evaporated the urine of diabetic patients to
discover the presence of a substance like brown sugar in taste and appearance, he also went on to observe that diabetic patients had the sweetish taste of sugar in their blood.\^1,\^5 This confirmed the relationship between the sugars present in the blood and those excreted in the urine.

John Rollo established the link between the food consumed by diabetics and the amount of sugar in the urine.\^6 Rollo recorded the amount and kind of food eaten by his diabetic patients, and then weighed the "sugar cake" which remained after evaporating their urine.\^6 He observed that carbohydrates increased sugar levels, and animal product consumption resulted in less sugar.\^1,\^5,\^6\^6 He promoted the idea that the treatment for diabetes should be a diet low in carbohydrates and high in fat and protein. This modification of diet became the recommended treatment for diabetes until the discovery of insulin.\^7

The first clinical tests for glycosuria were developed in the nineteenth century. In 1841, Karl Trommer, developed a qualitative test for sugar which involves treating a urine sample with a strong acid which results in the acid hydrolysis of disaccharides into monosaccharides.\^5,\^6 The solution is then neutralized and a solution of copper sulphate is added, then excess of alkali, followed by boiling, a brick-red cuprous oxide precipitate forms if glucose is present.\^5,\^6 In 1850, Hermann von Fehling developed a quantitative test based on Trommer’s work to measure sugar content.\^6 Frederick Pavy (1829-1911) established a quantitative relationship between the degree of hyperglycemia and glycosuria based on Fehling’s test.\^5 Pavy also improved upon the Fehling’s test for quantitative sugar urinalysis by substituting ammonia for caustic potash and thereby facilitating production of the first urinalysis tablets.\^5

In the twentieth century, easier methods to determine urine sugar content and tests for blood glucose were developed. In 1907, Stanley Benedict developed a milder test for glycosuria using a copper reagent with a carbonate base rather than the hydroxide base of Fehling’s test.\^8 In 1913, Ivar Bang pioneered a method to test blood glucose levels whereby blood proteins were fixed to filter paper and the filtrate was used to measure glucose using copper sulfate and KCl.\^9 However, the use of glucose-dependent copper reagent reduction reactions became increasingly analytically problematic as they underestimated the amount of glucose present.\^8 In 1941, the Ames company introduced the first “stick” or “strip” tests (Clinitest) which was still based on the old methodology involving copper sulfate reduction.\^10 Shortly thereafter, the Ames company produced the far more accurate Clinistix which is based on the enzymatic reaction of glucose oxidase.\^10 This enzyme generates hydrogen peroxide as it interacts with glucose, which in turn reacts with horseradish peroxidase to produce oxygen which oxidizes orthotoluidine to produce a blue or purple colour.\^10

In more recent times, the diagnosis of diabetes has taken on a more quantified approach. The emphasis over that last forty years has been on measuring blood glucose levels and response to oral glucose challenges. Debate, however, has ensued over the determination of cut-off values for diagnosis, and the accepted values have changed a number of times, reflecting changes in trends and attitudes.

In 1979, the National Diabetes Data Group and the World Health Organization developed diagnostic criteria for the diagnosis of diabetes that involved measuring glucose tolerance using an oral glucose tolerance test (OGTT).\^11 An OGTT involves giving a patient 75 gm of glucose by mouth and then measuring their blood sugars two hours later. If a patient’s blood sugars are elevated more than they would be in a normal individual, then that patient has impaired glucose tolerance. Using this test, the following criterion was established for the diagnosis of diabetes: fasting blood glucose 7.8 mmol/L or higher, or an OGTT two-hour blood glucose value of 11.1 mmol/L or higher.\^11

These guidelines were updated in 1997 by the American Diabetes Association (ADA), and then revised in 2003. The new guidelines require meeting one of three criteria in order to diagnose diabetes: a) a fasting blood glucose concentration
of 7.0 mmol/L or higher with symptoms of hyperglycemia, which include polydipsia, polyuria, and weight loss; b) a random blood glucose of 11.1 mmol/L or higher; c) a two hour value in an OGTT of 11.1 mmol/L or higher.\textsuperscript{12} The diagnosis must then be confirmed on a different day with any of the three criteria.\textsuperscript{12} The ADA cautions use of the OGTT as a tool for diagnosis, and stresses the use of fasting blood glucose measurements instead, because the results of the OGTT are not always reproducible and so the test is not reliable.\textsuperscript{13}

There has been recent interest in using hemoglobin A1c values to aid in the diagnosis of type 2 diabetes in conjunction with random blood glucose levels.\textsuperscript{14,15} Hemoglobin A1c is the glycosylated form of hemoglobin A, the major adult hemoglobin type. The utility in measuring hemoglobin A1c comes from the fact that its concentration is proportional to blood glucose levels. In non-diabetics, the normal hemoglobin A1c level is less than 5\% of the total hemoglobin.\textsuperscript{16} In patients with diabetes, chronically elevated blood sugars will lead to a higher than normal percentage of hemoglobin A1c. It has been proposed that to avoid the inconvenience of measuring fasting blood glucose as a means of diagnosis, an abnormal random blood glucose value (11.1 mmol/L or higher) in addition to a hemoglobin A1c value greater than 2 standard deviations above normal could be used.\textsuperscript{14,15} Before the incorporation of hemoglobin A1c measurements into diagnostic criteria, a number of issues need to be addressed including erroneous levels due to diseases that falsely elevate or depress A1c values.\textsuperscript{17} Despite these potential sources of error, since 1999 Japan has been using HbA1c levels over 6.5\% as a diagnostic marker for diabetes.\textsuperscript{18,19} It seems clear that there still remains work to be done to standardize the diagnostic tools in the determination of diabetes.

From the initial reports of sweet tasting urine to the biochemical analysis of glycosylated hemoglobin, the tests employed to diagnose diabetes have become more sophisticated over the past centuries as our knowledge of the disease grows. The future promises to have ever more specific tests to diagnose the different varieties of diabetes, some of which may enter the realm of genetic screening or pharmacogenetics.

References


Chasing Hippocrates: Dr. Paul Potter’s Journey through the History of Medicine

Renata Villela, Meds 2009

Dr. Paul Potter received his medical degree from McGill University in 1968 and subsequently completed his graduate classical training in Hamilton and in Kiel, Germany. One year after obtaining his Ph.D. in 1973, Dr. Potter became a member of the Faculty of Medicine at the University of Western Ontario. He currently holds the post of Jason A. Hannah Professor and the Chairman of the Department of the History of Medicine. Dr. Potter provides insight into his experiences as a medical historian and the future of the history of medicine.

The classical world opened its doors to Dr. Paul Potter in Hamilton, Ontario amidst a sumptuous chocolate cake and grape juice at a high school Greek club meeting. In spite of its enticing siren call, however, Dr. Potter’s love for the classical world was counterbalanced by his interest in science. Following his graduation from secondary school, he began a seven-year medical degree program at McGill University in 1961. Fortunately, the program’s structure allowed him to pursue a range of subjects, thereby enabling him to take several Greek courses in addition to his basic science requirements. By the end of his medical degree, Dr. Potter’s fascination with languages steered him towards the path of devoting himself full-time to the Greek language. He returned to Hamilton to complete a Masters of Arts degree in Greek at McMaster University and next departed for Kiel, Germany. There, he received his Ph.D. in 1973 for a dissertation on the Hippocratic text Diseases III. A subsequent sinecure provided him with ample time to study medical history. By 1974, he returned to Canada to begin teaching at the University of Western Ontario in London. Dr. Potter currently teaches undergraduate and graduate students and is cross-appointed between the Classics Department and the Faculty of Medicine.

Dr. Potter’s travels and medical training have provided him with a strong foundation for understanding the physician within various historical contexts. His research on Greek medicine has afforded him the opportunity to visit ancient healing temples and hospitals along the Mediterranean coasts of Greece, Italy, and France. In addition, his medical degree has proven valuable in ways that he had not originally foreseen. For example, several of his medical school laboratory sessions involved the use of frogs and other animals as subjects for physiology experiments. These experiences enabled him to relate to the work of past physicians who used animals as models to understand better the inner workings of the body. Thus, Dr. Potter views himself as an “insider” in medicine.

When not teaching students in the classroom, Dr. Potter explores topics in the history of medicine through the Osler Society. The group was originally founded in 1922 by Dr. J.W. Crane in memory of Sir William Osler, who died in 1919. Although the group began as an honor society, its focus moved towards the history of medicine after World War II. By the time Dr. Potter arrived at the University of Western Ontario, however, the society was barely active. In the late 1980s, Dr. Potter was informed of a potential removal of funds for the club, which served as a catalyst for renewing medical students’ interest. Since then, the club has enjoyed a solid membership increase. Using his former Greek club as a model, Dr. Potter offers his home as a meeting place for the Osler Society each month and serves a delectable selection of hors d’oeuvres and desserts.

Throughout his career, Dr. Potter has noticed some interesting developments within the study of the history of medicine. Prior to the 1950s, several medical historians were doctors interested in exploring the roots of their profession. Between 1950 and 1960, social and institutional historians began to enter the field.
Their view tended to be more critical of medicine than their physician counterparts. Whereas the latter focused more on medical achievements, the social historians were interested in how physicians exerted their power and influence in various cultures. Fortunately, these differing perspectives came together to form the Canadian Society for the History of Medicine. Dr. Potter foresees that important future topics in the history of medicine will include the limits of medicine, especially with regards to the amount of money society is willing to invest in health care and to how society will deal with technological advances such as genetic engineering. Ultimately, history will provide a template to guide physicians in confronting the future challenges of medicine.
While the Dark Ages were a time of intellectual and societal stagnation throughout much of Europe, the torch of academia continued to burn brightly in the Islamic world. The intellectual progress made during this time includes numerous medical breakthroughs which physicians, historians, and students should strive to understand not only for academic interest but also to learn and improve medicine today. The use of secular hospitals originated in this era and there were significant developments in a variety of medical fields including anesthesia, ophthalmology, pharmacology, neurology and psychiatry. A strong emphasis on patient-centered and interdisciplinary care was evident in many of the areas of Islamic medicine during the Dark Ages. The achievements of Islamic physicians during the Dark Ages also demonstrate the importance of strong communication within the global medical field, as the presence of avenues for global academic communication could have eliminated much of the disparity in medical care in different parts of the world over subsequent centuries. The need for improved international communication applies to medicine even today.

**Introduction**

The Dark Ages are known to be a time of intellectual and societal stagnation throughout much of Europe and as learners in the Western world we rarely hear about the academic achievements during this time. This is clearly seen in the medical field where historians often move from the work of the Greco-Romans before the Dark Ages to the discoveries of the Europeans afterwards. However from the seventh to thirteenth centuries the Islamic empire spread from Spain to China and was the centre for trading of goods, knowledge, and ideas. The Islamic civilization was thriving intellectually at this time yet many historians regard the role of the Muslims during the Dark Ages as merely translators and transmitters of the Greco-Roman medical knowledge.

There are three important stages in the development of medicine in Islam. The first is the compilation and translation of the medical works of previous eras which occurred in the seventh and eighth centuries. The second stage was that of significant and genuine contribution by Islamic physicians to the current medical and scientific knowledge base. The third stage, occurring after the thirteenth century, was that of intellectual stagnation and decline within the Islamic world.

This article will briefly review the above described second stage, discussing the unique contributions of Islam to medicine during the Dark Ages and their relevance to modern-day medicine.

**Hospitals**

One significant contribution of Islam to medicine was the introduction of hospitals as we are familiar with them today. Although hospitals had existed prior to the seventh century, it was the Islamic era that transformed hospitals into secular institutions for the first time in history. All ill individuals were treated irrespective of financial status, gender, age, and faith. Since Muslims required clean water to prepare for their daily prayers, all hospitals were also supplied with ample clean water and for the sake of modesty between genders separate wards were created for male and female patients in which the nurses and patients were of the same gender.

The nature of this hospital care is a clear example of making the patient’s needs and preferences a priority – a concept towards which medicine is returning today.

The contributions of Islamic medicine to the development of hospitals also included allowing only qualified physicians to practice medicine, originating an extensive teaching system within hospitals in which medical students became active learners, the advent of patient records for the first time in history, and the use of hospitals to care for lepers, the mentally ill,
and other groups that were ostracized for centuries to come in other areas of the world.\textsuperscript{8,9,16}
Ophthalmology
These centuries were also a time of tremendous growth in the field of ophthalmology. Not only did most medical manuals published during this time in the Islamic world include a chapter devoted to the eye, but a variety of compendiums were also written solely for diseases and conditions of the eye.\textsuperscript{17} Hunain ibn Ishaq's influential “Ten Treatises of the Eye” was a work that demonstrated significant advancement from the previous knowledge of the Greco-Romans,\textsuperscript{17-18} while al-Haytham’s “Optical Thesaurus” inspired the theories of future notables including Roger Bacon, Leonardo da Vinci, and Johannes Kepler.\textsuperscript{8,19}

Furthermore, it was Al-Razi (Rhazes) who discovered the light-reaction of the pupil, Ibn Sina (Avicenna) who first described the six intrinsic muscles of the eye, and Ammar bin Ali who was the first to describe cataract extraction using suction.\textsuperscript{8} This again reinforces the idea that the Islamic era was not merely one of translation but rather one of medical breakthroughs.

Anesthesia
Ali ibn Isa was the first in history to propose the use of anesthesia.\textsuperscript{20} The soporific sponge, which was a sponge soaked with aromatics and narcotics and then held to the patient's nostrils, was also invented by Islamic physicians.\textsuperscript{4,7-8,21} This implementation of anesthesia was one of the causes of the “rise of Arab surgery to the level of an honorable specialty” while it remained a less cultivated profession in Europe until the formula for the soporific sponge was received from Muslim sources in the thirteenth century.\textsuperscript{22} In 1886, Burton reiterated the precedence of Islamic physicians in the field of anesthesia by stating that “anesthetics have been used in surgery throughout the East for centuries before ether and chloroform became the fashion in the civilized West”\textsuperscript{23} thereby reminding that communication of medical research and discovery is integral to global health and well-being.

In addition, it was Avicenna who introduced the concept of oral anesthetics.\textsuperscript{7-8} He described numerous recipes for anesthetics and analgesics in his \textit{Canon of Medicine} and was the first to propose the pharmacological effects of opium as well as various other drugs.\textsuperscript{7-8,24} Avicenna was also the first to describe the effect of pain on one’s ability to ventilate.\textsuperscript{24-25}

Pharmacology
The field of pharmacology saw tremendous growth during the Dark Ages within the Islamic world. Indeed it was during this era that pharmacology was first established as a separate discipline from alchemy and medicine. For the first time, licensing for pharmacists was introduced.\textsuperscript{8} These changes were also accompanied by refinement of the methods of drug production as drug preparation and extraction became a high art.\textsuperscript{8,26} Furthermore, pharmacies were introduced adjacent to numerous hospitals for the first time in history\textsuperscript{7} this is yet another example of the precociously progressive approach of early Islamic medicine towards multi-disciplinary care.

Islamic physicians of the time also introduced a variety of new drugs, including camphor, musk, and senna.\textsuperscript{8,26} The use of alcohol as a pharmaceutical, anesthetic, and anti-septic also originated during this era.\textsuperscript{22} The various medical texts published during this time consistently included chapters devoted solely to pharmacology\textsuperscript{26} and it was Ibn al-Baytar whose compendium described more than five hundred drugs discovered by Islamic scientists in addition to over one thousand classical drugs derived from previous knowledge.\textsuperscript{27}

Neurology and Psychiatry
Several significant developments occurred in the field of neurology and psychiatry in the Islamic world as well. Contrary to the common practices in Europe, Islamic medicine attributed psychological problems to neurological deficits and not to demonic possession or supernatural forces.\textsuperscript{15} The importance of sharing knowledge globally is evident as this could have prevented much of the social stigmatization that accompanied psychiatric disorders throughout the world in subsequent centuries.
Some modern-day history-taking techniques were also evident during this time. For example, in his 11th century practice, Ibn Ridwan would ask questions to determine a patient’s state of mind and note both their responses and behaviour. He also noted whether the affliction was of recent or long-term origin and treated accordingly. Ibn Ridwan’s exam tested the acuity of vision and hearing and articulation of speech. Furthermore, he evaluated muscle strength by asking patients to lift weights and grasp objects. He also recommended that physicians observe a patient’s gait both forwards and backwards during their clinical assessments. Physicians such as Ibn Ridwan exemplify the truly advanced state of medical sciences in the Islamic world over one millennium ago.

Physicians in the Islamic world at this time were also responsible for discovering hydrocephalus and various brain tumours, as well as differentiating between delirium, meningitis, and meningismus. They were also the first to describe post-traumatic epilepsy and the notion of epilepsy as a manifestation of brain disease.

Numerous other developments in neurology were made, including Rhazes’ description of the pupillary light reaction and his original description of the laryngeal branch of the recurrent laryngeal nerve. Avicenna elucidated the differences between vertigo and epilepsy and also gave the first account of a trigeminal neuralgia. This era also brought the first description of a brain abscess following otitis as well as the association between headaches and temporal arteritis.

Other Contributions
Islamic physicians made numerous other notable contributions to medicine during this era. One of the most significant was the first description of the pulmonary circulation by Ibn el Nifas in the thirteenth century. Furthermore, it was Rhazes who distinguished measles from smallpox, Avicenna who introduced the use of catgut for surgery, Halle Abbas who first proposed that childbirth was caused by uterine contractions, and Ibn al-Quff who presented novel works on embryology.

Conclusion
The era between the seventh and thirteenth centuries was one of tremendous development and growth in the Islamic world, playing host to many physicians who made profound contributions to the world of medicine. Their compendiums and texts were commonly used throughout Europe during the subsequent centuries, illustrating that throughout time, the torch of knowledge was passed from one civilization to the next. It is important for physicians, students, researchers and historians today to realize that this torch continued to burn brightly even during the Dark Ages.

It is also important that we apply the lessons learnt from early Islamic physicians, such as the value of interdisciplinary and patient-centered care, as well as recognize that global sharing of information in medical care today is essential to ensure the success of medical care tomorrow.

References
Recent medical investigations have worked to decode some of the great mysteries surrounding the life of various Ancient Egyptians. The research has sparked debate over this mysterious civilization; debates that range from the genetic makeup of the Pharaohs to whether or not they were murdered. The scientific and historical knowledge gained from such research has opened the doors for medicine to unravel some of the great mysteries of Ancient Egypt and other past civilizations. Tutankhamun, better known as King Tut, became Pharaoh at the tender age of nine and died after ten years of reign when he was only nineteen. It had long been suspected that he had been murdered, as evidenced by X-ray images from the late 1960s indicating a blow to the lower base of his skull. However, a series of CT scans in 2005 have shown no evidence of this suspected blow but do implicate a large fracture in the Pharaoh’s left femur as the cause of death. Thus the most recent theory is that this Ancient Egyptian ruler was not murdered for his throne, but rather likely died due to an infection secondary to his broken leg.

Ancient Egypt – Mummification and Beyond
For over three millennia, ancient Egyptian civilizations have awed society with their unparalleled development and innovation. From the complex hieroglyphics found etched intricately into stone walls, the fine art of mummification, and the mysteries that remain regarding pyramid development and architecture, this era was replete with scientific and historical masterpieces.

With the infamous discovery of Tutankhamun’s tomb in 1922 by English archaeologist Howard Carter, the first tomb to be discovered completely intact, came rejuvenated excitement in academic circles as to the potential that these relics had in deciphering many mysteries from the Egyptian era. The discovery provided new insight into the process of mummification, the lives of the pharaohs of the 18th Dynasty, artistic practices of the time, and many other areas of history. It turns out that medicine has played an enormous role in deciphering this complex story.

Tutankhamun - King Tut
The ancient boy king Tutankhamun has captivated the interest of the entire world since the discovery of his intact tomb by Howard Carter in 1922. Ascending the thrown as a mere nine year old boy in 1334 BC, Tutankhamun is possibly a son of the heretical Akhenaten and has been given credit for the reversion of Egypt back to its ancient polytheistic beliefs and traditions. His reign lasted just over nine years as Tutankhamun died as a young nineteen year old in 1325 BC. His premature death as a nineteen year-old has led many Egyptologists to speculate as to the cause and numerous theories involve a murder in their explanation.

X-ray Vision
Tutankhamun’s body was left untouched until 1968 when a team led by anatomy professor R.G. Harrison of the University of Liverpool began their investigations. The first thing that was
discovered was that rather than leaving Tutankhamun to rest in peace, Carter and his team had left him resting in pieces, a fact that was omitted from Carter’s report and documentation. Harrison’s goal was to image the body of Tutankhamun but they found it to be in poor and fragile condition. The team did manage to perform X-rays on the skull of Tutankhamun. Their analysis showed two thick deposits of opaque material, later determined to be solidified embalming fluid, in the skull as well as a fragment of bone near the occiput. Several historians and Egyptologists have since suggested that the bone chip is concrete evidence in favour of the theory that Tutankhamun was murdered by a deadly physical injury to his head.  

The 1968 X-ray series also demonstrated that the sternum and some of Tutankhamun’s frontal ribs were missing which then led to various medical and historical theories. Egyptologist Dennis Forbes theorized that perhaps Tutankhamun died in a chariot accident that crushed his sternal area and the sternum and ribs were subsequently removed by embalmers in order to facilitate the embalming. Others claim that Tutankhamun may have been pigeon-chested, a birth defect, and note that his spine shows pronounced scoliosis to support this theory.

Astounding Discoveries  
The latest medical investigation of Tutankhamun was followed closely by many historians and gave rise to a strong sense of anticipation. World renowned Egyptologist Zahi Hawass performed a full-body CT scan of Tutankhamun on January 5, 2005. With a team of radiologists, anatomists, and forensic specialists from the Faculty of Medicine at Cairo University, Hawass and his team spent the next two months analyzing the 1,700 images that were taken on that historical night. Upon reaching their conclusions, the team confirmed their results with a variety of foreign consultants including paleopathologists and radiologists from several European countries. In March of 2005, the stunning results were published to an anxiously awaiting community of historians and Egyptologists.

Through a more detailed examination of Tutankhamun’s epiphyses and partially erupted third molars, Hawass and his team fixed the king’s age of death at nineteen years. They confirmed his height of 170cm and noted that Tutankhamun showed no signs of malnutrition or chronic disease. The team confirmed the elongated nature Tutankhamun’s skull, as had been noted previously, but added that there was no premature fusion of the cranial sutures, thus confirming that the elongated skull was not a developmental abnormality but rather a normal anthropological variation.

The detailed analysis also indicates that Tutankhamun did not suffer from scoliosis as previously claimed by some historians. The vertebra did not display any rotation or deformation and thus the medical team concluded that the curvature of the spine was likely a result of the manner in which the embalmers placed the body, and not scoliosis.

Another extraordinary finding involves the suspicious missing ribs and sternum. The CT scans reveal that the ends of the ribs have been cut with a sharp instrument. Hawass and his team believe that the removal may have been by the embalmers, however evidence fails to show any sings of serious chest trauma as has been suggested by some historians as the vertebrae remain undamaged. One cannot rule out a minor chest injury, although there is an alternate theory that is favoured by many. It seems difficult to conceive that Derry and Saleh, the two forensic pathologists who made detailed notes on their observations in the 1925 uncovering of Tutankhamun’s body, would fail to mention the obvious missing ribs and sternum – and fail to mention it they did. It would also make sense that the ribs, if removed by embalmers, would have been wrapped and kept within the sarcophagus of Tutankhamun, as was the Egyptian custom. This indicates that the frontal ribs and sternum may have been removed by Carter’s team and simply never replaced. These missing items would be in addition to the right
thumb and other body parts which were reported missing by Harrison’s team in 1968 but are evident in images taken by Carter’s team in the 1925 investigations.  

The most striking conclusion that has resulted from the CT scans involves the cause of death of Tutankhamun. It turns out that the team of investigators has been able to conclude that Tutankhamun did not die from a blow to the head, as previously theorized. The loose pieces of cranium could not have come from an injury prior to death as they remain outside of the solidified embalming fluid. The team is unanimous in their agreement that the cranial injuries constitute postmortem damage however there is some debate as to whether the injuries were due to the embalmers over three millennia ago or Carter’s team in the early twentieth century.  

A fracture of the lower left femur, at approximately the level of the epiphyseal plate, was also found in the full-body CT results. Although there are many fractures in the body caused by the (mis)handling of Carter’s team, this one is unique in several respects. Firstly, one of Carter’s forensic specialists, Derry, actually recorded this fracture in his notes as an observation, something which is not seen for the various additional fractures caused by the handling at the time. As well, the break has ragged, rather than sharp, edges and also has two thin layers of embalming fluid that have entered the injury site. Furthermore, Derry had also reported a loose left kneecap which may be used as additional evidence for an injury to the left lower limb.  

The theory that Hawass has proposed based on these findings is that Tutankhamun died not of a malicious attack to dethrone him but rather due to a severe fracture in his left femur. A fracture of this size could have easily led to infection and even caused gangrene, thus resulting in an infectious death secondary to the injury. Critics argue that although the blow to the head may not have been the cause of death, this still does not rule out the possibility of Tutankhamun’s murder by poisoning or other, less conspicuous, methods of murder.

Medicine in the future of Ancient Egypt

We can thus see how medicine has played a variety of roles in the uncovering and decoding of some of history’s great mysteries. Traditional medical analyses may be used to analyze the life and death of historical figures from a variety of eras and medical technology may be used to objectively analyze the physical remains of these historical figures. Ancient Egypt lends itself perfectly to this type of analysis due to the unparalleled preservation of bodies attained due to the process of mummmification. The benefits that the history of Ancient Egypt has already seen due to medicine’s contribution will soon carry over into various other ancient civilizations as the investigative power of medicine continues to expand. Advances in DNA analysis and recovery, fields that are still in their infancy, as well as the potential of future imaging techniques as computers continue to improve, expand, and surpass all previous expectations, will all continue to demonstrate the unlimited potential of the medicine to solve many of history’s great mysteries.

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Patient privacy is one of the fundamental tenants of the practice of medicine. Mutual trust and confidentiality form the basis of the physician-patient relationship and have been recognized as sacred from the beginning of the medical profession. In Canada, healthcare falls under the jurisdiction of the provinces, which are able to assess and accommodate their own unique healthcare needs. Today, privacy of personal information is a top priority of governments, as personal information gains more significance in the applications it can have. Health records are no exception to this; information such as family history of congenital disorders, psychiatric conditions and financial information are being included in patient records and the drive to protect this from being shared with undesirable parties is escalating. This drive however must be balanced by the needs of healthcare professionals who require the information to properly treat patients. After many recommendations and failed attempts to provide a comprehensive legislation, on November 1, 2004, Ontario passed the Personal Health Information Privacy Act [PHIPA]. The effectiveness of PHIPA will not be readily apparent for some time given its recent enactment, however the struggle to provide the adequate balance between the protection of personal information and allowing healthcare professionals ease of access to facilitate patient care will ultimately determine the effectiveness of this new Act.

Introduction
Patient privacy is one of the fundamental tenants of the practice of medicine. Mutual trust and confidentiality form the basis of the physician-patient relationship and have been recognized as sacred from the beginning of the medical profession.\textsuperscript{1} The Hippocratic Oath addresses the importance of protecting the health information of patients: “What I may see or hear in the course of the treatment or even outside of the treatment in regard to the life of men, which on no account one must spread abroad, I will keep to myself, holding such things shameful to be spoken about.”\textsuperscript{2}

In Canada, healthcare falls under the jurisdiction of the provinces, which are able to assess and accommodate their own unique healthcare needs. Today, privacy of personal information is a top priority of governments, as personal information gains more significance in the applications it can have.\textsuperscript{3} Health records are no exception to this; information such as family history of congenital disorders, psychiatric conditions and financial information are being included in patient records and the drive to protect this from being shared with undesirable parties is escalating. This drive however must be balanced by the needs of healthcare professionals who require the information to properly treat patients.

Who owns medical records?
The ability of physicians to share medical records hinges upon the ownership of the records. This question was addressed in the 1992 landmark Supreme Court decision of McInerney v. MacDonald.\textsuperscript{4} The principle behind this case is that the information contained within the health record belongs to the patient, but the record itself is property of the medical institution.\textsuperscript{4} As such, legislation must then provide a framework establishing the rights of both the patient and healthcare professionals in regards to the use, collection and distribution of healthcare information.

The Development of Health Information Privacy in Ontario
In 1977, the Royal Commission of Inquiry, lead by Mr. Justice Krever was established to investigate and make recommendations on the privacy of health information.\textsuperscript{5} This commission was created in response to allegations of police access to patient records in OHIP and healthcare facilities without obtaining prior consent.\textsuperscript{5} At this time, no overarching legislation for the protection of privacy and health information had
been established and each healthcare facility was subject to their own practices. After reviewing the seventy-seven statutes and numerous regulations that were in place, it concluded that many aspects of health information were not clearly covered under any legislation. The Krever Report identified for the first time the discrepancies in the practices of healthcare institutions, healthcare professionals and the ambiguity in the legislation governing privacy and health information. It also recognized that the implementation of legislation to provide a universal provincial framework for privacy and health information should not be so cumbersome to impede the effective and timely delivery of healthcare.

With these suggestions, the Ontario government attempted to update and clarify the existing legislation to provide clearer guidelines for healthcare institutions and healthcare professionals and reflected the growing role of patient autonomy and privacy. However, no one piece of legislation provided a comprehensive approach. The Krever Report, recognized that the many pieces of legislation were not sufficient to encompass all the aspects of privacy and health information, since each Act dealt with separate issues, targeted to specific populations and sectors of society. Many gaps in how patient health information was handled remained.

Two Failed Attempts

The Ontario Ministry of Health attempted to create guidelines in June 1996 with the paper, A Legal Framework for Health Information. If this initiative was successful, Ontario would be the only province to implement comprehensive rules for personal health information. In November of 1997, the Ministry of Health created the Personal Health Information Protection Act, 1997. The ambitious draft provided clear guidelines on the collection, use and disclosure of health information, the rights of patients to access their information, the procedure for the correction of health records. The scope of this draft was large and encompassed territory that had not been covered in previous legislation. Therefore, much debate was generated and in the end, the legislation was not made law.

In the wake of the failed attempt of the Personal Health Information Protection Act, 1997, Bill 159, An Act respecting personal health information and related matters was introduced to the legislature on December 7, 2000. The bill was not well received and found to be lacking the adequate balance sought by healthcare professionals and patients.

Federal Legislation and the Romanow Report

The provincial governments have the authority to regulate the delivery of healthcare but must do so in accordance with the Canadian Charter of Rights and Freedoms. The Charter does not explicitly protect privacy, but the Supreme Court of Canada has established that privacy is a constitutionally protected right.

In 2001, The Committee of the Canada Privy Council appointed the Honourable Roy Romanow, Q.C, as Commissioner to review and enquire to the future of Canada’s healthcare system. The results of the review, released in 2002 and popularly referred to as the Romanow Report, made many recommendations in regards to health information privacy that were similar to the Krever Report. Issues raised were the rights of patients’ access to medical records, concern over the misuse of information found in these records, the critical needs for patients to have access to their own information, and the need for health information to provide adequate treatment. Unlike the Krever Report, which made recommendations for the province, the Romanow Report called for clear and consistent privacy rules across Canada.

In April 2000, the federal government passed the Personal Information Protection and Electronic Documents Act (PIPEDA), which was limited to entities under federal jurisdiction, such as banks. However, if by January 2004, a province did not have its own privacy act that was substantially similar, PIPEDA would apply to all organizations within the province that collect, use or disclose personal information, including personal health information. PIPEDA was intended for commercial activities, and its
application to the health sector neither reflected the needs of the healthcare system nor provided a detailed framework for healthcare professionals to use.\textsuperscript{5} This would be the catalyst for the provincial government to draft comprehensive privacy legislation for health information that would better suit both the patients’ and healthcare professionals’ requirements in Ontario.

In December 2002, the Ministry of Consumer and Business Services and Ministry of Health and Long-Term Care, released a draft called Privacy of Personal Information Act, 2002 (\textit{POPIA}).\textsuperscript{14} The purpose of this legislation was to meet the criteria of being substantially close to \textit{PEPIDA} and relieve the pressure of Ontario health organizations from having to comply with the federal legislation. Unfortunately, \textit{POPIA} was far from ideal; it contained two separate sets of rules, one pertaining to personal health information, and the other that regulated personal information in the private sector.\textsuperscript{5} Although the pressure to introduce \textit{POPIA} was strong, with the 2004 deadline of the \textit{PIPEDA} approaching, the bill failed.

\textbf{Privacy Legislation Introduced at Last!}
On November 1, 2004, Ontario passed the Personal Health Information Privacy Act (\textit{PHIPA}).\textsuperscript{15} This legislation would provide an all encompassing framework for the protection of personal health information.

\textit{PHIPA} creates a set of rights and obligations relating to the collection, use, and disclosure of personal health information within Ontario.\textsuperscript{16} One of the overarching goals of \textit{PHIPA} is to strike an appropriate balance between (a) protecting privacy rights and (b) facilitating the effective delivery of healthcare services. Other objectives include providing individuals with the right to: access health records and correct erroneous information, request and independent review and resolution of complaints relating to the handling of health information, and obtain remedies for contraventions of the Act.

\textit{PHIPA} applies primarily to ‘health information custodians’ (HICs), which include professionals and organizations usually involved with the provision of healthcare services. One of the most salient features of \textit{PHIPA} is its treatment of an individual’s consent to the use of disclosure of health information. A patient’s consent can either be express or implied. Typically, consent will be implied when a health care provider discloses health information to another party within the patient’s ‘circle of care’. Express consent is necessary however when the provider discloses information to a party not classified as an HIC including, for example, a personal trainer.\textsuperscript{17} It is important to note that a request to hold health information confidential nullifies any implied consent which was presumed in the past.

\textbf{Conclusion}
The development of legislation to protect health information privacy in Ontario has been a long process, influenced by the federal and provincial governments and many healthcare and patient advocates. The effectiveness of \textit{PHIPA} will not be readily apparent for some time given its recent enactment; however the struggle to provide the adequate balance between the protection of personal information and allowing healthcare professionals ease of access to facilitate patient care will ultimately determine the effectiveness of this new Act.

(The website of the Information and Privacy Commissioner includes basic information, developments, and orders relating to the interpretation of the Act and serves as an invaluable resource to practitioners and administrators concerned with health privacy. For more information visit \url{www.ipc.on.ca})

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1. Advises to a Physician-Haly Abbas (Persian Code, 10 century AD).
When asked to contribute a commentary on ethics in the history of medicine, it demonstrates a distinct lack of imagination to write about the Hippocratic Oath. While it may not be imaginative, the Oath’s enduring role in modern medicine makes it a topic of fundamental importance. The Hippocratic Oath, or some derivative thereof, plays a central role in the graduation ceremony of nearly every medical school in North America. However, whether this is symbolic of one’s entrance into the medical profession, a tribute to the great tradition of medicine, or a solemn ethical commitment is rarely indicated. What exactly is an oath and what are its implications for the practice of medicine? What impact should it have? Why the Hippocratic Oath in particular? Why any oath at all?

These questions have concerned me since I first read the Oath, upon matriculation at medical school. Since, I have repeatedly reviewed the Oath, both in its original form and the “updated” form we used on the first day of class. I searched for meaning in the document I had always believed to epitomize the grandeur of medicine, but instead became incredulous that the archaic text was still read at all.

Perhaps it is understandable that the original oath, written in an era far removed from our own, would conflict with our understanding of ethics today. The Oath strictly prohibits abortion and euthanasia, takes a vague stance against all surgery, and indicates that medicine is strictly the domain of men. These positions so blatantly conflict with modern thought that the common, and convenient, solution is to simply omit the difficult passages. (The document I first read made no reference to these ideals.) Of course, ignoring the original tenets of the Oath does a great injustice to the field of medical ethics. If we truly believe that the positions articulated in the oath are in error, we must acknowledge and justify an alternate position. It is only through such acknowledgement that we can fully understand our ethical obligations.

While revising outdated positions may be seen by some as trivial, there is a more compelling reason why the Hippocratic Oath should no longer be sworn. There is a single theme that underlies the Oath – the so called “Hippocratic Principle.” By stating that all treatment will be applied “… for the good of my patients according to my ability and my judgement.,” the Oath is both paternalistic and individualistic. The Oath’s focus on the individual patient is at odds with the modern practice of medicine, where scarcity and rationing are common. We now understand the physician to fulfill multiple roles – with responsibilities to society as well as to individual patients. A Hippocratic understanding of medicine cannot recognize these divergent objectives, and is therefore a poor ethical guide for modern medicine. Furthermore, the emphasis that the Oath places on the physician’s “abilities and judgement” is incompatible with the modern understanding of the doctor-patient relationship. The Hippocratic ethic assumes that a vulnerable patient will place himself at the physician’s mercy and defer to the physician’s ‘better judgement.’ The doctor-patient relationship as described in the Hippocratic Oath is the antithesis of modern medical thought, which embraces the concept of patient autonomy. Therefore, the time has come to abandon the practise of swearing the oath.

However, if we abandon the Hippocratic Oath what, if anything, should fill the void? There are three related properties of oaths that must be considered to answer this question. Oaths, like promises, are properly described as ‘performative utterances’. That is, once sworn,
an oath does not simply describe the world – it changes the world.\(^5\) The motives, goals, and actions of the professor are fundamentally altered by the words of the oath. Consequently, an oath is also a serious moral commitment. “To make or go back on a promise [or oath] is a very solemn matter precisely because a promise [or oath] is world altering.”\(^6\) Finally, an oath is a lifelong commitment. Unlike a promise, an oath contains no qualifications as to time or place, and so the professor is declaring a principle that he will always uphold.\(^7\)

The significance and permanence of an oath might suggest that it has no place in medicine, where it is a simple fact that ethical thought can and has changed. While these changes are relatively easy to accommodate within professional codes of ethics – and even medical practice – it is far more difficult for physicians to learn that the solemn oath they have sworn, and that has changed their lives, is no longer relevant.

Furthermore, the assumption that ethics could be reduced to a set of rules is particularly troubling. The swearing of an oath – particularly an oath formulated like the Hippocratic Oath - implies that in simply doing this and not doing that, one is acting ethically. It is a thoroughly robotic and thoughtless process. Ethics requires more than this. In order to truly act ethically, one must understand the grounds for one’s actions. One must intend to act morally.\(^6\) Pragmatically, doctors must understand and be able to apply ethical principles, not just rules, because every circumstance is unique and no single set of rules could cover every scenario. Furthermore, with new technologies and redefined professional relationships, an oath cannot remain truly inclusive. Thus, as a set of ethical rules, the permanence of an oath makes it ineffectual and undesirable.

Yet, perhaps these arguments against oath taking can be resolved by examining the distinction between an oath and a code of ethics. It has been observed that “the Oath of Hippocrates, while primarily an oath, also contains elements of a code. While primarily a commitment to become a certain kind of person, working for the benefit of one’s patients, it also contains a specific list of do’s and don’ts. [sic]”\(^7\) Such rules are properly established in a code of ethics. Unlike oaths, there is little difficulty in arguing, changing, or augmenting ethical codes. Thus, the distinction between oath and code, if observed, can resolve the perceived difficulties with oath taking.

However, if an oath does not outline a specific set of moral rules, does it perform any function within the medical profession? Some might suggest that the Hippocratic Oath, as a medical oath, is a relic of an earlier time and should be abandoned.\(^3,4,8\) I believe there in another, more appropriate option. Although medical ethics has been increasingly viewed as a simple subsection of universal ethics, such an approach is likely over simplistic. While medical professionals certainly must adhere to all the directives of general ethics, the obligations of a physician may not be fully described by such ethics. For example, it would be very difficult, if not impossible, to describe the basis of medical beneficence in the language of universal ethics. Beneficence, as an ethical obligation, simply does not seem to apply to other professions or to society in general. While the ethical codes of lawyers, engineers, and even politicians employ the principles of justice and non-maleficence, they certainly do not demand the altruistic dedication obliged by beneficence. If beneficence is not a consequence of normal ethical responsibilities, how does it become an obligation in medical ethics?

The answer, as I see it, is that the medical oath has played a very important role all along. As a performative utterance, an oath has the power to alter the world, both for its professor and for the public who bear witness. Just as one who makes a promise creates a new ethical obligation for himself that is not generally applicable (to keep that promise), the medical community has established the ethical principle of beneficence through the solemn promise of its oath. Importantly, the specifics that caused such difficulty for the Hippocratic Oath – those statements that are more correctly delineated in a code – are not necessary to establish this general ideal. If the specifics are omitted, an oath can
easily accommodate new technologies and ethical theories. General principles, such as beneficence, can be applied in various ways without altering the underlying ideal. Therefore, a properly formulated medical oath could be both essential and enduring.

The time has come for the medical profession to do away with the tradition of swearing the Hippocratic Oath at graduation ceremonies – and to learn from its many short-comings. However, a medical oath is very important in establishing the altruistic ethic that is so central to medicine. The distinction between an oath and a code of ethics is important and must be recognised in order to preserve the validity of any medical oath. Professional codes of ethics are required to outline the individual rules that govern the practise of medicine, but these rules are too specific to preserve the permanence and incorruptibility necessary of an oath. Thus, although I presently offer no substitute for the Hippocratic Oath, I suggest that one be developed that focuses exclusively on the essential principles of medicine, including the physician’s altruistic dedication to his patients.

References

Since the ancient times, nutrition has always played an integral part in the pursuit of human health. Early physicians and philosophers like Hippocrates, Plato, and Galen recognized the importance of diet in health and wrote extensively on the subject. Ironically, while our ancient predecessors fell prey to famine and the plague\(^2\), North Americans are dying from obesity-related diseases. For most North Americans, the 21\(^{st}\) century has been an age of decadence, where, to paraphrase Christopher Marlowe, “quod me nutrit me destruit”\(^3\), what nourishes us is destroying us.

In the last 50 years, the public has been bombarded with promises of good health from myriad popular diets. Unlike many of the other fad diets, the Mediterranean diet is rooted in ancient tradition. “Mediterranean diet” is a general term used to describe the dietary style of ancient Crete and the majority of Greece.\(^4\) This diet (fig 1) is characterized by copious consumption of fruits, vegetables, whole-grains, olive oil, cheese and yogurt. Consumption of fish, poultry, red wine and eggs is moderate, while consumption of meat is occasional.\(^4\) The possible health benefits of the Mediterranean diet came to public attention with the “Seven Countries” study led by Ancel Keys. Keys et al. demonstrated a correlation between dietary patterns in 1960s Crete and low rates of coronary heart disease.\(^4\) This article seeks to examine the origins of the Mediterranean diet and discuss the efficacy of the diet with respect to health protectiveness.

Though the Mediterranean diet focuses on the habits of ancient Greeks and Cretans, it should be noted that the Mediterranean region is comprised of more than 15 countries, including Greece, Italy, Cyprus and Turkey. War and political acquisitions helped to blend dietary culture. For example, in 8\(^{th}\) century B.C., southern Italy was colonized by Greeks and is known as “Magna Graecia”.\(^5\) Diet played a key role in classical Greek society (500-323 B.C.) as evidenced by numerous references to food and nutrition in Plato’s Republic (360 B.C.). So famed were the Greeks for their plant-based diet, the satirical poet Antiphanes (407-343 B.C.) dubbed them the “leaf chews”. Olive oil was commonly used for lighting, cooking and as a therapeutic balm.\(^6\) Cereals played a central role in Greek diet, so much so that the Greek goddess of the Earth, Demeter played a central role in classical culture. Wheat was commonly fashioned into cakes and eaten with olive oil. Legumes were often boiled into soups and their laxative properties were championed by Pythagoras.\(^7\) Figs, pears, apples pomegranates, sorb-apples, bulbs, onions, greens, acorns and myrtle berries were also popularly consumed.\(^6\) Meat was rarely consumed, as it was expensive and also considered unfit to eat in certain regions.\(^7\) In classical Athens, fish (mackerel, tuna, mullet, anchovy, octopus, sole, eels, mussels and oysters) was more popular than meat.\(^6\) When it was consumed, meat was boiled with spices and salt or roasted. Milk was rarely consumed, but cheese was a staple of classical Greek diet. Red wine was very popular and was often diluted for consumption. Honey was used as a primary sweetener.

Moderation and balance were key parts of the Mediterranean diet as evidenced by Hippocrates’ comment on diets: “a regimen carried to the...”

“Let thy food be thy medicine, and thy medicine be thy food”

-Hippocrates (460-377 B.C.)\(^1\)
extreme of restriction is perilous; and in fact repletion too, carried to extremes is perilous”. Hippocrates also recognized the dangers of obesity: “those who are constitutionally very fat are more apt to die quickly than those who are thin”. Perhaps there is something to be learned from these two gems of ancient wisdom in our time.

It is important to note that although the Mediterranean diet has ancient beginnings, it can serve as a healthy dietary template for present day people – and adherence to the diet is easy. The diet’s staple foods, namely olive oil, fish, fruits, legumes, and vegetables, are widely available at grocery stores. These foods, while offering protection against cardiovascular disease and cancer, are also inexpensive. The majority of health benefits of the Mediterranean diet stem from its rich content of healthy fatty acids and antioxidants. Recently, the diet has emerged as a solution to the triad of cardiovascular disease, diabetes, and cancer; these diseases account for the majority of morbidity and mortality in the Western world. In fact, a close inspection of the Harvard School of Public Health’s “Healthy Eating Pyramid” reveals that the majority of the pyramid’s food choices consist of Mediterranean staples. The food pyramids of the Mayo Clinic and the University of Michigan are also inspired by the Mediterranean diet.

Virgin olive oil, a staple of the Mediterranean diet, is comprised mostly of monounsaturated fatty acids (MUFAs). These fats have been shown to lower blood pressure, protect arterial endothelium, and decrease post-prandial plasma glucose levels. The latter effect is likely related to the substitution of simple and complex carbohydrate consumption with MUFA consumption. Fish, another vital component of the Mediterranean diet, is rich in n-3 polyunsaturated fatty acids (n-3 PUFAs). This group of fatty acids exerts anti-inflammatory and anti-thrombotic effects. Eicosapentanoic acid (EPA), a type of n-3 PUFA, is known to inhibit the synthesis of thromboxane A2, a platelet aggregator and vasoconstrictor. EPA also enhances the vasodilator effect of nitrous oxide, and reduces leukocyte adhesion to the endothelium. Fish consumption is associated with a decreased incidence of cardiovascular diseases, and weekly fish intake has been shown to reduce the risk of sudden cardiac death by half.

Olive oil, while contributing beneficial fatty acids, is also a potent source of phenols. These compounds have strong anti-oxidant effects, and are known to be protective against cardiovascular disease, colon cancer, and prostate cancer. Virgin olive oil, which has an even greater concentration of phenols than regular olive oil, is a source of 30 phenolic compounds. Vegetables are another important source of phenols. Vegetables that are especially high in these antioxidants include artichokes, cabbage, broccoli, garlic, and red chicory lettuce. Wine is also especially high in these antioxidants, and is another key part of the Mediterranean diet.

As our knowledge of cardiovascular disease and cancer pathophysiology evolves, modern evidence increasingly supports the ancient menu of the Greeks and Cretans. One of the greatest challenges in public health today is trying to help Canadians improve their diets. This is perhaps more easily accomplished by providing them with a template from which to select foods. The Mediterranean diet provides such a template, and is pleasing to the palate. By encouraging the North American consumer to substitute “Mediterranean for McDonald’s”, physicians can arm patients with a health protective diet that is easy to adhere to and ascribes to the Hippocratic notion “Let thy medicine be thy food”.

References

1. Quotation attributed to Hippocrates (460-377 B.C.)
Telerobotic surgery has come a long way in its brief history. While teleconsultation continues to be used today, the advent of high speed communications and increased computational power is making long distance remote control of operating instruments, termed telepresence surgery, a reality. Based on laparoscopic technology, telerobotic surgery was tested first on animals and, more recently, on humans with success. The technology offers several advantages, including improved accuracy and the ability to bring difficult procedures to rural and remote locations where trained surgeons are not available. While various technical difficulties and ethical issues must still be worked out, the advantages of remote surgery ensure that this technology will continue to be developed for widespread implementation in the years to come.

Surgery, which is arguably as much art as science, has evolved from the early crude days of trepanation and battlefield amputations to modern procedures such as complex neurosurgeries and minimally invasive laparoscopic interventions. Just as the artist can do little without his brushes, however, the surgeon is virtually useless without his tools, and it is perhaps the development of these tools, which has directly driven the evolution of surgery. While various tools such as scalpels, loops, stitches, anesthesia and antiseptics have each expanded the range of possibilities for procedures, some of the newest tools to enter the surgical arena are computers and robotic instrumentation.

Teleconsultation and the dawn of remote surgery

While the advantages of computer and robotic assistance in surgery, in terms of enhanced accuracy and control may seem obvious, one of the most interesting and useful applications of this technology is to perform surgeries remotely. Patients in rural and remote locations often do not have access to advanced surgical care due to a lack of qualified personnel. This is not only the case in both wartime battlefields and third world countries, but is, unfortunately, a problem in many remote areas of Canada as well. Surgical care in these locations is either impossible or requires transportation to an urban center over long distances.

The first attempts at remote care were really what would be termed teleconsultation. The 1960’s saw the beginning of electronic transmission of radiological films, while the 1970’s brought the ability for practitioners to consult with experts remotely over video-conference systems. In a surgical implementation of teleconsultation, a remote videoconferencing system was set up in the operating room and was linked to an expert physician at an urban center. This ‘remote’ surgeon did not actively participate in the procedure, but rather offered advice or guidance to the attending surgeon at critical points. At best, electronic remote control of the video camera was available, but little else. While definite benefits in terms of transmitting expertise and training inexperienced surgeons could be realized with this setup, true remote surgical control was impossible.

Laparoscopic surgery: a catalyst for advancement of telerobotic surgery

This changed with the advent of a robotic system aimed at assisting in laparoscopic procedures. Laparoscopic surgery utilizes a miniature camera (i.e., laparoscope) and small surgical tools which are inserted into the body via tiny incisions and controlled via external manipulators. Minimally
invasive surgery performed using laparoscopy provided several advantages to the patient: less pain, a shorter hospital stay, better cosmetic outcome and faster recovery. Unfortunately, this surgical technique, in its original conception, had several shortcomings. The laparoscope produced only a 2-dimensional view of the surgical area, and hand-eye coordination was difficult due to the need to look at a monitor instead of one’s hands. Furthermore, the laparoscope was held by an assistant, and therefore direct was taken out of the hands of the surgeon. Perhaps most importantly however, laparoscopy, by its very nature, introduced amplification of tremor, loss of degrees of freedom in manipulation, and the brought the requirement for making non-intuitive motions when performing a procedure.

In an attempt to overcome the inherent limitations of laparoscopic surgery, research supported by the United States Defense Department’s Star Wars program was undertaken in the early 1990s at the Stanford Research Institute to develop a ‘master-slave telemanipulator’ – a system wherein a computer and robotic instrumentation intervened between the surgeon and the patient. Ironically, the original goal of this technology was to enable actual manipulation of surgical instruments by remote surgeons, a concept termed telepresence surgery. It was hoped that this technology would be useful in performing remote trauma surgeries on the battlefield or outer space, where surgeons could not venture. Unfortunately, while a system was developed, it lacked the required degrees of freedom necessary for efficient surgery, and its large size precluded widespread use. When this research program ended in 1994, the patents were sold to a private company, which continued development to produce what is now called the da Vinci robot system. This robotic system builds on traditional laparoscopic technology, rectifying some of its flaws while introducing the capacity for remote manipulation. The first refinement is that the camera platform is stable, and can be controlled by the surgeon’s feet or voice commands, eliminating the need for an assistant. Second, visualization is greatly enhanced with a 3-dimensional magnified system to simulate natural vision, or alternately 2-dimensional displays positioned near the hand controls. Moreover, since physical manipulation of the controls is processed by a computer, tremors can be digitally filtered out preventing undue error. Finally, the use of motion scaling, which reduces large movements to fine ones, allows surgeons to perform actions which were previously impossible due to their delicacy.

Telerobotic surgery matures

Early telepresence surgery research was extremely limited, and being hampered by technical limitations, was carried out only on animal models. Advanced manipulation techniques were not possible due to lack of adequate computational power and communication bandwidth. An early ‘procedure’ was performed in 1993 by issuing keyboard and mouse commands to manipulate an echographic probe, biopsy needle and scalpel over a transatlantic fiber optic telephone link to remove a cyst from a pig’s liver. Unfortunately, transfer of real-time video over the wired network was technologically impossible at the time due to bandwidth constraints; consequently, relatively expensive satellite links were required. One of the leading difficulties in developing clinically viable telerobotic surgery has been the requirement of minimal time lag between the issuing of commands, actual surgical action, and reception of visual confirmation on the screen. This lag is influenced by multiple factors including time required for converting video and movements into the appropriate signals and the inherent delay in the communication network itself. Experiments have determined that the acceptable limit for safe surgery is 330 milliseconds. Even with the satellite video link in early experiments, overall delays of approximately 2 seconds were inherent in the technology – obviously far from acceptable for a real-time surgical procedure. Accordingly, it was estimated that feasible distances for remote surgery could not exceed several hundred kilometers. This was, however, disproved in subsequent years.
The first successful telerobotic procedure on a human was performed in 1995 by Dr. Alberto Rovetta in Italy -- a prostate biopsy was obtained from a patient 5km away via a robotic telemanipulator. While this experiment was promising, the original dream of a true long-distance fully controlled remote surgery was not realized until several years later when suitable high speed, high bandwidth communications and adequate computational power were available. On September 7th 2001, the world’s first trans-Atlantic complete operation, termed the “Lindberg operation”, took place. In this case, a patient in Strasbourg underwent a cholecystectomy with the controlling surgeons located in New York. This surgery was completed using a second commercially available robotic surgery system, called ZeusT, which featured a robotic endoscope positioning system called AESOP (Automated Endoscope System for Optimal Positioning). With a time delay of 155 milliseconds, the surgery was deemed safe, and no post-operative complications were noted. While telerobotic surgery is still far from mainstream, several surgeries have already been successfully completed including fundoplications, sigmoid resections, hemicolectomies, inguinal hernia repairs, colectomies, radical prostatectomies and nephrectomies. Other surgeries, including the first Canadian remote coronary bypass (1999) and mitral valve replacements were performed at London Health Sciences Center.

The challenges ahead
While remote surgery seems promising, several issues remain to be worked out. For one, current systems lack tactile feedback, although this is actively being developed. Without the ability to feel resistance in tissues, the surgeon must carefully review visual information to avoid making an accidental tear. Another problem
stems from the compliance of certain tissues; for instance, the robotic manipulators have difficulty in grasping slippery surfaces\textsuperscript{11}. However, these obstacles will likely be surmounted in future versions of the technology, and a testament to the incredible functionality already achieved by these robots can be made by observing the actions of the surgeons. Almost without fail, surgeons using the telepresence system unwittingly find themselves removing their hands from the manipulators to retract a piece of tissue, the advanced technology making them forget for a moment that they are not really at the surgical site.\textsuperscript{12}

While telepresence surgery holds much potential for fulfilling many of today’s remote surgery requirements, it also brings with it a variety of unique challenges. First, the cost of equipment and communication links is high. Training surgeons with the technology is time-consuming, as is setting up the equipment. Second, it is essential that an adequately trained surgical team be present at the surgical site, ready for emergency intervention in case the equipment malfunctions, or the communications line is severed. This ties down surgeons who might otherwise be performing their own operation elsewhere. Similarly, significant time is required to switch surgical instruments on the machine between operations.\textsuperscript{9} Finally, there are many legal and ethical questions that must be answered before remote surgery can be widely adopted. Medical licensing over provincial and international borders is unclear, at best. Perhaps more importantly, however, the traditional patient-clinician relationship will have to be redefined, as the patient may never meet his surgeon face to face.\textsuperscript{10}

The prospects for telesurgery are exciting. From remote surgeries in space to mobile hospitals in war zones or developing countries, the possibilities are endless. While we have
already come a long way from the early surgeries performed with nothing more than a blade, the continuous evolution of computers, communications systems and mechanical surgical equipment ensures that many exciting developments in the field of telesurgery will take place in the years to come.

References

In the general prologue of the Canterbury Tales, Geoffrey Chaucer describes physicians as having a “special love for gold”.

Rightly or wrongly, physicians have been accused of extorting higher than deserved fees for the services that they provide and in this article I will briefly review how physicians have been remunerated throughout the history of medicine.

Probably the oldest extant primary source of medical fees is the code of Hammurabi. Written about 2000 B.C., the code is a set of laws decreed by King Hammurabi of Babylon. There are several references to physicians, including how they should be paid for their services. For example, sections 215-217 of the code read:

If a physician has treated a man with a metal knife for a severe wound, and has cured the man, or has opened a man’s tumour with a metal knife, and cured a man’s eye; then he shall receive ten shekels of silver. If the son of a plebeian, he shall receive five shekels of silver. If a man’s slave, the owner of the slave shall give two shekels of silver to the physician.

Ancient authors such as Hippocrates, Aristophanes, Sophocles, Plato, Aristotle and Galen debated whether physicians should be paid at all. There was disagreement as to whether medicine was an art or a “techne” (skill or craft). If medicine was a craft like carpentry then physicians should be paid similarly, for all craftsmen practiced their craft for money to earn a living. However, if medicine was a liberal art such as philosophy, mathematics or poetry, then a man would do it for the sake of virtue and collecting fees would “be regarded as doing something typical of a hireling or slave” according to Aristotle. The Hippocratic writings often refer to medicine as an art, and mention fees in some places but in others advise to practice medicine without payment. Aristophanes says that medicine was an art and not a mere skill or craft, while Sophocles called physicians “craftsmen of medicine”. In Plato’s Republic, Socrates discusses the question of whether a physician is a “money-maker or someone who treats the sick”. Galen believed that physicians practiced medicine either because they love humanity, or because they love honour, or because they love glory, or because they love money. According to Galen, it was preferable to practice medicine because of the love of humanity but those that practice because of other reasons were not inferior physicians but inferior philosophers. Galen says he never requested payment but would accept it if offered, which he believed was an important difference. Practically, there were many physicians in the ancient world who did not come from wealthy and noble families like Hippocrates and Galen, so there were many poor physicians who did request and even sued for payment.

There are examples from medieval Islamic writings of physicians who worked in other businesses on the side or received a patronage from wealthy individuals such as a caliph or sultan, so they had the opportunity to provide their services free of charge. Ishaq b. ‘Ali al-Ruhawi, a ninth-century Islamic writer says that
because health is the prerequisite for the performance of all other human activities, medicine occupies the highest position of all professions. Therefore, society should meet the physician’s financial demands in order that he does not have to do other work to support himself and that “the rich should pay the physician more than enough, because he cannot charge the poor towards whom he must extend his charity.”

According to the Hebrew scriptures, human physicians could practice medicine but ultimately, healing came from God. The Talmud quotes an adage “A physician for nothing is worth nothing”, and includes the fees a physician should receive. Nachmanides, a medieval Jewish writer says that “a physician may accept fees for the loss of time and for the trouble” of leaving his home and traveling but he should not be remunerated for simply giving instructions.

There were contracts between Jewish physicians and Jewish communities in European cities during the 17th and 18th centuries. The physician was appointed for several years, was given a yearly salary or was to charge stipulated fees, was to attend to the poor without taking payment, and was to receive special payment for night calls and treating children. The rich were expected to pay for their treatment but usually only a stipulated fee.

In medieval Europe, some physicians were employed by royalty and attended to the health of the royal court and perhaps some of its subjects, others were paid by the church to treat the sick of the parish and the poor. Some city-states such as Venice employed physicians to give free treatment to the poor, treat the rich at reduced rates and advise the state on medical and public health matters.

There are many sources from America which record how physicians were paid and whether fees were regulated or not. One example is the regulation of fees in Boston starting in 1780. It was the Boston Medical Society which developed the fee bill in order to stop physicians from undercutting each other. The fees on the fee bills were minimums so physicians could charge more, but no less. In addition, patients only wanted to pay for services if it included treatment such as a drug or a procedure. The fee bill however stipulated that charges be made for all visits. Because the physicians were controlling the fees, they made sure that they were always very well compensated, their general policy being to increase fees in good economic times but not to lower them in hard economic times. Between 1795 and 1806 the cost of living changed very little but the fees increased by 50-60%.

In Boston, we see an example were the physicians controlled their own remuneration and thus sometimes charged quite high amounts for their services. In South Carolina in 1844, we have an example of quite the opposite. The St. Peter’s parish, like the whole state, was very poor so the local officials decided to set a fee bill to curb the “exorbitant, oppressive” physician fees which “unjustly absorbs so large a portion of [the farmers] hard earned incomes.”

If we compare the fees in Boston and South Carolina, we can see the vast difference in fees when physicians or the community set them. In Boston in 1806, a regular single visit was $1.50, normal obstetrical delivery was $12.00, treating gonorrhea was $10.00 and the fee for amputating a leg was set at $40.00. In South Carolina, almost three decades later in 1844, a regular single visit was no charge, normal obstetrical delivery was $3.00, treating gonorrhea was $2.00 and the fee for amputating a leg was set at $5.00.

The advancing settlement of America westward necessitated innovative solutions for physician remuneration due to low populations and poor patients. For example, a physician only agreed to move to Tucson, Arizona in 1871 after twenty-five families agreed to pay him $100 a year for his services. The frontier medical practice also required novel ways of payment such as poultry, cattle, tobacco, fruit, vegetables, wood and clothes.

Barter was also a common payment method in Australia. The very first physicians were military and naval surgeons and so would have been paid as salaried practitioners. As free settlers came though, “civilian” physicians would need to be paid and payment with goods and services would have been acceptable.
because the early Australian physician would have few places to spend his money. By the middle of the nineteenth century there are examples of fee regulation in Australia. The Port Philip Medical Association set fees for three different classes of patient with different fees for different classes. The 1st class patients (i.e. rich patients) had to pay two to five times as much as 3rd class (i.e. poor patients) for the same treatment.

In Canada, the first known surgeon came to Montreal in 1653 as a military surgeon earning 147 livres a year from his military salary. He also treated 42 families for 5 livres annually each and trained an apprentice for 150 livres per year giving him an annual income of about 500 livres which was about 17 times that of the lowest salaried worker. The first physician came to Quebec City early in the eighteenth century and earned about 2400 livres which was about 60 times that of the lowest salaried worker. In 1851, Dr. James Lanstaff’s medical income was only about $500, but climbed to $2000 in 1861 and $3000 in 1880. During the same period, a labourer would make about $300 per year. Langstaff became a wealthy man, but only because he had income other than medical fees. In fact, several hundred families owed Langstaff money during his active practice and he accepted payment from some families in the form of food, produce, lumber, animals and labour. Sir William Osler charged his rich patients very high fees and his poor patients nothing at all.

From the very earliest of recorded history in the code of Hammurabi to the present day, we can find records of physician remuneration. It was an important matter of debate in medical texts as well as non-medical writings from Aristophanes’ and Sophocles’ plays as mentioned above to Molière’s “Le Malade imaginaire” and George Bernard Shaw’s “The Doctor’s Dilemma”. For the subject to be found throughout recorded history – medical and non-medical – the issue must have been important, as it is today. Perhaps, some ideas to help us fix our current problems can be found in the past.

References
The conquests of Muhammad starting in the 7th century led to the spread of Islam and the teachings of the Qur’an, a theology believing that genuine health and happiness is the natural state of existence. While medieval Europe rejected the medical knowledge of the pagan Greeks, the early Islamic world was eager to assimilate and expand the Hellenistic medical teachings, emerging as the collector and preserver of Western medicine. For ophthalmology, an especially extensive literature developed. The prevalence of eye diseases in the Islamic lands resulted in particular interest in their skilful diagnosis and treatment. Using principles of clinical observation, many ocular diseases were described or classified for the first time. Intricate surgical excision with an array of minute instruments was used in the treatment of several external diseases of the eye such as pannus and pterygium. Suction removal of cataracts using a hollow needle was also described. Their advances in the knowledge of optics, anatomy, and physiology of the eye became major contributions to modern ophthalmology. Latin translations of the extensive Arabic literature on ophthalmology influenced late medieval Europe, and many of these contributions of early Islamic empire remain today. Medieval Islam made these advancements because it eagerly encouraged knowledge and physician thinkers from all cultures.

A Medium for Medieval Medicine

Three civilizations emerged from the fall of Rome in 476: the Byzantine Empire, the Early Medieval West, and Islam. The Islamic empire emerged as the sole preserver of the classical knowledge of ophthalmology and added contributions that are still significant today. The Islamic empire was able to achieve its great contribution to ophthalmology because of unique cultural conditions within its borders during its establishment and its golden age.

When Arabia was split into many different tribes in 622, Muhammad founded his ideal community in Medina, where religion and state became one. Muhammad gave specific instructions on various aspects of health, treating people himself, stressing that genuine health is the natural state of existence. With the prevalence of disease, medicine became a central part of medieval Islamic culture.

With Muhammad’s death in 632, Arabia was at peace for the first time, united under a new and resourceful religion, which espoused sound health amongst its followers. Inclusion of other societies within its growing borders allowed the young Islamic world to flourish, absorbing the culture and scientific knowledge of other civilizations.

While conversion to Islam outside Arabic lands was gradual, linguistic conversion proceeded more rapidly. After only a century, Arabic was the official and working language, often completely replacing older languages within the empire. Islam not only inherited the earlier scientific and medical traditions, but also received contributions from its non-Arab, non-Muslim peoples who adopted Arabic as a common language of scholarship, facilitating unprecedented scientific and medical exchange and enabling significant expansion of past knowledge.

Because copying the Qur'an was an act of piety, Islamic culture also had an engrossing tradition of book-making, including calligraphy, illustration, paper-making, and binding. Illustration practices were adopted from the Byzantine and Persian cultures, while Chinese paper making was improved upon. Islamic medical knowledge was recorded in textbooks and transmitted across its lands and to future generations.

The Royal Library of Baghdad

The knowledge of the earlier Greek medical teachings came to Islam through Nestorian Christians, driven out of Byzantine and settling in Persia. Their translations and teachings were valued by an emerging Islamic empire which needed to find ways of dealing with common medical problems: disease, pain, injuries, and
successful child-bearing. Upheavals in the first millennium of Christianity caused the loss of many Greek medical works which are now only known from Arabic translations.

This heritage of medical theory and practice was assimilated and elaborated by an international community of scholars of many different cultures and languages including Arabic, Persian, Syriac, Hebrew, and Turkish. During the Abbasid Dynasty (750-1258), Islam’s Golden Age, translation of Greek, Hindu, Syriac, and Persian texts accelerated. Caliphs of this age promoted knowledge and curiosity and the Royal Library in Baghdad became a centre where countless precious manuscripts from all corners of the empire were collected for translation.

Hunayn ibn Ishaq, a Syriac-speaking Christian working in Baghdad at this time, made Arabic translations of nearly all known Greek medical books. He also wrote several medical and ophthalmologic treatises that later circulated in Latin in Europe. His treatises were fundamental in establishing the basic conceptual framework of medicine in renaissance Europe. These translations maintained a continuity of ideas between Roman, Islamic and late Medieval European practices.

Islamic physicians like Hunayn produced a vast medical literature of their own, combining Greek doctrines and their own observations. By the end of the ninth century, Arabic medicine had fully integrated the Galenic humoral system, and further developed the Galenic tendency to systematize by writing medical treatises that organized the vast body of medical knowledge into one comprehensive and logical structure. Hunayn’s original work, Ten Treatises on the Eye, is an example of this new organisation and an exhaustive work on the eye.

As opposed to theoretical reflections on illness, a new trend developed that focused on expanding empirical knowledge and on practical procedures for treatment. Abu Bakr al-Razi or Rhazes, criticized the inherited medical knowledge for inferences that did not always correlate with clinical observations. He pioneered clinical medicine by conducting what amounted to controlled experimentation. For instance, he used bloodletting in one group of patients while giving no treatment to another group. He also wrote case histories, 900 of which were included in his casebook, Kitab al-Tajarib. His casebook described 48 cases of eye conditions, often differing from his theoretical writings. A third of the ophthalmologic complaints in his casebook, with their complex mixture of symptoms, do not appear in his famous theoretical book, Kitab al-Mansuri. Furthermore, several treatments used in the casebook deviated from the theoretical work because of adjustments to the particular needs of the patient.

Works of the late Islamic golden age reflect the mature development of all these trends as demonstrated by the Perfected Book on Ophthalmology written by Ibn an-Nafis (b. ca. 1210). The first part, on the theoretical principles, deals with anatomy, physiology, pathology, aetiology and symptomology. The second, on the clinical treatment and surgery, is systemically organized and provides an account of the improvements made based on clinical observation.

Medieval Islam was responsible for translating and preserving many medical works into Arabic, allowing an international community of scholars to improve on inherited knowledge in two broad themes: the systematization of contemporary medical and ophthalmologic knowledge in manuals for easy transmission; and the development of clinical medicine through rigorous research and observation, challenging pre-existing theoretical frameworks. These frameworks allowed the Arabic advancement of classical ophthalmology.

A Specialty is Written
Blindness was a major cause of disability throughout the Islamic lands. As a result, Islamic physicians displayed particular concern and ability in the diagnosis and treatment of eye diseases and nearly every medical compendium had chapters on ophthalmology. Rhazes’ work, Kitab al-Mansuri, included a large section on the specialty. It was one of the most widely read
medieval medical manuals in Europe and often reprinted with commentaries by prominent Renaissance physicians such as Vesalius. There were a large number of monographs devoted solely to ophthalmology. The early work of Hunayn’s ninth-century manual, Ten Treatises on the Eye, and Ibn an-Nafis’ thirteenth-century manual, Perfected Book on Ophthalmology, are two examples. Ali ibn Isa’s tenth-century Memorandum Book for Oculists was the classical Arabic textbook of ophthalmology and became the standard treatise of the eye for several centuries in Islam and Christendom. The text describes over a hundred different diseases of the eye organized by anatomical location and combined Greco-Roman knowledge with novel observations.

The Greco-Roman attitude to ophthalmology was poor, with only five works on ophthalmology in the 800 years between Herophilus and Alexander, all of these lost and none by a specialist. Moreover, the writings of Galen referred to ophthalmologists in a derogatory manner. In contrast, during the 500 years of the Islamic golden age, thirty textbooks on the eye were written, thirteen of them surviving and ten written by ophthalmologists. These doctors had thorough specialty training and were honoured by the public.

New Insights
Anatomy
The Islamic scholars based their anatomic knowledge upon Galen’s works and as a result made similar errors: the posterior chamber was too deep, the optic nerve had a canal and there was an extra extrinsic muscle. Nonetheless, two important contributions to modern ophthalmology were made. First, Arabic medical literature contained the first illustrations of eye anatomy, with the earliest surviving drawing appearing in Hunayn’s Ten Treatises on the Eye. The optic chiasm and brain were illustrated in Ali ibn Isa’s Memorandum Book for Oculists. This was passed on to the European Renaissance, including Vesalius, whose figures resemble the Arabic (Figure 1).

Second, modern day terms for eye parts are derived from Arabic terms and not from Greek. For instance, the medieval Latin translation of Hunayn’s figure of the eye, left, is the first known anatomical illustration, originally illustrated ca. 850 and shown here in translated form by Meyerhof (Wood, 1936). Vesalius (1514-1565) was greatly influenced by Arabic anatomy of the eye in his figure, right (Sorsby, 1933).
the Arabic word, qarniyah, became a part of the standard Leipzig anatomical nomenclature as cornea. In contrast, Galen used the Greek word, keratoëides, which is not used today to describe the cornea.\textsuperscript{13}

**Optics**

Ibn al-Haytham, known as Alhazen, rejected Hellenistic theories of vision postulating that vision resulted from rays emitted from the eye (Euclid), or transmission of a form from the object to the eye (Aristotle). Alhazen’s remarkable insight was that an image of the object is formed due to the emission or reflection of light from the object to the eye.\textsuperscript{4} He worked out his theory sufficiently to create the foundation for use of lenses to correct vision. However, this possibility was recognized only after the transmission of his discovery to Europe, where two centuries later Roger Bacon suggests the use of lenses for vision correction.\textsuperscript{14}

**Cataract**

The first authentic document on the treatment of cataracts was by the Roman, Celsius, who described entering a sharp needle into the eye to downwardly displace the lens from the pupil, breaking it up into many fragments if needed.\textsuperscript{14} This technique, known as couching, was commonly employed in the Arabic lands, with the major complications being infection and glaucoma. Although the success rate was only 4 in 10, it found wide acceptance because the alternative was blindness.\textsuperscript{3} Ammar, born in the late tenth century, invented the suction method for cataract extraction, by which a glass tube is introduced through a corneal incision for evacuation of the lens by suction (Figure 2).\textsuperscript{15} Unlike other contributions from the Arabic lands, the suction technique was only popular in the eastern part of the empire, and thus failed to reach Christian Europe, where couching continued until the technique was separately described by Daviel in 1748.\textsuperscript{14}

**External Diseases of the Eye**

Chalazions were described as collections of a gross humor that gathers in the lid. If conservative topical treatments failed, it was incised with a round-headed lancet, scraped out with the spoon at the end of the sound, closed with a suture, and irrigated.\textsuperscript{11} Today’s treatment is similarly incision and curettage.\textsuperscript{16} Styes were described as an abscess at the root of an eyelash. Treatment was rubbing with very hot bread.\textsuperscript{11} Modern treatment is likewise hot compress.\textsuperscript{16} Original surgical techniques dealt with treating the sequelae of trachoma, a leading cause of blindness. Trichiasis was treated through extraction of the inverted hairs and cauterization of the roots using a needle that was heated red-hot. Trachomatous pannus was recognized as the superficial vascularization of the conjunctiva and treated surgically by raising the pannus with a number of very small hooks and excising the raised film with very thin scissors or cataract needle (Figure 3). Pterygium was described as the encroachment of the conjunctiva on the cornea and was removed using a similar technique as the removal of pannus.\textsuperscript{11}

**The Reflected Light**

The Renaissance in Europe was the result of the normal development of science coming from the Islamic Orient, passing through the multilingual communities of Southern Italy and Spain, and finally reaching Western and Central Europe.\textsuperscript{9} Constantinus Africanus, an Italian monk born in Carthage in 1018, translated numerous books into Latin. The translations into Latin occurred at the same time as the Crusades. The crusades both aggravated relations between Christendom and Islam and provided opportunities for Europeans to learn different Arabic technologies and practices.\textsuperscript{7}

Systematic medical texts, such as Rhazes’ Kitab al-Mansuri and Ali ibn Isa’s Memorandum Book for Oculists, carried both classical and Arabic knowledge of ophthalmology and medicine to Christian Europe. Used by European physicians for centuries, these works had permanent influences on the formation of Western ophthalmologic theories, practices and terminology. Rhazes’ writings were part of the curriculum in Western medical schools until the nineteenth century.\textsuperscript{1} An analysis of De Oculis, a Latin textbook about eye diseases written by Peter Hispanus (Pope John XXI) in the thirteenth century, concluded that the text depended on
treatises from Hunayn, Rhazes, Galen and Plato alike.  

Although Arabic medicine and ophthalmology were founded on the work of other cultures, and although several of its brightest minds were not Muslim but Nestorian Christian, the golden age of Islam was responsible for numerous advances in ophthalmology that remain with us today. The common language of Arabic within Islamic lands allowed discussion of ideas and development of manuscripts by an international community of scholars. Medical knowledge was improved by the systemization of information and testing theory with clinical observation. Curiosity and knowledge, as well as acceptance of other cultures, allowed early Islam to rapidly develop scholarly knowledge in all fields, including ophthalmology.

References

Since its first discovery in the early 1980s, the mystery of the Human Immunodeficiency Virus (HIV) has continued to elude health care workers. While the standard of living has increased in developed nations with the advent of new medication, the treatment offered to patients in undeveloped countries is still primitive. In Guyana, a country of about 700,000 people, it is roughly estimated that 3% of the population has Acquire Immunodeficiency Syndrome (AIDS). However, many cases go unreported as a result of poor governmental statistics collection and lack of testing facilities. A large number of infections occur in the mining regions in the interior of Guyana where many of the miners are young men who engage in promiscuous engagements with local women. Furthermore, the prevalence of malaria in the interior of Guyana has lead to HIV-malaria, leading to a greater number of both malaria and HIV cases. Throughout the last 10 years, many Non-Governmental Organizations (NGOs) have been established throughout Guyana to offer educational workshops on prevention and counselling services. However, the lack of capital has been a major obstacle. While Guyana does receive developmental aid from developed countries, it is insufficient to substantially improve the AIDS epidemic under Guyana’s current health care delivery system.
resurgence. Poor health care services in the interior has led to this mining and natural resources exploration coupled with previously eradicated. It is thought that the extensive has re-established itself in areas from which it had been previously. P. Falciparum, the more dangerous species of the parasite has developed a resistance to chloroquine and fansidar, two common anti-malarial medications. This is especially dangerous since the victim can die within 24 hours of symptomatic high fever and chills. Remote villages in the interior do not have easy access to health centres and it often takes hours just to get to the nearest health centre, which are often not well equipped with medications.

High malaria prevalence in areas where HIV is present is especially alarming. Immune T-cells and B-cells function as the body’s defence system against infectious diseases such as malaria. However, these lines of defences are weakened during the first stages of HIV infection rendering the body vulnerable to infections such as malaria. Conversely, malaria could also exacerbate HIV infections because the immune system could be overwhelmed dealing with multiple infections.

In a study done by French and Gilks (2000), it was shown that malaria infections were more frequent individuals with compromised immune systems. The researchers looked at three different categories of individuals according to their CD4 T-cell counts. The groups were as follows: 1) >500 2) 200-499 3) <200. French and Gilks (2000) found that 4.5% of those with CD4 T-cells >500 were infected with malaria compared with 7.3% with CD4 200-499 and 11.5% with CD4<200. Thus, an increase in malaria infection is observed in HIV infected adults, suggesting an important correlation between malaria and HIV.

During the early stages of the AIDS epidemic, it can be argued that non-governmental organizations played as great if not a greater role in battling the disease than governmental departments. Non-governmental organization sprang up in all regions of the country offering a variety of services from counselling to education. In the year 2000, many of the non-governmental organizations decided to combine their resources and began a national crusade against HIV/AIDS and sexually transmitted infections (STI). As a result, the Guyana HIV/AIDS/STI Youth Project was born. This 5-year program is funded by the United States Agency for International Development (USAID) and will work to educate people about the disease, as well as collecting data to assess the knowledge Guyanese have about the disease and their perceptions of the disease. This project also works to interview focus groups such as sports clubs to understand their view of the disease. Furthermore, the project also interviews prominent members of communities to understand the specific needs of communities as well as draw on their leadership capacity to motivate the community to wage the war against HIV/AIDS and sexually transmitted infections.

The organizations that make up the Guyana HIV/AIDS/STI Youth Project are all reputable organizations with a history of their own. Each of them is very active in their community in their field of work whether it is counselling, education or medical care.

One of the more prominent NGO’s is Youth Challenge Guyana (YCG) which is a part of the Youth Challenge International alliance that includes partners in Canada, Australia, and Costa Rica. Traditional, this organization has worked on infrastructure development and health promotion issues with a number of local and international volunteers. Lately, Youth Challenge Guyana has transformed itself to move away from infrastructure projects and focuses on three streams: governance, women’s issues and HIV/AIDS work. The HIV/AIDS stream of work will be YCG’s contribution to the youth project. International and local volunteers will travel into different regions of Guyana to collect statistical data on HIV/AIDS as well as provide educational workshops.

Although the NGO’s have the good intentions of helping to ease the suffering of AIDS, the lack of resources has truly hampered the efforts. In most countries, NGOs’ purpose is to support and complement the services offered by the government. However, in the case of Guyana, the poor state of the country’s health care infrastructure has made many NGO’s primary care providers rather supportive care providers. Although these organizations have a depth of experience in aid work, they simply do not have the manpower or financial resources to provide adequate care to everybody. To the best of their abilities, the non-governmental organizations can only offer indirect methods such as counselling and workshops in the hope that people will learn to protect themselves from contracting HIV. As the HIV incidence rate increases, the NGOs can only watch helplessly, hoping that the international community will contribute aid. In the end, only proper medical services and pharmaceuticals can slow down this epidemic.

References


The struggle to alleviate pain is not a new one. The modern day science of anesthesia provides this remarkable ability with great success. The present era began in 1846 with the reported use of ether as an anesthetic during surgery. The field blossomed quickly and the field of surgery grew exponentially. However, the history of anesthesia does not begin here; an exploration through antiquity is required to gain a true understanding of the foundations of this impressive science.

Throughout history and across civilizations, the use of herbal remedies as medicines is well documented. Even though the anesthetic capabilities of some of these methods is debatable, it is worthwhile to explore the history of the science of anesthesia. Herbal remedies as analgesics and sedatives have a rich history. Indeed, before ether, chloroform and nitrous oxide there was hemlock, mandrake and dwale. Physical attempts at anesthesia were also frequently employed, including a literal blow to the head. Although they were often unsatisfactory these methods withstood the test of time in the pre-modern era. Finally, several breakthroughs in anesthesia occurred as civilization marched onward towards the modern era. Attempts at sedation took many forms in ancient times. It is these antiquated methods of anesthesia that are the subject of investigation in this paper.

The chimera is a mythical beast whose body is composed of parts of natural animals. The French surgeon Velpeau describes a chimera of pain and surgery. He argues that they are combined into one entity that is impossible to separate. In the modern era of anesthesia pain is separated from surgery with great ease. However, prior to modern anesthesia humankind still partook in surgical interventions. The problem of pain during surgery has victimized humans throughout the ages. The history of anesthesia will provide an interesting and impressive account of how this problem was addressed.

Before discussing the history of anesthesia it is necessary to explore the state of surgery in the pre-modern era. Surgery in ancient times included amputation, caesarian section, treatment of hernias, hemorrhoids, tumours and tooth extraction as well as attempts to cure epilepsy, serious headaches, insanity, and depression fractures of the skull. It was not unusual for a surgeon to approach a patient with several strong men to literally hold the patient down. A good surgeon is one who can perform quickly and one who has strong nerves to withstand the screams of the patient. The concept of surgery without anesthesia is expected to cause some shock to those who practice modern medicine. However, the testimony of patients screaming during an operation and the intense psychological distress caused to patients awaiting surgery establishes that the problem of pain was very real. It is therefore highly likely that for as long as patients were subjected to surgery people have searched for methods of anesthesia.

Medicinal plants have been used throughout the ages to treat many diseases. Medicinal plants alone or in combination were often utilized as anesthetics. Dioscorides, a Greek physician in the first century AD recorded hundreds of plant preparations for use in medicine. Pliny the elder, a Roman of the same era as Dioscorides recorded the use of opium and henbane. These therapeutic plants were well
known in antiquity and there are many records of their use.¹

The first description of a preparation used for anesthesia is found in the 9th or 10th centuries AD where the spongia somnifera or the soporific sponge is first mentioned in the context of anesthesia.⁵ This concoction was made with the following ingredients: mandrake, opium, hemlock and henbane. The plant extracts were dissolved in water and soaked in a sponge. The sponge was then left to dry in the sun. When needed the sponge was placed in warm water and then placed under the patient’s nostrils to be inhaled, putting him to sleep. Once the surgery was complete the patient would inhale vinegar fumes and awaken.⁵

Mandrake or Mandragora was a popular agent with many references throughout the ages.² Its particularly curious physical characteristic bifid root resembled the form of man, which undoubtedly added to the mystique surrounding the plant.⁶ The medicinal activity of the mandrake was well known to many ancient civilizations including the Egyptians, Greeks, Assyrians, Babylonians, Hindus and Chinese. Babylonians are believed to be the first users of mandrake in pain relief more than 2000 years B.C..² The Greeks described its use mixed with wine and given prior to surgery to avoid pain. There is no doubt as to potency of the mandrake root and its use during surgical procedures of ancient times is well documented.¹ Pliny went as far as claiming that anesthesia can be induced by smelling the juice.⁷ However, it was also identified as a narcotic and necessarily a poison when taken in large amounts. Dosing was also a problem as the potency of the plant was variable based on season and geographic location. This caused it to fall out of favour.⁸

The opium poppy is the oldest, most familiar and most effective of all the ancient drugs. Opium’s use in pain control can be traced back to the Roman Empire.¹ However, its regular use for anesthesia is only observed in the Middle Ages. Opium is a well-known potent narcotic and pain reliever. Dosing was again a problem since in high doses the opium will cause central nervous system depression and death.¹ As with mandrake the variable effects of the opium poppy made it difficult to consistently use as an anesthetic.

Dwale was a liquid mixture that the patient was required to drink prior to surgery. Recipes for dwale were found dating back to the 12th century AD. Dwale was composed of bile of a boar, lettuce, vinegar, bryony root, hemlock, opium and henbane. All of these were mixed together in wine and drunk by the patient to render him asleep before surgery. To arouse the patient afterwards, vinegar was used just as it was in the case of the spongia somnifera.⁹ Bile, lettuce, vinegar and bryony root can be discarded as ineffectual ingredients in the realm of anesthesia and will not be discussed. While opium has already been dealt with, henbane and hemlock are both important plants in the history of anesthesia.

Henbane or Hyoscyamus and hemlock were not referred to nearly as much as mandrake or opium. Henbane was a lesser-known sleep inducer. It was generally used as a local anesthetic in treatment of toothache.¹ However, it too has deadly consequences if ingested in high amounts and was considered a dangerous medication. Hemlock was the poison ingested by Socrates that caused his death. It was a well-known drug and obviously quite dangerous. It was also described in the 15th century as a method of inducing sleep before surgery.¹ Both of these were strong poisons and were not frequently used.

At this stage in the discussion it is important to note that potent analgesics, sleep inducers and anesthetics were known and used by people throughout antiquity. Problems arose for several reasons including method of administration, lack of dosing control and most of all the ever-present danger of fatal overdose. These methods all fell out of favour and patients still endured pain during surgery.

The discussion must turn now to one of the oldest and most popular anesthetics, alcohol. Alcohol has always been a vital part of the struggle against pain. It was likely the spur that caused people to attempt to alleviate pain through ingestion of medicines.² Often, other
herbal remedies are mixed in with alcohol and administered for pain relief, a fact that certainly improved the potency of these ancient medicines.\textsuperscript{1} For example, the often used laudanum, which was very popular and was one of the only known consistent pain relievers of antiquity, was simply opium mixed with alcohol. Although alcohol alone is not sufficient to be deemed an anesthetic in the true sense it does have a valuable place in the history of medicine.\textsuperscript{2}

The investigation into anesthesia through antiquity shifts to a discussion of physical mechanisms. Herbal remedies were discovered to be either ineffectual or too dangerous. In an attempt to control pain patients were literally clubbed on the head prior to surgery. In ancient Egypt men who dispensed this treatment became highly skilled in the technique. The blow had to be strong enough to knock the patient out but not too strong as to kill him. While this method was crude and unsatisfactory, it was used throughout history as it was better than providing nothing.\textsuperscript{2}

Local pressure proximal to the site of surgery was found to help control pain. By using a tourniquet that placed pressure on both the vessels and the nerves, it was found that pain could be numbed. This method was found to cause significant pain itself as well as tissue injury, which increased the risk of infection.\textsuperscript{2} This method can be traced back to ancient Egypt, 2500 BC, where evidence has been found in the form of pictures. These pictures show pressure being placed on the brachial plexus during surgery on the hand\textsuperscript{1}. This was a very crude method of anesthesia that did not provide much benefit to the patient.

The carotid artery translated from the Greek means artery of sleep. It was found that by choking both arteries, a person could be rendered unconscious. One could imagine that this was a truly ineffective method since the patient would regain consciousness soon after the pressure was removed.\textsuperscript{2}

The exploration thus far has discovered many options for anesthesia throughout antiquity but none of these are viable, reproducible or effective options. The attention shall now be turned to more contemporary methods with significantly more promise.

Joseph Priestly is credited with the invention of the first modern anesthetic, nitrous oxide or laughing gas, in 1773. This gas is still used in the modern day as an anesthetic.\textsuperscript{10} Unfortunately, during Priestly’s era doctors were not courageous enough to make use of the new discovery for fear of its potential danger and despite the positive outcomes of his experiments.\textsuperscript{10} It took another pioneer in the form of Sir Humphry Davy to bring nitrous oxide into popular use.\textsuperscript{2} Davy showed that nitrous oxide was a safe and breathable gas.\textsuperscript{7} He further went on to show that nitrous oxide could render a person unconscious and went as far as to write that it was capable of removing physical pain, even during surgery.\textsuperscript{7} No surgeon made use of the newfound anesthetic and so nitrous oxide was destined for rediscovery at a later date.

Henry Hill Hickman was another man who came close to a breakthrough discovery. His idea of suspended animation involved introducing sufficient inhalant so that painless sleep could be induced. His initial experiment in the 1820s involved depriving an animal subject of air and providing carbon dioxide alone, essentially anesthesia by asphyxiation. He noted that without oxygen an animal would soon be unconscious and would remain so throughout the surgery. As a further benefit the subject did not bleed as much and healed much faster.\textsuperscript{7} In retrospect this was not much different from the carotid artery compression discussed previously.\textsuperscript{2} This discovery truly provided an alternative to pain during surgery. Hickman attempted to present his results with the animal subjects in the hopes of gaining recognition and eventually attempting the procedure on humans. However, his theory on suspended animation was ignored completely and this promising discovery died with him.\textsuperscript{2}

It is commonly accepted that 1846 was truly the birth of modern anesthesia with the use of ether in surgery. However, ether was discovered in the 14\textsuperscript{th} century by Raymond Lully, who synthesized it from sulfuric acid and alcohol. He named it sweet vitriol. The power of his
discovery eluded him and the discovery remained dormant until the 16th century when Valerius Cordus rediscovered it. Cordus recorded the method of synthesis and his contemporary, Paracelsus, documented its analgesic effects on chickens. Paracelsus determined that it quieted all suffering and relieved all pain. At this point in history, approximately three hundred years before Morton’s landmark discovery the effects of ether were recorded for all to appreciate. As with Day and Hickman, this discovery too was buried and ether was forced to wait for its famous unveiling.

Mechanisms of pain control found their way into the culture of their time. Their existence was common knowledge and they provided plot mechanisms to both Marlowe and Shakespeare. However, these plants did not provide adequate anesthesia. The practice of surgery was continuing to flourish and the need for pain control was great.

It is worthwhile here to discuss what is truly meant by anesthesia. The exploration of the history of this science unveiled the possibility of providing some pain relief and methods of rendering a person unconscious but it cannot truly be declared that the ancients were in fact practicing anesthesia. A general anesthetic not only puts a patient to sleep but also keeps him asleep throughout the operation. The medicinal herbs discussed in this paper had the capacity of causing some degree of unconsciousness yet these did not replace the physical means of clubbing and physically restraining a patient. One must ask the question, how effective could the spongia somnifera or dwale be if a patient can be roused by simply inhaling vinegar. Furthermore, a utilizable drug must be reproducible and consistent in its effects. Since the potency of the plants was variable with the season and geographic area, it was impossible to establish a single effective and reliable method of providing anesthetic coverage during surgery.

The discovery of anesthesia by inhalation, nitrous oxide, carbon dioxide and ether, provided a great benefit and it is only at this stage in history that people truly began practicing anesthesia. A gas can be administered until the patient is unconscious. No longer were people tied to the variable potency of the ingredients or to the innate variability of the patient’s metabolism and overall health. It is at this stage in history that the foundation for modern anesthesia is built.

It has been over 150 years since the Velpeau’s chimera has been abolished. The ability to remove pain from surgery is one of the great marvels of modern medicine. By investigating the history leading up to this great discovery one may gain an appreciation of the great trouble that pain has caused humanity. Those whose experiments whether they were successes or failures deserve praise since they furthered humanities understanding of the science of anesthesiology and in doing so helped solve the problem of pain during surgery.

References
In 1939, German scientist Franz H. Muller published the world’s first epidemiological, case-control study showing a link between tobacco smoking and lung cancer. Another more rigorous epidemiological study by Eberhard Schairer and Erich Schoniger in 1943 further supported this link. The Nazi regime was very supportive of anti-smoking initiatives. In addition to funding research, the government posted propaganda, passed legislation and offered medical assistance in an effort to encourage Germans not to smoke. This anti-smoking campaign was part of a public health initiative that included restrictions on alcohol and exposure to occupational contaminants as well as an emphasis on good nutrition. A number of reasons have been suggested for the government’s desire to improve health-related behaviour. These include economic and strategic - medical care and lost productivity from sick workers was expensive, and Germany needed its soldiers to be healthy. Another is ideological - the Nazi government viewed alcohol, workplace pollutants, and especially tobacco as genetic poison to the pure German race. After Germany’s defeat, the research linking smoking and lung cancer went virtually unnoticed by academics in the rest of the world, perhaps due to the connection between the anti-smoking campaign and Nazi ideology.

Research Linking Tobacco Smoke and Lung Cancer in Nazi Germany
Until the sharp increase in incidence in the early 20th century, lung cancer was very rare. German autopsy records show that it represented 1% of cancer deaths in 1878, 10% in 1918 and 14% by 1927. An even larger increase in tobacco consumption occurred in the latter decades of the 19th Century, with inventions such as safety matches and industrial-scale cigarette rolling machines. Despite the temporal correlation, doctors and researchers didn’t initially recognize the link, attributing the cause of the excess lung cancer to automobile exhaust, road tar, and the influenza pandemic of 1919.

Among the first to postulate a link between tobacco smoke and lung cancer was the German clinician Schonherr in 1928 who noted that many of his female lung cancer patients were exposed to “2nd-hand” smoke. Other doctors, such as Fritz Lickint in 1929, noted increased frequency of smoking in patients with lung cancer.

Scientists working during the Nazi regime built on this earlier research. In 1939, Franz H. Muller published the world’s first epidemiological, case-control study showing a link between tobacco smoking and lung cancer. He compared the tobacco consumption of 86 men with lung cancer to 86 healthy men (controls) of the same age. Patients with lung cancer were more likely to be heavy smokers than the control group and likewise the control group were more likely to be moderate or non-smokers than the lung cancer group.

This link was supported by a more rigorous study by Eberhard Schairer and Erich Schoniger in 1943. Questionnaires, asking about amount and duration of smoking, were sent to relatives of 195 patients who had died of lung...
cancer, relatives of 555 patients who died of other cancers (mostly stomach and colon), and to healthy controls.\textsuperscript{4} In their analysis, Schairer and Schoniger attempted to account for confounding variables such as occupational exposure to dust. They concluded that “there is a high probability in support of the contention that lung cancer develops much more frequently in heavy smokers and is much rarer among non-smokers than expected.”\textsuperscript{4} Later analysis showed their results to be statistically significant with \( p<0.0000001.\textsuperscript{5} \)

These studies were financed by a Nazi regime very supportive of anti-smoking initiatives. At a large conference about the effects of alcohol and tobacco in March 1939, Hans Reiter, head of the Reich Health office, “charged all the medical societies of Germany with the responsibility for determining scientifically the degree to which tobacco caused disease.”\textsuperscript{3}

The Nazi government’s support of research into the health effects of tobacco extended to the very top of their government. Adolf Hitler donated 100 000 Reichmarks (RM) of his personal finances in 1941 to help fund the establishment of the ‘Scientific Institute for the Research into the Hazards of Tobacco’ in the city of Jena.\textsuperscript{5} This institute funded the study by Shairer and Shoniger, as well as other research into the health impacts of smoking including ‘nervous disorders’, gastrointestinal function, and tobacco's effect on the body’s potassium:calcium ratio.

### Anti-Smoking Initiatives in Nazi Germany

Such research provided scientific rationale for the government’s anti-smoking initiative which included propaganda, education, legislation and economic measures. The government’s anti-smoking advertisements often used role models, most notably Adolf Hitler, an ardent anti-smoking activist. One advertisement read:

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Brother national socialist, do you know that your Fuhrer is against smoking and thinks that every German is responsible to the whole people for all his deeds and omissions, and does not have the right to damage his body with drugs? \textsuperscript{3}
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The education ministry banned smoking in schools and ordered education about the dangers of tobacco to be included in school curricula.\textsuperscript{6} Anti-smoking propaganda was also disseminated through the Hitler Youth, League of German Girls, and Federation of German Women. A popular slogan aimed at women was “Die deutsche Frau raucht nicht!” (“The German woman does not smoke!”).\textsuperscript{7} Restaurants and cafés were forbidden to sell cigarettes to women. Smoking among women was further restricted by denying tobacco-rationing coupons to women younger than 25.

Restrictions were also put on cigarette advertising – they couldn’t imply that smoking had any hygienic value or associate it with masculine or feminine imagery.\textsuperscript{3} Smoking was banned in many public places, including military barracks, government offices, workplaces and trains. Specific groups of men were also prohibited from smoking including uniformed soldiers and anyone under 18.\textsuperscript{6}

In addition to restricting smoking and its advertising, the Nazi government implemented medical programs to help people quit. These included counselling, provision of nicotine gum, and use of silver nitrate mouthwash which made cigarettes distasteful.\textsuperscript{6} The government also researched ways of producing nicotine-free tobacco, and by 1940 it comprised 5% of the German tobacco harvest.\textsuperscript{6}

The Nazi government also used economic means to limit tobacco consumption. In June 1940, the government ordered that cigarette rations for soldiers be limited to six a day\textsuperscript{6} and raised taxes on cigarettes to 80% in 1941.

The Nazi government’s anti-smoking campaign was part of a broader public health initiative that emphasized preventative medicine. In an attempt to limit alcohol consumption, the Nazi government used similar strategies to their anti-smoking campaign. Advertisements claimed that alcohol “was sapping the strength of the German people.”\textsuperscript{6}
Government authorities promoted a diet high in fruits and vegetables, while encouraging a reduction in fatty foods such as meat and whipped cream. A concerted effort was made to encourage bakeries to make whole wheat bread instead of white and laws were passed that limited the use of carcinogenic additives, such as dyes, in food.

Regulations were also put on occupational exposure to toxins such as limiting the use of asbestos in factories.

Just as the research into the dangers of tobacco-smoking in Nazi Germany was ahead of the rest of the world, so too were these public anti-smoking initiatives. The government’s multi-pronged combination of advertising, legislation, medical therapy and economic measures is similar to the strategy used in current anti-smoking programs.

Rationale for the Public Health Initiative
A number of reasons have been proposed for the government’s desire to improve health-related behaviour, including economic, strategic and ideologic. Throughout the 1930s, lung cancer had risen to be the second most common cause of cancer death in German men. By 1944, it was the most common. This rapid increase had tremendous economic impact: it was a large expense for the German healthcare system and health insurance companies, and workers’ morbidity and mortality affected the bottom line of companies.

In 1941, the Nazi government’s accounting division estimated that smoking was costing the economy approximately RM 4 billion annually. To put this in perspective, Germany's entire military budget as it prepared for war in 1938 was only RM 16 billion. The government had a strong economic impetus to reduce tobacco consumption. Similarly, the rise in morbidity and mortality from lung cancer was a concern to the military, which needed soldiers to fight. There was also concern that smoking tobacco would affect the German soldiers’ stamina and military prowess.

Another important reason for the German government’s public health campaign involves Nazi ideology, specifically racial hygiene. This was a central tenet of Nazism, involving the maintenance of a 'pure' Aryan race. The racial hygienists attempted to accomplish this goal through three main avenues:

Racial hygienists distinguished 'positive', 'negative' and 'preventive' racial hygiene, encompassing encouragement of breeding among the 'fit' (eg. by marital loans and prizes for large families), limitation of breeding among the 'unfit' (especially by sterilization), and prevention of exposure to genotoxic hazards.

Racial hygiene helps explain the Nazi government’s public health policies that attempted to ban or decrease use of many potential mutagens including food dyes, asbestos, and especially tobacco smoke. In 1939, the Reich Health office commissioned studies investigating the effects of smoking on chromosome damage.

After 1941, most of Germany’s research into the health effects of smoking involved the Institute for Struggle Against Tobacco Hazards in Jena. It was founded and directed by Dr. Karl Astel, Dean of the University of Jena, head of both the Office for Racial Affairs and the Office for Public Health and Social Affairs for the state of Thuringia, a high ranking SS officer, and a leading racial hygienist. His rationale for anti-tobacco research is evident through his belief that “We cannot change our genes, but at least we can safeguard them from future damage.”

Astel was also involved in other aspects of the Nazi’s racial hygiene campaign including organizing the euthanasia programs that murdered over 200 000 mentally and physically disabled and was involved in organizing Hitler’s ‘final solution’ to murder all Jews.

Why the Anti-Smoking Research Went Unnoticed After World War II
After Germany’s defeat, the research showing a link between smoking and lung cancer went virtually unnoticed by most academics. Logistics would have contributed to this:
German scientific journals were not sent abroad during the war. Another more important reason was that the research was done in Nazi Germany. Even though both Muller's and Shairer and Shoniger's studies were purely epidemiological, many associated all research from Nazi Germany with the atrocious human experiments carried out. The scientific community ignored much of the research, because, as biochemist James Watson explained, some thought "that good work simply could not have been done by Nazi scientists." Muller's 1939 paper wasn't completely ignored and was occasionally referenced in the 1950s, even in the influential papers by British and American authors such as Doll and Wynder, whose studies are generally credited with demonstrating the link between smoking and lung cancer. Yet, Shairer and Shoniger's study, which was methodologically and statistically superior, was cited only three times in the 1960s, and only once in the 1970s. The study also went unnoticed in Germany, and failed to be mentioned in a German bibliography about the links between tobacco and cancer published in 1953.

This may have been because the study was conducted at the Institute for Struggle Against Tobacco Hazards, whose director had involvement in the Nazi sterilisation, euthanasia and murder of the Jews. Some other scientists connected with the Institute engaged in horrific human studies. Muller's study was completed before the conception of the Institute, and so lacks the same stigma. It also lacks Nazi ideology. For example, "race", a common theme in many medical studies from Nazi Germany, was not mentioned at all. Furthermore, Muller refers to work by Jewish authors in his study. Perhaps this is why it received some minimal attention after the war, compared to almost none for the paper by Shairer and Shoniger.

The Effect of the Nazi Government’s Anti-Smoking Policies
Despite the Nazi government's anti-smoking initiatives, German tobacco consumption continued to rise throughout the 1930s. One reason for this increase may have been that smoking was a form of passive resistance against the authoritarian Nazi government. In the latter stages of the war, tobacco consumption did drop considerably, but rationing and economic problems were likely the major factor.

At a glance, it appears that the Nazi government’s anti-smoking initiatives were a failure. Yet, the rise in smoking throughout the 1930s was due to growth in the German economy, and it is possible that the Nazi government's opposition kept this increase lower than it would have been otherwise. Furthermore, in 1990, lung cancer mortality among German women was one fourth that of American women. As much of the anti-smoking policies were aimed at women, it is possible that the Nazi government’s public health initiative is partly responsible for this reduction.

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From Marjorie to Leonard: Leaping the Clinical Hurdle of Insulin in 1922

Aaron R. Mocon, Meds 2008

In the study of no other non-infectious disease has there been closer collaboration between laboratory and clinical investigators than in that of diabetes.¹

Leprosy has long had a reputation for being one of the most feared of all human diseases. In Canada today the disease is a rarity and the few existing cases are considered little threat to public health; however, this was not always the case. In the mid- to late nineteenth century an endemic leprosy was found to exist among the Acadian Population of New Brunswick, a discovery which caused much concern within the nation’s medical and legislative communities of the time. In this outbreak, which occurred prior to the discovery of the leprosy bacillus, the physicians involved with the situation were deeply divided as to the nature of the disease: was it hereditary or was it contagious? Their decision would prove fateful for the victims of the disease in this area. Furthermore, issues of race and class would become central in the discussion surrounding the appearance of leprosy in this population.

When J.J.R. Macleod wrote this statement in the February 1922 edition of The Canadian Medical Association Journal (CMAJ), he was referring to the contributions of numerous groups of scientists and physicians over many years, including his own Toronto-based team, to the study and treatment of diabetes mellitus. Macleod, a professor of physiology at the University of Toronto and assistant dean of the Faculty of Medicine, was the primary investigator who supplied the laboratory space, advice and medical science community clout that ultimately allowed F.G. Banting, C.H. Best and J.B. Collip to isolate the pancreatic hormone insulin and to be the first to use it to successfully treat diabetes mellitus. Macleod’s commentary prefaced Banting, Best and Collip’s preliminary report published in the same issue of the journal entitled “Pancreatic Extracts in the Treatment of Diabetes Mellitus.” This was the team’s first publication, which, although preliminary, indicated that their pancreatic extract (later named insulin) was able to control the clinical manifestations of diabetes mellitus in humans and in their opinion left “no doubt…that [insulin] was a therapeutic measure of unquestionable value.”² The impact of insulin can be regarded as one of the most dramatic events in the history of the treatment of disease and in 1923, the Nobel Prize was awarded for the discovery of insulin at Toronto.

In early November of 1920, Dr. Banting arrived in Toronto to meet Dr. Macleod after being directed there by Prof. Miller of the University of Western Ontario in London, Ontario. Upon reading volume XXXI, number 5 of “Surgery, Gynecology and Obstetrics” (1920), Banting, a struggling physician in London, was struck by an idea of how to make a pancreatic extract that contained the mysterious substance or internal secretion, which was hypothesized to control the metabolism of carbohydrates in blood.³ He was sent to Macleod, a specialist in diabetes, with the hope that he would give advice and laboratory resources. After two turndowns, Banting’s persistence was able to convince Macleod to provide him with eight weeks of lab space, experimental dogs and a bright young physiologist named C.H. Best to partially compensate for Banting’s lack of medical science research skills. In May of 1921, Banting and Best began what would be a tedious and tumultuous conquest to ligate the pancreatic ducts of dogs, wait for their pancreases to degenerate and isolate isletin, a working term for what was later called insulin. Upon injection into depancreatized dogs, it was hoped that the extract would counteract the clinical features of diabetes. On July 30th, 1921 Banting and Best found that injecting their extract into a diabetic dog’s veins was able to transiently reduce the blood and urine sugar levels and relieve the
dog’s diabetic comatose state — their first promising results.\textsuperscript{3}

Since 1887, when Von Mehring and Minkowski discovered that depancreatizing an animal renders it diabetic, many efforts had been attempted to devise methods for extracting the principle ingredient of the gland that mediated its anti-diabetic effects. However, no method was sufficiently robust to produce large enough quantities needed to sustain a diabetic animal once treatment had started while at the same time being pure enough to eliminate unwanted toxicity reactions.\textsuperscript{4} In an issue of the CMAJ, an editorial by Macleod recognizes Knowlton and Starling, Kleiner, Murlin, E.L. Scott and Paulesco as the investigators that provided the most notable evidence of an internal secretion before the Toronto team had done. He notes, however, that their “results...have been...insufficiently constant and significant to justify more intensive research with the object of securing preparations of greater potency that could be used for the treatment of diabetes in man.”\textsuperscript{5} Banting wanted to produce the elusive sufficiently constant results and Macleod apparently believed that he might be able to succeed.

Aware of the progress that Banting and Best had accomplished in dogs and perhaps foreseeing the potential of clinical implications, Macleod expanded the Toronto team, at the request of Banting, to include the biochemist and endocrinologist J.B. Collip in mid-December 1921. At this point, Macleod had shifted the focus of his other research interests and instructed his whole staff to work to purify insulin (the Toronto team had now used the term insulin for their extract, coined years earlier by Sir A.E. Schafer).\textsuperscript{6} It was Collip’s principle task to work on Banting and Best’s newly discovered extract in order to refine its purity and increase its yield through the use of more sophisticated biochemical techniques. The priority was to produce enough pure insulin for use in human testing — the hurdle that so many other researchers had failed to leap.

It was merely six months later, on January 11, 1922, a refined version of the extract used in the summer was injected into 14-year-old Leonard Thomson in Ward H of the Toronto General Hospital (TGH).\textsuperscript{2} Many significant events occurred within this time period. Most notably, the extract was able to prolong the life of a depancreatized dog named Marjorie (referred to in lab note books as dog #33) for 70 days beginning in the last week of November until it was sacrificed. These long-term results were a significant and unprecedented achievement and it was the formula for this extract that was chosen by Macleod to be used in Leonard Thomson, heralding the first clinical trial of insulin.\textsuperscript{7}

Interestingly though, the extract injected into Leonard Thomson, was of Banting and Best’s formula that they had been using on Marjorie since November, a month before Collip began working on the project. In fact, Collip’s extracts were only starting to be used on January 23, 1922, which was 12 days after the first clinical trial of insulin in Leonard.\textsuperscript{8} Perhaps the mixed experimental results were sufficient to convince Macleod that Banting and Best’s extract was refined and safe enough to be injected into a human. Insulin’s first patient, Leonard Thomson was 14 years old when he was admitted to TGH on December 2nd, 1921 as “poorly nourished, pale, weigh[ing] 65 pounds, hair falling out, odour of acetone on [his] breath...abdomen large and tympanic...dull, talked rather slowly [and] quite willing to lie about all day.”\textsuperscript{2} He had been diagnosed with a case of severe juvenile diabetes with ketosis and according to Macleod, Banting, Best and the rest of the Toronto group, his “careful dietetic regulation [(the prevailing treatment for diabetes at the time)] failed to influence the course of the disease. [B]y January 11th his clinical condition [was]...definitely worse.”\textsuperscript{2} Banting et al., made it evident in their 1922 CMAJ publication from which these excerpts are taken that it was Thomson’s unpromising and grave circumstance that prompted them to inject what was described as a “thick brown muck” into the boy’s buttocks — this muck, as described by Walter Campbell, the chief clinician at TGH at the time, was 15 cc. of beef pancreas extract made by Banting and Best.\textsuperscript{9}
The effect of this first clinical test with Banting and Best’s extract was not spectacular. In the Banting et al. CMAJ paper, it is described with one sentence:

The extracts given on January 11th were not as concentrated as those used at a later date, and, other than a slightly lowered sugar excretion and a 25% fall in the blood sugar level, no clinical benefit was evidenced. 2

More extracts were administered to patients at TGH beginning on January 23rd. It was these injections that justified insulin’s eventual fame as a wondrous therapeutic because they resulted in immediate improvement to the diabetic patient’s clinical and emotional condition. But the extracts that provided these positive results, which, were given subsequently to the one that Thomson received, were made from Collip’s formula and not Banting and Best’s. On January 19th, 1922 Collip recalled, “I discovered a way to get the active principle free from all the ‘muck’ with which it appeared to be inseparably bound.” 9 With additional insulin therapy, approximately 85 units per day for 13 years, Leonard Thomson was able to live a “more or less normal life” until he died on April 20, 1935 of complications due to pneumonia. 5 Collip had accomplished the duty to which he was specifically assigned. He had prepared a more pure extract by refining Banting and Best’s method and, in doing so, as Macleod had requested, made available an extract that was more suitable to be injected into a human for clinical testing. The result was that for the first time in recorded history, an extract of pancreas had been unambiguously successful in having a distinct antidiabetic effect on a human. Now, millions of people worldwide who suffer and would surely die from diabetes mellitus are offered life and the hope of fulfilling their goals and achieving happiness.

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Laennec and Auscultation

Milli Gupta

René-Théophile-Hyacinthe Laënnec invented the stethoscope in 1816 while trying to examine a young female thought to have a heart problem, improving the diagnosis of disease and establishing objectivity in clinical medicine. This invention came while physicians were struggling to correlate post-mortem pathology with clinical symptoms. Until 1816, symptomatology was the only means to diagnosis. The stethoscope not only connected post-mortem findings with clinical findings but also helped identify illnesses that were asymptomatic. Laennec’s invention furthered the study of physiology, and he used it to study the lung and heart. This paper discusses both his life and his pivotal contribution to medicine.

Biography

René-Théophile-Hyacinthe Laennec was born on February 17, 1781 at Quimper, Brittany, the first born in a respectable family. After his mother’s death from tuberculosis in 1786, he and his brother were sent to live with relatives and eventually ended up with Guillaume-Francois Laennec, a physician at Nantes, a second father to them, and a positive influence in René’s life. Through his uncle, René received the finest education during the revolution, and got a job as a medical aide in the army at the age of 14. He learned clinical work, surgical dressing, dissections and patient care. By 1799, after 34 months of service, René had decided on a career in medicine. However, the revolution had closed the medical faculty in Nantes, bringing René to Paris for his medical education.

On coming to Paris, he enrolled in the École de Sante, a school which received a huge boost in surgical studies from Napoleon. He was able to sharpen his clinical skills and broaden his knowledge by studying with some of the best: Jean Nicolas Corvisart des Marets, later Napoleon’s personal physician, and Jean-Noel Halle, professor of hygiene and a mentor. It was Laennec’s work with Corvisart that would have implications on his study of the chest and invention of the stethoscope.

Around this time, Laennec became interested in the new science of pathological anatomy. He wanted to connect presenting symptoms with physiological and pathological processes. He is reputed to have written roughly 400 case reports during his first few years in Paris, including important information on peritonitis, amenorrhea and liver disease. He eventually transferred to École Pratique de Dissection in 1802.

In 1803, he received first prize in surgery and runner up in medicine from the Grandes Écoles of Paris. He was the first to win two awards in one year, an acknowledgement of his skill as a surgeon. Hoping to make more money and use his own organization of pathological anatomy, Laennec started his own anatomy class at the age of 22. He was also working as a ghostwriter on

Figure 1: René-Théophile-Hyacinthe Laennec

Through his uncle, René received the finest education during the revolution, and got a job as a medical aide in the army at the age of 14. He learned clinical work, surgical dressing,
many medical texts, but stopped when remuneration was scarce.\textsuperscript{5}

In July 1804 he successfully defended his thesis on Hippocrates and his support of pathological anatomy. This successful defense made him part of the Societe de l'Ecole, to whose journals he made many contributions. He was still active as editor, contributor and reviewer in the ‘Journal de medecine’, in which he had been publishing as a student.

Laennec managed to accomplish much at a young age, and had hoped that his research, impressive publications and prizes would garner him a position - but this was not so. He had little political influence as a devout catholic and proud royalist at the time when Napoleon was taking over. It wouldn’t be until 1816 before that dream would be realized.

Following his graduation he pursued work in many different specialties, such as parasitology, pathological anatomy, nosology (classification of disease) and philology (study of ancient texts and authors). He also wrote a two-part treatise on pathological anatomy that was never published. The classification system from this treatise is important because his future work relied on this framework. He tried to distinguish between benign and malignant tissue growth without describing the process behind their production.\textsuperscript{3}

In 1810, he applied for the chair of Hippocratic medicine, but the chair was dissolved in 1811 and he focused on clinical medicine instead. He also found that most of his income came from the care of patients. However by then, he was showing signs of tuberculosis infection, believed to have been acquired through a needle-stick injury during an autopsy in 1803 (he did not acknowledge his illness until the end). He also felt a change of work style would do him good.

He carried on his practice in Paris for a few years and took care of such prominent figures as Napoleon’s uncle before accepting a position at the Necker Hospital in Paris in 1816. His most important contribution to medicine, inventing the stethoscope, would be made there.

In 1819, Laënnec published the first edition of his book, entitled \textit{De l’Auscultation Médiate}. Two years later it was reorganized, translated into English, and published by John Forbes under the title \textit{A Treatise on Disease of the Chest}.\textsuperscript{2} These books described in exquisite detail many lung diseases, especially tuberculosis. A second edition with many additions was printed in 1826.

A few months after the book’s release in 1819, he returned to his native Brittany due to failing health. His health improved and his recognition grew. He became a professor of medicine at the College de France and was put in charge of Hopital Charite in 1822. In 1824, he was made Chevalier of the Legion of Honor of France and was married. His health deteriorated in April 1826 and he returned to Brittany, to pass away in August. His physician may have used Laennec’s own invention to diagnose him, but kept the diagnosis from him until the end.\textsuperscript{3}

\textbf{Auscultation}

As Laennec and others moved toward correlating post-mortem findings with clinical disease\textsuperscript{1}, physical examination became an exciting new area of clinical medicine. Given that Laennec’s mother, uncle, brother and friend Bayle succumbed to tuberculosis, he did considerable investigations in chest medicine. During his early days with Corvisart, he learnt of percussion, which was being re-introduced into medical practice. Percussion was initially introduced by Leopold Auenbrugger in 1761, who applied the
technique to examine a wine barrel towards the thorax, surmising that a normal thorax would resonate, but one filled with secretions would sound low-pitched.

Corvisart used his physical exam findings of percussion to predict postmortem findings before the patient died. He then applied this to the heart and could detect an enlarged heart. He could also discern a thrill, which led him to believe “the palpitations of the heart are sometimes so intense that the sound of the heart can be heard beating against the chest wall”.5

Direct auscultation (placing the ear on the chest wall) was another technique (Figure 3). This was known to Hippocrates and extensively used in ancient Greece. However, it was hard to perform this act on obese or heavily endowed females as it was socially unacceptable and unhygienic, and sounds would often be muffled and hard to interpret.

It was only a matter of time before the stethoscope would have been invented. Many glorified tales exist of how Laennec came to create it, but the consensus is that in 1816, he saw a young female presenting with generalized symptoms of heart disease. He was uncomfortable with direct auscultation, so he rolled up a paper notebook, applied one end to the chest, and listened to the heart. He felt that he could hear the heart more clearly than if he had used direct auscultation. He coined a famous double entendre “J’entends,” meaning “I hear and I understand” and named his instrument the stethoscope, from the Greek “to explore the chest”.5 He subsequently used his invention to identify many pathological lesions within the heart and the lungs.

Laennec needed a very good ear and wide vocabulary to create a classification system for his findings. He described what he heard by creating a common vocabulary to correlate anatomy and pathophysiology for others to use and understand. To describe what he heard, Laennec relied on imagination and the common sounds in nature. Examples include animal voices and pitch, music, and urban life.4

In identifying what findings he considered to be a sign of the disease in question, Laennec used the basic concepts underlying sensitivity and specificity.5 Findings with high specificity (being present with just one disease) were deemed “pathognomonique,” while findings that were of low sensitivity (present in only some cases of a disease) were deemed less reliable. As an example, pericarditis can occur without friction rub, therefore making it not sensitive.

Pulmonary Signs
Although it was cardiac disease that led to the invention of the stethoscope, Laennec’s legacy arises from his work on the lung. Laennec set up the first categorization of these findings. His classification style relied on defining disease by its post-mortem characteristics. For instance, in his time, tuberculosis was defined by presenting symptoms. Laennec defined tuberculosis by the presence of lung caverns (tubercles) on autopsy.4 He used the stethoscope to identify these lesions.
and to diagnose patients earlier, not waiting for late symptoms to give the official diagnosis.

Through percussion and auscultation, Laennec identified the pathophysiology of the cavitary lesions. He believed there was a change in tuberculous ‘matter’ from grey to yellow, which then liquefied (caseation) and expelled through the airways, leaving a cavity (often calcified) at autopsy. He was the first to use his stethoscope to identify tuberculosis in patients who had no signs or symptoms (latent tuberculosis), but had anatomic defects.

Laennec initially believed in a direct, one-to-one relationship between the sound heard and the pathology a patient presented with. He considered pectoriloquy, a change in the patient’s voice heard with a stethoscope, to be indicative of tubercles. Even if the patient did not present with the symptoms, if pectoriloquy was heard, the patient undeniably had tuberculosis. However, he soon realized that all cavities may result in pectoriloquy, but not the converse. By 1817 he thought that bronchiectasis (dilation of the airways) and the second stage of pneumonia (hepatization) also resulted in a similar sound. To maintain his "pathognomonique," rule, he changed the name of the sound in the latter two lesions to bronchophony. He was initially resistant to this, and so this revision only appeared in the 1826 edition of his book.

Similarly, he claimed egophony was a variant of pectoriloquy but sounded like the bleating of a goat, and believed this to be synonymous with acute pleural effusion, refusing to be challenged. Ironically, he admitted having troubles differentiating between the two. He also believed rales (bubbling or silent respiration) was pathognomonic for bronchitis (1816-17), metallic clinking for pneumothorax with small quantity of fluid, and decreased breath sounds for emphysema (1818). He acknowledged the various sounds of rales, but attributed this to differing sputum color, quantity and texture.

His invention also helped him put physiology into practice. The first time he heard “puerile respiration”, he thought it was a physiologic response to increased oxygen demand in adults, and a normal variant in children. He later realized it was also a sign for asthma, but there was no post-mortem lesion to associate with this. He relied on physiology to explain the clinical presentation of shortness of breath: constriction of the bronchiolar muscles was separate from costal and diaphragmatic movements, leading to decreased air entering the bronchioles and reduced oxygen delivery. Patients had to increase their breathing rates to increase oxygen flow. In those without clinical signs of asthma, hyperventilation secondary to ‘white coat effect’ led to these findings.

Conclusion
The stethoscope made it possible to reveal physical changes before the patient died. The discoveries by auscultation of the thorax led to a frenzied search for pathognomonic signs in other parts of the body. The stethoscope allowed physicians to detect asymptomatic lesions and introduced objectivity to clinical medicine, but it shifted the focus of medicine away from the sick person.

Although active in establishing objective signs of disease, Laennec believed that patient’s symptoms were just as important when it came to diagnosis. Even when the stethoscope did not tell him anything, he continued to believe in the possibility of the disease, and paid his patient due respect. The work that Laennec did was indisputably amazing and accurate for his times.

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Lovesickness: The Most Common Form of Heart Disease

Nancy Dzaja

"My mouth doth water, and my breast doth swell, My tongue doth itch, my thoughts in labour be;" 1

As Astrophil pines for his Stella in Sir Philip Sidney's sonnet, he describes the physical symptoms of his infatuation which point to a rampant case of lovesickness. In addition to its common presence in works of literature, lovesickness has been described as an actual medical entity with a specific etiology, pathogenesis, and treatment. Amazingly, many of the described symptoms of lovesickness are consistent across time and place, including fever, agitation, loss of appetite, headache, rapid breathing, and palpitations. On the other hand, other aspects of the disease and its care differ tremendously depending on the cultural context. Lovesickness (also known as lover’s malady, mal de ojo, mal amor, amor heroes, inordinate love, or philocaptio) had a variety of proposed etiologies. In the Middle Ages it was often attributed to love philters and demons, while the ancient Nahua of Mexico thought it had to do with the evil eye. The disease had serious consequences: failure to treat an afflicted patient could result in losing one’s genitalia, death, or eternal damnation. Treatments were creative and varied widely, from herbal remedies to the prescription of sexual intercourse, to drinking water that had been boiled in the desired person’s underwear. Lovesickness is a disease that permeates medical literature since the time of Hippocrates, and may still have a place in modern medicine in the form of somatoform disorder, bipolar disorder, or erotomania.

Introduction

In a case description, the physician Erasistratus (4th century BC) is called to the bedside of Prince Antiochus, who is extremely ill. On examination, the prince is weak, emaciated, and near death, and no one understands why. As Erasistratus feels Antiochus’ wrist, he realizes that the prince’s pulse quickens and he becomes flushed when his stepmother Stratonice enters the room. Erasistratus realizes that Antiochus is suffering from lovesickness, and tells King Seleucus, who gives his wife to his son. 2 Similar stories are attributed to Hippocrates and Galen. Indeed, lovesickness is a disease that permeates medical literature and the ability to diagnose it was the sign of a great physician. 2 Descriptions of the disease have changed extensively over hundreds of years and it may exist today in the guise of psychiatric disorders.

Signs and Symptoms

The signs and symptoms of lovesickness (also known as lover’s malady, mal de ojo, mal amor, amor heroes, inordinate love, or philocaptio) are often consistent regardless of time or culture. Lovesickness involves fixation on a person: the afflicted individual has obsessive thoughts about the object of their fixation. 3 Insomnia, loss of appetite, hollowing of the eyes, anorexia, pallor, rapid pulse, and jaundice are consistently described. 3,4,5,6

Other symptoms are more specific to the time or place in which they were described. For example, the Islamic physician Rhazes (850-923 AD) described a unique syndrome. In the early stages, the patient’s eyesight would become weak, the tongue would dry up and pustules would grow on it. 5 A dusty substance, and marks like dog bites would appear on the patient’s back, calves, and face. If untreated, the person would eventually wander through cemeteries at night and howl like a wolf.

One of the manifestations in medieval Spain was the “Frog/Diana syndrome,” caused by excessive desire of a person, and led to a person viewing something unpleasant and repulsive as beautiful and desirable. 6

Some medieval writings connect lovesickness and bipolar disease. Depressive symptoms of weeping, insomnia, and loss of appetite were accompanied by manic symptoms in many. 4 Rapid mood swings between
inappropriate laughter and depression were common. Ferrand described a situation where patients “have a look about them that suggests they see something pleasing, or else are hearing it, or longing for it…one moment they laugh, a moment later they turn sad and weep, now they jest, and a short time later are sorrowful, pensive, and solitary.”

Toohey maintained that the depressive type was more of a cliche with the manic form more common, and patients often becoming violent. Similarly, Hippocrates described violent symptoms with melancholy madness, which may have been related to lovesickness. He described how some women are prone to this condition, which causes them to become insane, homicidal, and produces a desire to asphyxiate themselves. This is akin to the violent impulses that may occur in people during a psychotic manic episode.

The Nahua of Mexico describe unique findings, including grabbing posts as substitutes for the desired person, the formation of blisters on the face, and a red eye with a yellowish mucus discharge. In extreme cases, the disease interrupted the circulation, causing blood to freeze in the heart. Lovesickness could also result in the disappearance of the genitals. Although the major symptoms of lovesickness are fairly consistent, the disease also had a lot of variability in its atypical presentations.

Etiology and Pathogenesis
Physicians of Hippocrates’ era believed that maintaining a balance of the four humors (blood, phlegm, choler, and melancholy) was essential to maintaining health. Disturbances of the melancholy humor led to psychological problems and somatic side effects, resulting in symptoms of lovesickness. The early Christian writers did not clearly distinguish between illnesses of the body and illnesses of the spirit, believing that lovesickness was a disease of the senses that could also corrupt the soul.

Medieval medical writings had a more clearly defined pathogenesis for the disease. The first stage occurs when the object of desire causes overheating of the “vital spirit.” The vital spirit inflames the middle ventricle of the brain, which was where the faculty of estimation (or the virtus aestimativa) is located, resulting in dryness in the faculty of imagination (virtus imaginative). Consequently, the image of the beloved becomes imprinted in the patient’s memory, causing obsession, decreased ability to reason, and abnormal behaviour.

Hereditary causes were considered possible during the Renaissance. The child of a parent who suffered from lovesickness was at greater risk unless this predisposition was countered by other factors including a good education, excellent discipline, or an orderly lifestyle. It was also believed that most people who developed the illness had a susceptibility to it: young children, the very old, eunuchs, and the impotent were considered essentially immune.

Lovesickness befell men and women equally in the ancient Nahua. The disease did not necessarily occur in the person who was experiencing the desire: it had to do with which person was the weakest. The stronger person had more heat power in their eyes, and could cause harm to others by looking directly at them. For example, a woman might see a man she liked and make him ill by looking directly into his eyes. For this reason, lovesickness was considered a form of mal ojo, or evil eye.

Magical and Demonic Causes
In the Middle Ages, use of magic in the matters of love was fairly popular. For example, some believed that hair from a hyena’s muzzle was a love charm when placed on a woman’s lips. Similarly, it was thought that if a woman kept the Eucharistic host in her mouth while kissing her beloved, she could make him fall in love with her permanently. In the 13th and 14th centuries, academics began writing about “visual species;” objects that mediated between the physical world and the mind. Visual species could cause lovesickness by imprinting images into the imagination from a distance. It followed that incantations and magic could also generate species in the mind and cause changes that affected the body. Consequently, magic was a possible cause of lovesickness. Temptation by demons was could also cause the disease since it
was thought that the Devil had a partiality for inflicting sexually-related diseases on people. By the 15th century, lovesickness became associated with the occult and the disease was listed as a widespread form of witchcraft in manuals for witch hunters. During the Renaissance, potions and philters were also considered to be possible causes of the disease.

Lovesickness in Women versus Men
The sex of the patient was also a risk factor. In medieval times, lovesickness tended to be a male disease, especially since medical writings came from monasteries where the illness was negatively regarded. Eventually, lovesickness became regarded as a form of courtly love, where a man worships and idolizes a woman as perfect even while she scornfully rejects him. This form of love was considered ennobling and chaste. In the Renaissance the illness was interpreted as a shameful and debasing sexual, and not a mental disease, and so it became attributed to women. According to medical treatises, women enjoyed intercourse more than men, were more impulsive, and were not rational enough to resist their desires. Medical writers believed lovesickness could be caused by a distended clitoris, or by satyriasis (pain caused by a voracious desire for sexual intercourse). An illness known as uterine fury may also have been linked to lovesickness: in this disease, the woman has an inordinate interest in sex and experiences painless burning sensations in her genitals. Uterine fury was usually a disease of overly sensuous, greedy, and gluttonous women.

Treatment
Treatment options varied depending on the cultural values and medical beliefs of the time. Greek and Roman physicians often prescribed sexual intercourse for the illness. Galen maintained that men should make love for the sake of staying healthy, even if they derived no pleasure from it. Similarly, the Iranian physician Avicenna recommended sexual intercourse, but only if law and religion allowed it. If this was not possible, physicians would attempt to distract their patients with baths, sleep, and exercise. They also hired old women to belittle the object of the patient’s affection.

Lovesickness in Modern Medicine
Lovesickness has been a common medical entity for hundreds of years, and yet it has no mention in modern medical texts. It is possible that the disease exists today under a different title. Many symptoms of lovesickness are similar to
symptoms of modern psychiatric disorders, including obsession, rapid mood swings, loss of appetite, insomnia, and compulsions. In a recent study, Marazziti et al looked at serotonin levels in people who had recently fallen in love and patients with obsessive-compulsive disorder. They found that both groups had lower than normal levels of serotonin, suggesting shared psychological elements. Many of the symptoms of lovesickness have to do with alternating between depression and mania, so perhaps lovesickness in modern medicine is encompassed in bipolar disorder. One study used functional MRI scanning to show that very specific areas of the brain were activated in patients who were in love, and perhaps a pathological stimulus in these areas of the brain could lead to lovesickness. Tallis makes the point that some of the therapy used for lovesickness over a thousand years ago is similar to modern cognitive behavioural therapy, such as Avicenna’s encouragement of distracting the patient from his fixation using physical exercise, trips, and so on. Finally, lovesickness may be a somatoform disorder, where physical symptoms exist that are not part of another medical condition or mental disorder. These patients may have psychological conflicts that are translated into somatic problems.

Conclusion
Lovesickness was a common disease that persisted throughout centuries and may still endure today. The supposed etiological factors and treatments changed as cultural beliefs evolved and as the understanding of science developed. Many of the symptoms and signs remained constant regardless of what point in time or in what culture you examine them; this adds to the authenticity of the disease. Many aspects of the disease can be explained by elements of modern psychiatric disorders, which makes it likely that there are still many patients suffering from lovesickness even today.

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Paracelsus the Innovator: A Challenge to Galenism from On the Miner’s Sickness and Other Miners’ Diseases

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Phillipus Aurelius Theophrastus Bombastus Von Hohenheim, called Paracelsus, occupies a curious place in the history of medical innovators: on the one hand celebrated for his emphasis on empirical observation, and on the other reviled as a hot-headed and arrogant mystic. His works show great devotion to the Light of Nature, a property of the world which caused it to reveal its God-given healing secrets to the discerning and knowledgeable physician. This emphasis on experience was radical in the days when scholastic study of the works of Hippocrates and Galen was the basis of medical practice. Paracelsus rejected the authority of Galen but lacked the tools of the scientific method to replace Galen’s teachings with empirical knowledge. Instead, Paracelsus devised a highly creative and interwoven mystical system of macrocosm and microcosm - God had devised the stars, spirits and the natural world in a pattern which was repeated in man’s sidereal, spiritual and physical bodies. The wise physician could study the natural world, waiting to reveal its healing clues. This paper will evaluate Paracelsus the innovator based on one of his most influential and important writings, Von der Bergsucht und Anderen Bergkrankheiten, (On the Miners’ Sickness and Other Miners’ Diseases), written in 1534. An in-depth look at Paracelsus’ theories of pathogenesis, cure, and prevention of miner’s diseases will show that Paracelsus was a positive innovator in the history of medicine in his role as a reformer of medical therapies, as proponent of preventive medicine, and as advocate of learning through experience.

Introduction

While some are remembered for important contributions to medicine, and others as icons of their time, Paracelsus is most remembered for a lively and infamous temper. Phillipus Aurelius Theophrastus Von Hohenheim, called Paracelsus, was probably not a pleasant man. Paracelsus had a prolific output, and his follower Huser of Basel collected and edited these works (1589-91). Huser had difficulty separating Paracelsus’ life and works from colourful legend. Paracelsus was deeply concerned with healing the outcast and sick, and with reforming a stagnant and bastardized Galenic medicine, but was grandiose, self-assured, with poor political judgement and a wicked temper.

Sixteenth century medicine was the product of medieval scholasticism filtered through Eastern commentators. Galen, interpreted by Avicenna, was the medical authority of the day, while the Church ruled over diseases of supernatural origin. Medical knowledge was complete with Hippocrates and Galen, and although these early physicians had experimented, this was no longer done. Medieval observations were limited to those which reinforced pre-existing theories. Dissections were rare, crude, and viewed as immoral. Scholastic medical ideas were based on Galen’s theory of four humours: phlegm, blood, yellow bile and black bile representing the elemental influences of cold, dryness, warmth and moisture. Disease resulted from an imbalance in these humours, and was treated with a “cure by opposition” approach using complicated concoctions of herbs and unsavoury animal products, or bleeding and purging. Insanity was viewed as a supernatural affliction stemming from demonic activity. A rebel from the beginning, Paracelsus burst onto the scene with his own elemental system, the idea of like curing like, an increased emphasis on simple herb and mineral remedies, and natural origins of insanity.

Theophrastus was born in Einsiedeln, Switzerland in 1493. His father, William of Hohenheim, was a local physician, from whom he presumably learned the basics of medicine. His name Paracelsus, a Latin creation perhaps meaning “equal of Celsus,” a classical physician, was taken on during his university days. His early education is mysterious: he may have obtained a medical degree at the University of Ferrara. He spent some years practicing in the
Fuggers mines at Hutenberg and Schwaz, possibly penning an early version of Von der Bergsucht und Anderen Bergkrankheiten, (On the Miners’ Sickness and Other Miners’ Diseases). He worked as an army surgeon before arriving at Straussburg in 1526. The great turning point in his career came in 1527 when he was appointed as city-physician to Basel. He lectured at the university in vernacular German, an innovative insult to the scholastic sensibilities of the time, and gave lectures criticizing Galenism, demanding reform in medicine. He publicly burned a copy of Avicenna’s Codex at a student gathering. After two years in Basel, he had so many enemies that he was forced to flee, spending years wandering and studying in various degrees of poverty. He wrote prolifically on syphilis, plague, and surgery, completing his fundamental books, Paragranium and Opus Paramirium, in 1531. He returned to the mines at Hall and Schwaz in 1532-1533, refining his knowledge of mining and chemistry. He died in relative comfort in Salzburg in 1541.

Paracelsus took ideas from ancient writers, neo-Platonists and alchemists, synthesizing them to create his own new metaphysics and cosmologies. He believed that when God created the universe’s astral, spiritual and physical realms, he echoed the human being’s astral, spiritual and physical bodies. Nature was a macrocosm, ordered into different groups and stages of being, reflecting a human’s different and ordered components. The components were Paracelsus’ new elements: salt, the principle of stability; mercury, the principle of volatility; and sulphur, the principle of combustibility. The stomach was the Archeus, a sort of alchemist that sorted out and arranged the salt, mercury and sulphur in the patient’s food and air.

A physician was gifted by God with the ability to read the Light of Nature, a property which revealed secret patterns of Nature’s macrocosm which could be harnessed to heal disease. This is probably Paracelsus’ greatest scientific achievement: knowledge is to be sought through the observation of Nature. However, Paracelsus was a medieval man, not an empiricist. Without the tools of hypothesis and experiment, he was forced to substitute his own metaphysical theories for those that he had rejected. This is evident in his four pillars of the practice of medicine: Philosophy, the study of the Light of Nature, Astronomy, Alchemy, the earliest branch of chemistry, and Virtue, theological understanding and right practice.

The Von der Bergsucht
The Von der Bergsucht und Anderen Bergkrankheiten may have written as early as 1525, though others favour 1534. It was published posthumously by Samuel Architectus in 1567, and was not widely read until a century later. It is based on years of up-close observation of the workers made by Paracelsus in local mines, who favoured experience over theoretical talk. As Paracelsus puts it:

It is no longer meet to speak with the learned men and the philosophers, but with experienced men; for it is the manner and the innate custom of any experienced man not to confront another experienced man with talk...Experience is so constituted, that an understanding of its works makes itself known to everyone without much gab.

The Von der Bergsucht is divided into three books, each subdivided into four tractates. The first book deals with diseases of miners, the second with diseases of smelters and metal workers, and the third with disease caused by mercury, which Paracelsus considered unique enough to be treated separately. The four tractates introduce the disease and elements in question, and discuss pathogenesis, signs of the disease, and finally, the disease’s cure.

The First Book
Paracelsus, always humble, begins the first book, with an observation that no previous scholar has attempted such a classification. He then explains the basics of how sicknesses of the lungs are generated in the second tractate. Air is the food of the lungs, and is digested there. Air can be polluted through contact with the stars,
whose alchemical furnaces cause air to become separated into its separate elements which are harmful to human health. These elements are mercury, which causes disease by coagulating from smoke, sulphur, which can be roasted by fire onto the lungs, and salt, which precipitates into the lungs. Altogether, these imbalanced elements cannot be properly digested by the lungs and form tartarus, a sort of mucus that induces disease. Paracelsus draws a distinction between the lung diseases that all people suffer, and those unique to miners. Those suffered by above-ground dwellers are caused by the poisoning of surface air by the celestial stars. Those suffered by miners, however, result from the digestion of subterranean air that is poisoned by subterranean stars. By this Paracelsus meant the minerals themselves, forming constellations under the earth in the same manner as proper stars do in the sky. Thus, astronomy, the second pillar of Paracelsus’ medicine, informs philosophy, his first pillar of medicine.

The third tractate concerns the recognition of miners’ diseases. He stated that physicians are ordained by God to protect men from the dangerous but necessary work of mining. Paracelsus understands himself as a divinely ordained servant. He recognized the importance of shortness of breath due to excessive cold, and acidity and hoarseness due to excessive sulphur. Paracelsus expounds the importance of observing disease to be able to accurately identify these signs. He then poses two ideas of enduring worth to the progress of medicine: a recognition of acute versus chronic forms of poisoning, which he attributes to ingestion of the body instead of the spirit of a mineral. Eating arsenic produces instant death, but a vapour coming off the mineral produces a slower disease with the symptoms similar to pulmonary fibrosis, neoplasia, or emphysema. The other idea is his formulation of what would become known as the homeopathic principle. As Paracelsus puts it:

Now our physic (cure) is in mercury, sulphur and salt, and our poison is also in these three things, for they both exist together. For instance:

whatever causes jaundice, also cures jaundice. It is thus: good and evil are in the same thing, the jaundice arises from the evil, and when the good is separated from the evil, the arcanum (cure) against jaundice is there.

The final tractate concerns itself with cures for miners’ diseases. The first cures are preventative, beings recipes for prophylaxis against ore vapours. A diet rich in salt and deficient in spices is prescribed for the same reason. Once the disease has taken hold, Paracelsus divides his cures into natural cures and arcana cures. Natural cures include sweating and the use of cyclamen roots. Arcana cures take advantage of the astrological and elemental correspondences that caused the disease in order to cure the disease. The poisons are divided into arsenic, antimony and alkali sub-types, and each has its own mineral cure designed to produce sweating within the effected organs to wash off the polluting tartarus.

Discussion
In treatment, Paracelsus rejects the Galenic model by rejecting the theory of bodily humours and by rejecting cure by opposition. Paracelsus’ pathogeneses are not internal humoral imbalances, but external poisons that have accumulated inside the body. This is much closer to our understanding of the modern pathogen. Of course, Paracelsus is reluctant to leave the older imbalance model behind entirely, as his dissertations imbalances of air, fire, water, and earth indicate. Paracelsus is also the first to suggest that the cause of disease may also be its cure - the homeopathic principle and the idea that one substance may contain both good and evil within it, which has played such an important part in the history of medicine. Paracelsus’ pharmacy is also of interest to history. He is an early, if certainly not the first, proponent of a return to simple herbal remedies. More importantly, he is the first to introduce mineral remedies effectively. These would become increasingly popular, entering England’s materia medica in the next century.
Paracelsus was also a strong advocate of what we might today call “lifestyle management”. He clearly understood that certain occupations carry their own specific risks, hence an entire book devoted to the diseases of miners and refiners. Of particular interest is his emphasis on the prevention of disease, something whose importance is sometimes forgotten in today’s medicine. Lifestyle control plays some part in this: Paracelsus recommends specific diets and sweatbaths for miners. Paracelsus shows a rudimentary understanding of primary and secondary prevention of disease by discussing those therapies that keep the patient from becoming weak and susceptible to mine vapours in the first place, and those that drive out infections before they take hold.

Finally, there is Paracelsus’ emphasis on experience, and where his sermons reach their most bombastic heights. He was nothing less than fanatically passionate about rejecting book learning and going out to the patients and local healers to understand disease. In the Von der Bergsucht he says:

This experience should defend itself and the results which should move every unbeliever to believe in physic should be examined. For the results are so clear, that they are not in need of any disputation... However, each one should retain his own experience; for who can or wants to fathom the end of medicine?\footnote{10}

Paracelsus anticipates the secular and empirical trends that would soon sweep medicine as the Renaissance took hold. However, he cannot make the leap away from the medieval scholasticism in which he was raised; he does not have any guides or tools with which to do so. He cannot be properly understood as a de-mystifier of medical knowledge.\footnote{11} His own mystical systems are complex and frequently self-incompatible. For all his arrogant confidence in his own mystical ideas however, Paracelsus remained a stubborn proponent of experienced facts, and as the above quotation shows, he remained open to the idea that his own understanding might someday be surpassed by others’ experiences.

Conclusion
So was Paracelsus a positive innovator? It depends on the measure. The Von der Bergsucht is the first handbook of occupational disease, and one of the first therapeutic texts to endorse a homeopathic ideal. Paracelsus’ descriptions of the physiognomy of mercury poisoning are quite accurate. On a practical level, Paracelsus’ Von der Bergsucht is a mixed success. Some of his herbal and mineral cures may have worked, and some undoubtedly did not. His observation that a substance might be helpful or harmful depending on context is a valuable one. However, to focus entirely on the practical therapeutic value of Paracelsus’ cures is to miss out on his greatest contribution to the history of medicine. This is a catalogue of diseases not heretofore recognized by medical authorities- the idea that the ancients might have missed a few things is radical and valuable. Furthermore, Paracelsus’ physiognomic data on the miners’ diseases more than any others (save perhaps his studies on syphilis) were based on real, objective observation. Openness to new ideas and close observation and relationship with the patient, was an ideal of Hippocrates, and is something still highly prized in medicine today. It is also an innovation of which Paracelsus was one of the earliest proponents. For this reason, Von der Bergsucht und Anderen Bergkrankheiten, demonstrates the Paracelsus was indeed a positive innovator in the history of medicine.

References


Leprosy has long had a reputation for being one of the most feared of all human diseases. In Canada today the disease is a rarity and the few existing cases are considered little threat to public health; however, this was not always the case. In the mid- to- late nineteenth century an endemic leprosy was found to exist among the Acadian Population of New Brunswick, a discovery which caused much concern within the nation’s medical and legislative communities of the time. In this outbreak, which occurred prior to the discovery of the leprosy bacillus, the physicians involved with the situation were deeply divided as to the nature of the disease: was it hereditary or was it contagious? Their decision would prove fateful for the victims of the disease in this area. Furthermore, issues of race and class would become central in the discussion surrounding the appearance of leprosy in this population.

Introduction
In Canada today leprosy is a rare disease that is diagnosed exclusively those who acquired the infection outside of Canada’s borders. However, this was not always the case. In the nineteenth century endemic leprosy was found to exist in Maritime Canada, particularly among the Acadians of northeast New Brunswick. The appearance of leprosy on Canadian soil posed several challenges for the medical and legislative community of eastern Canada, and brought Canadian physicians into the debate regarding the nature of this particularly loathsome disease. Consequently, the medical community of eastern Canada made some significant steps toward understanding the transmission and pathogenesis of this disease. However, an examination of the era of endemic leprosy in New Brunswick also demonstrates the extent to which concepts of race and class influenced nineteenth century medical thinking.

It is impossible to know exactly when the first cases of leprosy appeared in the Acadian population of New Brunswick or how it was introduced to this population. The first generally accepted case of leprosy in the Acadian population occurred in a woman named Ursule Benoit who began exhibiting symptoms of the disease around 1815. Other than her illness, which claimed her life in 1828, there was nothing particularly unusual about Mrs. Benoit. There were no reports of leprosy in her parents’ or her husband’s families prior her illness; however, after she became ill the disease appeared in two of her sisters and in her husband. By the 1840’s several small Acadian towns surrounding Chaleur Bay, New Brunswick, all had cases of leprosy among their townspeople. The cases were clustered within several families, and in most cases the afflicted families were in some way related to Ursule Benoit and her family. In 1844, the parish priest of Tracadie, one of the affected towns, began to suspect that the disease amongst his parishioners was leprosy, and notified the local health authorities and urged them to investigate the illness. In 1844 the New Brunswick Legislature sent an investigative Commission to the region to confirm or disprove the existence of the leprosy. This Commission reported that they found eighteen confirmed cases of leprosy and several other highly suspicious cases. The investigators unanimously agreed that the illness was contagious and advocated for the creation of a lazaretto to separate the sick from the healthy. In response to the report, in April 1844 the New Brunswick Legislature passed legislation which authorized the construction of a lazaretto, and gave the Board of Health the authority to forcibly remove leprous individuals from their homes and transport them to the facility.

From 1844 to 1849, leprous individuals from the Acadian communities around Chaleur Bay were sent to a lazaretto which was built on
Sheldrake Island, a small island in the mouth of the Miramichi River. Those confined there were expected to be self-sufficient for all of their basic needs such as cooking and cleaning. With the poor living conditions, and deprived from the support of friends and family, most leprosy victims deteriorated within months of their arrival on the island. During the Sheldrake Island years, the Acadian sufferers of leprosy were given no formal medical treatment. In 1849, thanks in large due to the lobbying efforts of the local Catholic Church, the Board of Health agreed to close the Sheldrake Island lazaretto and to transfer the surviving individuals to a lazaretto which would be built in Tracadie. In its five year history thirty-seven people had lived on Sheldrake Island; five vanished after escaping the island, fifteen died, and another seventeen were transferred to the new facility in Tracadie.

The Tracadie Lazaretto, while certainly not without flaws, would over the next century prove to be a vast improvement over the Sheldrake Island lazaretto. However, in its early years there was little improvement in quality of life for those confined there. In 1850’s the population of the lazaretto grew and the mortality rate remained high. The situation was exacerbated by the lack of formal medical care inside the facility. In 1861, again as a result of the efforts of local parish priest, a permanent physician was finally found for the lazaretto. Dr. James Nicholson served as resident physician at Tracadie before dying at an early age of tuberculosis. In 1865 Dr. Alfred Corbett Smith, a twenty-five year old graduate of Harvard Medical School, was hired to replace Dr. Nicholson; he would remain at the lazaretto until his death in 1909. In 1868, ‘Les Hospitalieres de Saint-Joseph’ a Montreal-based order of cloistered nuns agreed to establish a religious community and nursing hospital at Tracadie. The presence of the nursing sisters, who would stay with the various incarnations of the lazaretto until it finally closed in 1965, was pivotal in transforming the quality of patient care within this facility. With the arrival of first six ‘Hospitalieres’ in 1868 the facility for the first time functioned as a hospital rather than a medically enforced detention centre.

At the time of the leprosy outbreak in the Acadian population of New Brunswick the origins of the disease was a hotly debated topic in the medical circles of Europe and North America. With the discovery of leprosy in New Brunswick this debate became a local concern. In their 1844 report to the government of New Brunswick the medical commission led by Dr. Alexander Key stated that they unanimously agreed that leprosy was a contagious disease. This conviction paved the way for the legislation that would create the Sheldrake Island lazaretto. In spite of this, one of the other authors of the report, Dr. A.H. Skene, seemed somewhat less certain of the contagious nature of the illness. In a report which he submitted to the Montreal Medical Gazette just a few months later, he states that those who are vulnerable to the disease are so by virtue of “hereditary taint, and by contagion” and he goes on to demonstrate his conviction by providing genealogical tables linking the disease to the relatives of Ursule Benoit. In 1847, New Brunswick legislature appointed a committee of doctors to investigate the heredity-versus-contagion debate. This committee led by Drs. Robert Bayard and William Wilson, conducted a thorough investigation of all of the known cases concluded that the illness was non-contagious and transmitted by hereditary means. To support their argument the authors pointed out the genealogy of the illness, and they also recounted the numerous reports of healthy spouses who had slept in the same bed as their leprous husband or wife for years without contracting the disease. Nevertheless, they did qualify their conviction by stating that a small number, perhaps one percent of the population, with no known hereditary connection to the disease may be able to contact the illness through casual contact with a leprosy sufferer. The significance of this report, aside from the surprisingly accurate description of the immunological basis of leprosy, was that in their conclusions they foreshadowed the modern approach to leprosy management by almost a century. They
recommended that the lazaretto be abolished as, “It coerces the leper, and removes him from his family, without any regard to his feelings”. In the place of a lazaretto, they suggested that the leper should be given a small monetary appropriation and be allowed to be cared for at home. None of the recommendations of this seminal, albeit theoretically flawed, report were followed by the New Brunswick government. The legislature ultimately decided that the medical evidence was inconclusive, and therefore, they could not risk the health of the general public by closing the lazaretto.

As the heredity versus contagion debate continued within the medical community there was one aspect of the transmission of the illness that was quite generally agreed upon—that certain peoples, or races to use the term of the time, were more vulnerable to leprosy, either by virtue of some inherited factor or by means of their lifestyle. Although it was acknowledged that leprosy had once plagued the European population it was felt that most European ‘races’ were no longer vulnerable to the leprosy by virtue of their civilized habits. Foreign places and their ‘inferior’ peoples, on the other hand were felt to be a reservoir of leprosy and other diseases that afflict those uncivilized in mind, body and soul. Race and class were frequently used by English speaking medical and governmental authorities and to a lesser degree by French Canadian religious authorities to explain the existence of a foreign or even ‘tropical’ disease in the Acadian population. The Acadian people were considered to be racially different from the English-speaking of New Brunswick and even from the French-speaking population of Quebec. One Quebec-born priest wrote that his parishioners were “Acadian fools who live in disorder...being a racial mixture of Indian, Negro, French, Spanish and even Italian with all of the natural and intellectual defects of their origins.”

Dr. A.C. Smith, the longstanding physician of Tracadie Lazaretto, would become known as Canada’s foremost expert on the subject of leprosy. Although he was known to be a man of considerable good-will, he was steadfast in his convictions that leprosy, while contagious to a degree, preferentially infected inferior classes and races, such as the Acadians. In 1891, reflecting on the New Brunswick experience, he wrote: “Leprosy never appears in the better class of our French population”. In the 1890’s, after investigating several cases of leprosy among Icelandic immigrants in Western Canada, he reassured authorities that leprosy would not be able to make headway among hard-working people such as these. Here the condemnation of the Acadians is implicitly obvious. There are several reputable reports of the existence of endemic leprosy on Cape Breton Island in the late nineteenth century. In 1889, Smith traveled to the island where he confirmed the existence of leprosy and brought one man to Tracadie; however, he did not propose the creation of a lazaretto in Cape Breton, nor did he formally publish his findings. Later, in 1904, Smith admitted that he had not disclosed his finding at the request of the Nova Scotia government after it was discovered that some of the descendants of the Cape Breton leprosy victims had achieved prominence within business and government. In addition to assuring a low profile to the Cape Breton cases, Dr. Smith also never made any racial or class generalizations regarding the presence of leprosy among these English speaking Scottish immigrants. To Dr. Smith the appearance of leprosy in those of superior racial stock was to be regarded as an unfortunate act of nature rather than as a condemnation of the intrinsic worth of the population.

Conclusion
The era of endemic leprosy in New Brunswick was significant to Canadian medical history on several levels. In terms of the elucidation of the nature of leprosy Dr. A.H. Skene proposed a theory that incorporated both features that we now understand to be prerequisites for the development of leprosy, an infectious particle and a susceptible host, in his paper published a full thirty years before Hansen first observed the leprosy bacillus. Drs. W. Wilson and R. Bayard advocated a humane treatment strategy for the treatment of leprosy sufferers which included the
abolishment of leprosaria; a strategy which would not be utilized for another century after their proposal. Finally, the history of leprosy among the Acadians of New Brunswick is significant as it illustrates the racialized thinking which was so accepted in the Western medical paradigm of the nineteenth century, with ‘inferior’ peoples acquiring ‘inferior’ diseases. While acting well within the acceptable standards of their time, the medical community openly contributed to the discrimination of the Acadians suffering from leprosy, who were felt to have acquired leprosy by virtue of their racial inferiority. Looking at this case with modern eyes, the discriminatory attitude of our Canadian physician forefathers is startling. However, this was not an isolated or particularly unusual case as throughout history and even up to our modern times there are many examples illustrating the role of the medical community in contributing to the oppression of an already vulnerable population.

References

6. Report of the Commissioners appointed by the Executive to visit and examine the lazaretto and lepers upon Sheldrake Island. In Journals of the House of Assembly of the Province of New Brunswick. 1848:58-72.
Caesarean section has been performed for many centuries and is considered to be one of the oldest operations in the history of medicine. References to cesarean section date back to ancient Hindu, Egyptian, Roman and Grecian folklore. For example, in Greek mythology, Apollo removed Asclepius, originator of religious medicine, from his dying mother's abdomen. Even the socio-economic structure of Jewish society accommodated such surgery. According to the Mishnah (140 B.C.), twins born by this method could not receive the right for primogeniture (obtain office or inherit property). Up until (and including) the 15th century, cases documented suggest that caesarean sections were performed only when the mother was dying or dead, in an attempt to save the unborn child or bury it separately (as was the religious custom). It was not meant to save the mother’s life. It was not until the 19th century that steps to improve the chances of survival of the mother were successfully made. This included the usage of anesthesia (allowed surgeons to take the time to operate with precision), surgical asepsis (carbolic acid introduced by Joseph Lister) better equipment (low obstetrical forceps reduced number of craniotomies performed and vaginal tears) and uterine sutures (used to treat the vaginal tears/fistulas resulting from traumatic childbirth). Following these changes, surgeons were able to focus on improving incisions made to the uterus. Advocated by British obstetrician Munro Kerr, between 1880 and 1925, transverse incisions of the lower aspect of the uterus were found to reduce infections and uterine ruptures in pregnancy, increasing survival rates. This still remains as the most common method today. This is in contrast to the vertical incisions made classically.

Origins of the name: Caesarean operation to caesarean section
Caesarean section involves the delivery of the baby through an abdominal cut. Initially, “cesarean section” was referred to as “caesarean operation”. There is rampant debate over how the name “caesarean operation” came to be. Many theorize that the name came from Julius Caesar, who supposedly was born by this method. This, however, is unlikely because it is known that Caesar’s mother, Aurelia, was still alive when he invaded Britain, and it is unlikely that she could have survived such a surgery given the crude technique and amount of knowledge of the female anatomy and physiology known at that time. Also, it is believed that at the time of his existence, the surgery was mostly done on dead or dying women. A possibility as to why his name is associated is that during his reign he ordered the use of this procedure to procure the child from a dying mother.

Romans described caesarean birth until the last century B.C as “a caeso matris utero”, which means, “to cut an infant of its mother’s womb”. Another possible source is from the King of Rome, Numa Pompilius, who codified Roman Law in 715 B.C. Lex Regia, which later became known as Lex Caesarea (under the rule of the Caesars) made it mandatory to remove the child from its dying mother, even if there was no chance of its own survival. This was done in part to ensure separate burial for both mother and child. Also, the state was interested in raising its population size, and did not wish to loose any person unnecessarily.

Pliny (28-70 AD) in Book VII of ‘Natural History’ suggested that the term might come from the Latin verb ‘caedere’ which means ‘to cut’, implying delivery by cutting. Children born by this method were called ‘caesones’, which is another possible origin. As for the change from caesarean operation to section, the first person to use the now common phrase was Jacques Guillumeau, who in 1598 used ‘section’ in his book of midwifery.

Historical references
The oldest authentic record of a living child is that of Gorgias, a famous orator of Sicily, 508 B.C. References to caesarean section appear in ancient Egyptian, Hindu, Grecian and Roman folklore. Religious laws of Egypt in 3000 BC and of India in 1500 BC required abdominal
delivery of the child from its dead mother. Greek and Roman mythology have tales of this surgery, and it is believed that Asclepius, the god of medicine, was removed by a cut from his dying mother’s (Coronis’) womb by Apollo (Figure 1). Bacchus, the god of wine, was also delivered this way, with Jupiter taking on the role of Apollo.

Figure 1: The extraction of Asclepius from the abdomen of his mother, Coronis, by his father, Apollo. Woodcut from the 1549 edition of Alessandro Beneditti’s De Re Medica.

Ancient Chinese texts portray this as being done on living women. The story of King Sol’s wife, as recounted by Machnezie (1927) also suggested that she delivered a son by this method and survived. These references to women surviving is odd considering that many of the operations (done in the earlier part of its history) were carried out after the woman had died, or it was late in the pregnancy/labor and done when the health of the child was at risk. Perhaps this operation was successfully done on living subjects a lot earlier than is actually documented.

Caesarean section was an integral part of life and accommodations were made within religious, literary and societal texts. The Jewish book of Law, the Talmud (400AD) states that women do not need to observe the usual days of purification following this type of delivery. In Mishnah (Jewish text from 140 BC), twins born by this method had restrictions placed on their birthright:

“... in the case of twins, neither the first child which shall be brought into the world by the cut in the abdomen, nor the second, can receive the right of primogeniture, either as regards the office of priest or succession to property”

Many great works of literature also refer to this operation. In Shakespeare’s ‘Macbeth’ for example, Macbeth is horrified to realize that Macduff was ‘from his mother’s womb untimely ripped’, therefore making him susceptible to death by Macduff’s hands (Macbeth could not be killed by “one of woman born”. Since Macduff was not ‘born’ in the sense of the word, he could kill Macbeth). Shakespeare also refers to caesarean sections in “Cymbeline”.

Religious influence
Islam before 1500 was against the procedure and stated that any child born by this method was an offspring of the devil and therefore should be killed immediately. Now of course such is not the case.

On the other hand, Christianity was positive towards this operation, being more concerned
with saving souls. Specifically, in the Middle Ages, the Roman Catholic Church encouraged the use of caesarean section to save the child and wanted to offer their souls a chance of salvation through baptism. The mother, on the other hand, was not a concern since the church prohibited usage of abortion, fetal dismemberment and craniotomy to save the mother. Other church councils did not decree anything positive for the mother either, but allowed for operating on a dead pregnant woman to save the child and allow baptism. In 1280, the church councils of Cologne made it mandatory to do this surgery. The Republic of Venice in 1608 actually laid down severe penalties for any doctor that failed to make an attempt to save a child in this way. The need to baptize and therefore save the soul of the child was so prevalent and important, especially in France, that Peu in his “Practiques des Accouchements” states that:

“... immediate opening of the abdomen as soon as the mother is assuredly dead and within the space of time taken to say one “Ave maria”, and as soon as the child is visible, pouring water over it and adding to the usual words of baptism, “si tu as vie”

Similarly, in the United States, during the Franciscan mission period (1769-1833), it became the responsibility of the missionary priest to do the operation on dying women. They were actually taught pertinent maternal anatomy, the actual procedure and given instruments to aid in their task.

Earliest documented cases
Even though references in ancient texts indicate this surgery was performed on live subjects, it was during the 1500’s that debates issued over the possibility of doing this on live women. Francois Roussett in 1582, was the first physician to endorse the operation on living women. In fact, he was the one to record Jacob Nufer’s story (below), and use it as proof that such surgery should be considered for live women. Except for the Trautmann case (below), even though the authors were not the ones that performed those surgeries, many were penned down and used for debating purposes.

Trautmann performed the first generally accepted and authenticated case in the presence of two midwives in Wittenberg, Germany in 1610. The patient died 25 days after the procedure and the uterine wall was found to have already healed.

Jacob Nufer, in 1500, performed the first documented, successful operation on a living woman. He was not a doctor, but rather a Swiss sow-gelder. The story goes that the wife was pregnant for the first time, and was having severe labor pains. The skills of the 13 midwives involved were not leading to the subsequent delivery of the child. There did not seem to be much hope and so the husband wanted to perform caesarean section. She was willing, unfortunately, the municipal authorities were not willing to allow it. Only after the second request did the mayor consent, and then Jacob “...laid his wife on a table, incised the abdominal wall (with a razor), then the uterus and after which he quickly extracted the child. Several sutures were placed in the abdominal wall”. The wound healed and she lived to bear several children, even twins, vaginally, with no complications. This documentation suggests that this is the first successful vaginal delivery after a caesarean birth. The cesarean baby lived to be 77. However, some historians do not accept the validity of this case because it was not reported until 1582, 82 years after the procedure was done. This delay suggests publication of this case was based on hearsay. Adding to that, had this been really done, it is expected that such news would have spread far and wide long before 82 years.

Some caesarean sections happened to occur under interesting and unique circumstances. For example, pregnant women were gored by the horns of animals such as bulls or cows, resulting in the birth of the child. Earliest case documented was in 1647 Holland, where the wife of a farmer in Zaandam was tossed by a bull in the ninth month of pregnancy and:
"… sustained an incision into the abdominal wall, which stretched from one ischium to the other, and through the pubic bone in the shape of a crescent. She had another wound through skin and peritoneum into the uterus, twelve finger breadths in length, from which the child issued."

The woman died 36 hours later, and the child escaped unscathed.\(^9\)

**Refinements in the medical profession and caesarean sections**

Improvements in many aspects that helped to enhance the medical profession had an impact on the mortality and precision of caesarean sections. According to Boley\(^5\), three major reasons can be attributed to the death of these women: using the surgery only when the woman was close to dying, high rates of infection (lack of sanitation) and lack of uterine sutures. Many improvements with instruments (high vs. low forceps) and procedures employed (including other than caesarean sections) to remove the baby all further enhanced and strengthened arguments for using caesarean sections, and eventually lead to the current style of surgery.

**Anesthesia**

In 1846, at Massachusetts General Hospital, dentist William T.G. Morton used diethyl ether to desensitize the face to remove a tumor. However, there was opposition to its use in obstetrics because of biblical injunction that women should suffer while giving birth in compensation for Eve's sin.\(^3\) This argument was weakened when Queen Victoria, the head of the Church of England, had chloroform administered for the births of two of her children (Leopold in 1853 and Beatrice in 1857). Subsequently, anesthesia in childbirth became accepted and practical in cases of cesarean section.\(^3\)

The use of anesthetics gave surgeons the time to operate with precision, clean the peritoneal cavity properly, record the details of their procedures, and learn from their experiences. Women were spared from feeling the cuts made, and were less susceptible to shock, which was becoming a leading cause of post-operative mortality and morbidity.\(^3\)

**Procedures other than caesarean sections**

Using anesthesia shifted the argument for caesarean section versus relying on craniotomy. Craniotomy had been practiced for hundreds, perhaps even thousands, of years.\(^3\) It has been performed on both live and dead fetuses. This procedure involved the destruction of the fetal skull (by instruments such as the crotchet) and the extraction of the entire fetus vaginally. Figure 2 shows how this was done. Unlike caesarean section, it entailed lower risks to the mother.\(^3\) Another reason craniotomy was popular was because it was believed that the fetus felt no pain during this procedure.\(^2\) Closer to 1855 Sir James Y. Simpson showed otherwise and this seemed to have an effect on the number of such procedures done.\(^2\)

![Figure 2: Craniotomy](image)

Another method to deliver the baby involved forceps (figure 3). Initially, high forceps were used, which reduced the number of deaths that would have occurred via craniotomy. However, it ended up creating severe tears (fistulas) in the
The fetus could also be injured if the forceps used to pull the baby were pressed too tightly. Harold Williams (1879) of Boston researched the number of cases and mortality with these forceps, and he concluded they were more lethal than caesarean sections. An improvement with this method was the use of low forceps, which did not cause as many vaginal tears. These forceps are still used today.

Neither craniotomy nor obstetrical forceps were of any help when severe pelvic distortion or contraction existed, and that is when caesarean sections were especially useful. One of the first men to suggest factors when caesarean sections should and should not be used was William Smellie (1752). He was a British physician who suggested that women should not be operated on when they were weak and in poor condition. If they were in such a situation then it was best that the operation was delayed until she died, after which it should be immediately performed to save the child. He suggested that it should only be done in:

“... laborious and preternatural labors, on account of the narrowness or distortion of the pelvis into which it is sometimes impossible to introduce the hand; or from large excrences and glandular swellings that fill up the vagina and cannot be removed...or adhesions in that part and at the os uteri that cannot be separated, ...in such emergencies, if the woman is strong and of good habit of body, caesarean operation is certainly advisable and ought to be performed; because the mother and child have no other chance to be saved, and it is better to have recourse to an operation which has sometimes succeeded than leave them both to inevitable death...”

Uterine sutures
In the 16th century, obstetricians opposed performing surgery on live patients because maternal mortality was incredibly high. As well, during most of the 19th century (1877 to 1876), no successful caesarean operation had been performed in Paris. This was attributed to the wrong belief that the natural rhythmic contraction and relaxation of the uterus prevented the use of sutures. Therefore, after the baby was removed, incisions in the uterus were left open. Due to this, women died from hemorrhage and infection. As well, in those days, sutures had to be removed, and it was impossible to remove them from the uterine wall after the abdomen had been closed. The first man to close a uterine incision with sutures was Lebas, a French surgeon in 1769. However, the usage of sutures did not become popular until the Sanger method (below) resulted in reduced mortality rates.

Antiseptic
It is interesting to note that the early documented cases with successful births took place under unusual circumstances, and far away from hospitals (Bull horn goring and Jacob Nufer). Most of the surgeries in remote areas lacked medical staff and facilities. As well, because they lacked a medical community, time was not wasted on professional consultations. Instead it was being used to take action earlier. This meant that surgery was being performed earlier, when the fetus was not under much distress and the mother was not close to dying. Treating both parties at an earlier time increased their survival rates. Since operations got performed on kitchen...
tables, beds and any other facilities but the hospitals, infection rates were low (sanitation was not practiced in hospitals) and survival rates were higher.

Hospitals during those times were notorious for being ‘infection beds’, especially because the surgeons came in wearing street clothes and did not clean their hands in between patients. As a matter of fact, it was estimated that if a woman performed surgery on herself or was gored by a bull, she had a 50% chance of survival, compared with 10% survival rate if she were being taken care of by a New York surgeon! In the mid-1860s, the British surgeon Joseph Lister introduced an antiseptic method using carbolic acid. Introducing this method however helped reduce the number of deaths due to infection (seen as being the most common cause for women mortality), and allowed physicians to focus on their technique and style of operating.

**Time of intervention**
As cesarean section became safer, obstetricians increasingly argued against delaying surgery. Rather than waiting for hours of unsuccessful labor, physicians like Franz von Winckel in Germany, Thomas Radford in England and Robert Harris in the United States opted for early intervention. Higher rate of survival were likely with early intervention. Such arguments eventually led to greater numbers of operations occurring earlier, and the data collected showed lower mortality.

**Porro Operation**
The Porro operation, or the ‘radical caesarean section’, is defined as a surgery where the uterus is completely removed (hysterectomy). This left the woman unable to have any more children, which in itself had profound effects on emotional well being of the woman. Dr Joseph Cavallini had suggested this surgery as early as 1768, but attempts to perform this surgery then had been unsuccessful. In 1876, Eduardo Porro successfully performed this surgery. With the widespread usage of this surgery, presence of antiseptic protocols, and intervening earlier, mortality rates showed a marked decrease.

**Sanger operation**
In 1882, Max Sanger used uterine sutures (silver and silk wire) to sew up the cuts made in the peritoneum. This was just as successful in reducing mortality rates as the Porro operation, and it did not involve removal of the uterus. Development of the silver wire stitches to treat vaginal tears (fistulas that resulted from traumatic delivery) was done by 19th century American gynecologist J. Marion Sims. Sanger operation was just as effective as the Porro method, and thus a lot of physicians moved to using this, for the woman’s benefit.

**Where to incise?**
As confidence in the outcome of their procedures increased, doctors turned their attention to where to incise the uterus. Various styles (longitudinal, oblique, etc.) were debated for a century (1770-1880). Between 1880-1925, obstetricians experimented with transverse incisions in the lower segment of the uterus. The first person to suggest this type of incision was Robert Wallace Johnson (1786) in his book “A New Systems of Midwifery”. He suggested this because of low bleeding that occurred with such a cut. Kehrer in 1881 successfully performed this type of incision.

Munro Kerr, a British obstetrician, highly advocated the Kehrer method during the 1920’s. He believed that such an incision had low bleeding, low infection rate and low uterine rupture from subsequent pregnancies (because the scar would make the region stronger).

A further modification -- vaginal cesarean section -- helped avoid peritonitis in patients who were already suffering from certain infections. However, with the discovery of penicillin in 1928 by Alexander Fleming, this method was eventually eliminated from practice.

Most incisions today either involve transverse incision of lower segment (Kerr technique) or classical/vertical incision, which is a cut made through the abdomen and front wall of uterus. The latter has high blood loss and increased incidence of infection. However, if it
is an emergency C-section, a pre-term fetus, or a tumor that obscures the lower segment, then vertical incision is used.6

Conclusion
Caesarean section has enjoyed a very long history and has been continuously refined by society. At one time such a procedure was only used on deathbeds. But now it is heavily being considered as elective or first line when it comes to delivery of a child (especially in South American countries like Brazil). Before where the child’s health and well being was put first, now the mother’s health and cosmetic outlook is considered just as seriously. The art and style of caesarean section has developed despite many problems, and has grown with civilization as human nature has throughout these centuries.

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The Birth of Defibrillation: A Slow March Towards Treating Sudden Death

Stephen M. Chihrin

Recent years have seen the rapid fine-tuning of external cardiac defibrillation for the treatment of cardiac arrest. However, this rapid advancement conceals the slow march of physiologists over several centuries to address this life threatening state. Frequently, accounts of defibrillation research begin with the turn of the 20th century. However, the birth of the field was rooted millennia earlier, and became the object of scientific investigation a full 150 years before Einthoven received the Nobel Prize for his work developing the electrocardiograph. Early accounts of resuscitation demonstrated an understanding of the necessity of respiration for life, as well as the correlation of respiratory and cardiac function. The eminent danger posed by ventricular fibrillation was noted by the Egyptians as early as 3500 BC, when it was observed that “When the heart trembles, has little power and sinks, the disease is advancing and death is near.” However, it was the discovery of electricity that proved critical to research into heart function, and ultimately, defibrillation. In the mid 18th century, Luigi Galvani made the classic observation that an electrical impulse could cause a frog’s leg to twitch “as though it were seized with tetanus at the very moment when the sparks were discharged.” The excitement generated from Galvani’s experiments led to the almost instantaneous application of electricity to the treatment of cardiac arrest. However, it would take a number of innovative physicians, in roles spanning from basic researchers to public educators, to bring defibrillation from a baseless practice attempted out of desperation, to a scientifically validated, reliable, and widely available procedure. It is the intent of this report to highlight a number of these innovative individuals, and to detail the research that provides a foundation for the rapid advancements in cardiac care seen today.

Introduction

Recent years have seen the rapid fine-tuning of external cardiac defibrillation for the treatment of cardiac arrest. The recent announcement of the Phillips HeartStart Home Defibrillator as one of Fortune Magazine’s “25 Best Products of 2004”¹ can be seen not only as a testament to medicine’s growing response to one of society’s greatest health risks, but also as the culmination of several centuries of discovery in cardiac electrophysiology.

While our ability to respond effectively to sudden death has greatly improved in recent years, it comes as no surprise that the desire to do so is as old as antiquity itself. Reviving someone apparently dead was no doubt a dramatic tale in any time, and countless instances of it are found in mythology and ancient texts. One of the earliest and most widespread written depictions of resuscitation can be found in the Bible, where Elisha was detailed on more than one occasion to raise the dead:

“And when Elisha was come into the house, behold, the child was dead .... And he went up, and lay upon the child, and put his mouth upon his mouth, and his eyes upon his eyes, and his hands upon his hands: and stretched himself upon the child; and the flesh of the child waxed warm .... And the child sneezed seven times, and the child opened his eyes.” (2 Kings 4:32-35).

While techniques to aid in true cardiac arrest did not emerge until the 18th century, knowledge of ventricular fibrillation – the most common cause of sudden cardiac death – existed more than 3500 years ago. At that time, it was written in the Ebers Papyrus that “When the heart trembles, has little power and sinks, the disease is advancing and death is near...”.² The link between trembling (fibrillation), little power (poor circulation), and death, was again described by Vesalius as “worm-like” motions of the heart. Vesalius added to this description in 1543, by also noting the correlation between respiration and cardiac function:

“...Indeed, with a slight breath in the case of this living animal the lung will swell to the full extent of the thoracic
cavity, and the heart become strong and exhibits a wondrous variety of motions…. And as I ... take care that the lung is inflated at intervals, the motion of the heart and arteries does not stop...”.

Electricity
It was the discovery of electricity that proved critical to research into heart function, and ultimately, defibrillation. In the mid 18th century, Luigi Galvani began experimenting with electricity, and made the classic observation in that an electrical impulse could cause a frog’s leg to twitch “as though it were seized with tetanus at the very moment when the sparks were discharged”. This account of “animal electricity” quickly caught the interest of seemingly every scientist in Europe. And while it undoubtedly put great survival pressure on the common frog, the discovery ultimately spawned the field of electrophysiology.

Early Discoveries
The excitement generated from Galvani’s experiments, and the countless experiments that followed, led to the almost instantaneous application of electricity to the treatment of cardiac arrest. While it wouldn’t be until Prevost and Battelli’s work in the turn of the 20th century that true defibrillation would be depicted scientifically, the first case report describing successful resuscitation using electrical shock was made in 1774, when a young woman fell out a second-storey window and was believed by all accounts to be dead. After approximately twenty minutes, a doctor was summoned, who after exhausting all conventional techniques, attempted to apply electricity “to various parts of the body in vain; but upon transmitting a few shocks through the thorax, he perceived a small pulsation’ in a few minutes the child began to breathe with great difficulty, and after some time she vomited.” This account, and many others, were recorded in the register of Royal Humane Society of London, an organization established the very same year to promote resuscitation as a means of saving otherwise healthy people – victims most often of falls, drowning, mining accidents, and lightning.

While doctors across Europe began using electricity as experimental treatment for sudden death, the first report of scientific investigation into this practice was not conducted until a year after the first recorded “save”. In 1775, Dr. Peter Abilgaard published his observations on shock and countershock – a full 124 years before Provost and Battelli’s documentation of ventricular fibrillation and defibrillation. Abilgaard observed that electrical stimuli could, when applied anywhere across the body of a hen, in particular the head, render his animal specimen lifeless, and when applied again across the thorax, restarted the heart:

“With a shock to the head, the animal was rendered lifeless, and arose with a second shock to the chest; however, after the experiment was repeated rather often, the hen was completely stunned, walked with some difficulty, and did not eat for a day and night; then later it was very well and even laid an egg.”

Surprisingly, given the importance of Abilgaard’s observations, few references were made to it in the literature of the time.

A True Beginning
While the study by Abilgaard and the numerous case reports from the Royal Humane Society suggested an early beginning to cardiac arrest research, it was not until the beginning of the 19th century that work began in earnest. The mechanism of cardiac arrest began to be elucidated by Ludwig and Hoffa, who in 1850 were the first to physiologically describe fibrillation in animals, while also noting that electrical shocks can reliably induce the phenomenon. By 1851, chloroform had gained considerable popularity in operating theatres across the world, and numerous cases of sudden death left surgeons hesitant to use the anesthetic. Dr. Steiner was one of the first to investigate chloroform and ether induced cardiac arrest, and published accounts of successful
ventricular pacing in 10 dogs, 14 cats, 6 rabbits, and 1 donkey. Unfortunately, his one attempt at resuscitating a human patient was unsuccessful. 9

Work on fibrillation continued by many physiologists in the later half of the 19th century, aided by advances in knowledge of cardiac function and in technology to observe it. John McWilliam made several significant observations about ventricular fibrillation through a series of reports in 1887 10 and was one of the first to insist that ventricular fibrillation must occur in humankind. Until this point, and in fact for a number of years after, ventricular fibrillation had only been clearly observed in animals, leading many to believe it simply did not occur in mankind. 6 McWilliam, however, demonstrated that ventricular fibrillation occurs with greater frequency and severity in larger mammal species, and suggested quite reasonably that the reason ventricular fibrillation had not been clearly identified in humankind was simply that most cases of cardiac arrest occurred out of hospital, where response time exceeded fibrillation duration. 10

Around the same time, two other physiologists were studying fibrillation and made some significant discoveries. The focus of Prevost and Battelli’s report was not unlike the conclusions made by McWilliam: the heart’s ventricles could be made to fibrillate with a small amount – as little as 40 Volts – of electricity delivered across the chest wall. 5 What was not the focus of this report, but would become the focus of countless reports in the next hundred years was the casual observation – in a footnote – that a second, larger shock (between 240 and 4800 Volts) could often defibrillate the heart. While it is likely that Prevost and Battelli realized the importance of their observation for the animals they studied, they must not have been aware of McWilliams suggestion that ventricular fibrillation is likely a major cause of sudden cardiac arrest in mankind. 11 Thus, with what could be the understatement of their professional careers, Prevost and Battelli helped electrophysiology conclude the 19th century with a solid background in ventricular fibrillation and defibrillation – in animals only – setting the stage for rapid advancement in the 20th century.

Development of Defibrillation

While cardiac arrest due to early application of anesthesia prompted research early in the 19th century, the advent of public electricity in the early 20th century prompted further development of the field of cardiac electrophysiology. Spurred by a growing number of employee accidents, in 1926 the Consolidated Electric Company of New York City funded a collaboration at John Hopkins between Orthello Langworthy and Donald Hooker, both physicians, and William Kouwenhoven, an electrical engineer. 6 By 1933 the trio had published a summary of their initial research, expanding upon the findings made 30 years earlier made by Prevost and Battelli. Specifically, the group noted that for defibrillation to be successful, the shock must be applied within a few minutes of arrest if no other intervention is made: 99% of cardiac arrests defibrillated after 30 seconds were successfully resuscitated, but after one, two and four minutes the success rates dropped to 90, 27, and zero percent, respectively. 8 They also noted that open- and closed-chest cardiac massage could extend this window, an observation that ultimately lead to the chest compressions used in CPR today.

Around the same time that Kouwenhoven and colleagues were developing clinically usable defibrillation techniques, a man who would later be cited as one of the most influential individuals in cardiac resuscitation was completing his internship. During his internship in Cleveland, Ohio, Claude Beck witnessed a number of cardiac arrests during surgery, and stood back with amazement as the surgeon would request that the local fire department be summoned to administer oxygen in an attempt at resuscitation, leaving him feeling, quite fairly, that “we were not doing our best for the patient”. 8 He went on to construct his own defibrillator and developed the first in-house cardiac resuscitation team – the precursor to the crash cart team. 8 In 1947 Beck achieved the first clearly documented defibrillation, in a young boy undergoing surgery
for a congenital form of funnel chest. Upon noticing ventricular fibrillation, Beck maintained manual heart massage for over 30 minutes before he had an electrocardiograph confirmation and then delivered a shock directly to the heart. The first shock was unsuccessful, procaine was administered to improve the heart’s susceptibility to electricity, and upon a second shock normal sinus rhythm was restored.

Figure 1: Electrocardiogram recorded by Dr. Claude Beck detailing the first documented successful defibrillation of a human. The three tracings demonstrate: a) ventricular fibrillation, b) ventricular fibrillation still present after first shock, c) supraventricular tachycardia following procaine administration and successful second shock.12

Beck went on to fine-tune his device, and in the interest of promoting defibrillation, promising to “furnish this apparatus to anyone who would like to have it for the cost of the various parts”.8 In 1950 Beck began to educate others in his protocol, establishing a course that trained surgeons, anesthetists, nurses, and dentists from around the world in his protocol, forming the basis of today’s CPR and ACLS courses.6,8 By 1961, the advantages of closed chest cardiac and external defibrillation, first suggested by Kouwenhoven 30 years before, were proven clinically by Dr. Paul Zoll.8 Beck capitalized on the development of external defibrillation as an opportunity to expand his training to the lay public, establishing the Resuscitators of America program to train members of the public in CPR using the now ubiquitous CPR mannequins.

Research continued from the early models designed by Kouwenhoven, Beck and Zoll, refining the amount and type of electricity, the method of delivery, as well as improvements in safety and automation. The advances in cardiac treatment witnessed in just this last generation are substantial, and reveal a history of scientific research spanning over 300 years, and a history of curiosity in the heart’s operation spanning over 3000 years. What will be the future of cardiac resuscitation? The Phillips HeartStart Home Defibrillator is likely just the beginning. When Abilgaard conducted his initial research into “countershock” in 1775, science and society were not ready to appreciate the importance of his work in the context of improving patient care. Perhaps with time we too will find modern research deemed insignificant today shedding light on significant issues of tomorrow.

References

Introduction
Surgery before the mid nineteenth century is difficult to comprehend today – patients suffered unbearable pain only relieved by a speedy conclusion. The necessity of anesthetic agents was not lost on surgeons, but there was a lack of systematic research. Opiates were administered gratuitously, alcohol intoxication, hypnotism, and sometimes even a blow to the chin was used. Unfortunately none worked reliably, and surgical textbooks of the day scarcely mentioned pain. Illustrations showed patients lying quietly, apparently unconcerned in the midst of gruesome and painful procedures. All this changed on October 16, 1846 thanks to a resourceful but profiteering dentist.

Discovery
William T.G. Morton began his dental career at the Baltimore College of Dental Surgery. Without finishing his degree, he studied with Horace Wells, a Hartford dentist, in 1841. The two became partners during 1842 and 1843, but this proved unsuccessful and Morton set up his own practice in Boston. He attended several classes at Harvard Medical School in 1844 and studied briefly with Charles T. Jackson, an internationally famous physician, chemist, and geologist. He quit his extracurricular academic interests to focus on his practice when it began to flourish.

Morton specialized in prosthetic dentistry, considering it essential to extract all tooth material from the jaw before fitting a prosthesis. Although skilled, his technique was laborious and painful, discouraging many potential clients. He realized that he was losing business, so he looked for a way to make extractions painless. At this time, dentistry was a trade, not a profession, and many kept their special techniques secret. It is no surprise that Morton was so cautious in his search. He took interest in ether because Charles Jackson had suggested its local application might deaden the pain of extractions. Results were inconsistent, and his interest turned to ether vapor. His experiments in the summer of 1846 were on household pets, then on himself and his assistants. His results were unreliable, and Morton sought Jackson’s help. Jackson suggested that Morton could improve his results if he used chemically purified sulfuric ether rather than less pure commercial products. After additional tests on himself and his assistants, Morton felt confident...
enough to administer ether to a patient. On the evening of September 30, 1846, Eben Frost came in with an intensely painful tooth and begged Morton to hypnotize him, a standard but ineffective pain reliever. Morton claimed that he could offer something far more effective, and Frost agreed to ether. After inhaling the ether through a handkerchief, Morton painlessly extracted the tooth and Frost had no recollection of the extraction.  

After this success, Morton inquired about the possibility of patenting a new process using sulfuric ether. He received an uncertain response, but was assured that a definitive answer could be provided by consulting the law. Morton then approached John Collins Warren, head of the surgical staff at the Massachusetts General Hospital (MGH), about a public demonstration. Hoping for a patent and fearing piracy, he refused to disclose his exact preparation. Warren had ethical misgivings because the preparation’s identity and safety were unknown. Despite misgivings, Warren had an invitation sent to Morton written by one of the junior house officers, perhaps reflecting Warren’s skepticism and reservations.

Morton’s demonstration was scheduled for October 16, 1846. The operating theater was full and skepticism was pervasive. Morton was late because of several last minute changes to the inhaler. Warren was impatient and decided to proceed. “As Dr. Morton has not arrived, I presume he is otherwise engaged,” he remarked to the audience implying that Morton was too fearful of failure to show up. Morton rushed in with his newly configured inhaler and applied the ether vapor to the patient, who was soon asleep. The theater watched in silent anticipation as Warren started his incision over a vascular tumor in the patient’s neck. To everyone’s surprise, the patient didn’t startle, scream, or give any indication of pain. As Warren ligated the deep vessels, the patient started moving his limbs and uttering nonsensical expressions. Warren doubted the success of the operation until he had full confirmation from the patient that he had had no pain. He then turned towards the amazed audience and famously remarked, “Gentlemen, this is no humbug.”

Origins
The origins of inhalation anesthesia predate Morton’s interest. After nitrous oxide was shown to be relatively safe in the early 19th century, traveling chemistry professors lectured on gases and demonstrated their exhilarating effects. Nitrous oxide was quite popular because intoxicated individuals spoke foolishly and would sometimes laugh uncontrollably. It became fashionable to inhale nitrous oxide at lectures and social gatherings. In many social circles, ether replaced nitrous oxide because of the ease of obtaining, storing, and administering it. Ether frolics, where participants would become drunk from ether vapor, became popular, particularly among students.

Morton wasn’t the first to demonstrate ether as an anesthetic - Crawford Long, a well-trained physician practicing in the small town of Jefferson, Georgia, was. His offices were a clubroom for the town’s young intellectuals, and meetings often turned into ether frolics. Long enjoyed inhaling ether and often discovered new bruises on himself and his friends afterward. They had no recollection of pain or the causes of these bruises, and Long concluded that ether could eliminate pain. He put his observations into practice on March 30, 1842, when a boy named James Venable approached him requesting removal of two small neck masses. Long explained his observations to Venable, as he knew that Venable enjoyed inhaling ether. After getting consent, Long painlessly removed one of the sebaceous cysts. Although thrilled with his achievement, he only gave ether for seven minor operations over the next four years and didn’t publish the report of his cases until 1849. Regardless of his lack of influence, Long had the innovation and courage to experiment with ether as a surgical anesthetic.

Horace Wells also had an important impact on the development of anesthesia. On December 10, 1844, he and his wife attended a lecture in Hartford, Connecticut by Gardner Colton, a traveling professor. Colton demonstrated with
laughing gas, but Wells noticed that a participant suffered a severe gash to his knees without reacting to the pain. He reasoned that nitrous oxide might be able to alleviate the pain associated with dental procedures. After asking Colton to produce some nitrous oxide for him, Wells inhaled it and had one of his own wisdom teeth extracted. Upon waking he exclaimed, “I felt it no more than the prick of a pin. This is the most wonderful discovery of our time”.

In the following month, Wells performed about fifteen painless dental procedures with nitrous oxide and felt confident enough to demonstrate it publicly. John Warren invited Wells to demonstrate a dental extraction on a student in January 1845. Unfortunately, the gasbag was withdrawn too soon, the anesthesia was incomplete, and the student screamed in pain. This proved disastrous, and the surgeons took no further interest in Wells or his methods. This demonstration had a strong and lasting impression on Morton, launching his clandestine quest for an effective and reliable anesthetic agent.

Fallout
Morton’s success with ether continued after his original demonstration. The following day he aided in the removal of an adipose tumor from a woman’s arm. The patent commissioning office confirmed that etherization could be patented. Unhappily, the patent commissioner was a friend of Thomas Jackson’s, and had been persuaded by Jackson to consider a joint discovery. Although Jackson was a distinguished academic, he had an unsavory tendency to take credit for other people’s inventions, especially when they had financial promise. Jackson’s friend at the patent office persuaded Morton to include Jackson’s name, and the patent was issued on November 12, 1846.

During this time, Morton had been prohibited from using ether at MGH because he had kept his preparation a secret, calling it Lethon, Greek for forgetfulness. John Warren and other senior surgeons at MGH were concerned about using a preparation whose composition and safety were unknown. He finally revealed it to be nothing more than sulfuric ether on November 6. The next day Morton administered ether in two major operations both of which were complete successes, and the MGH surgeons were fully persuaded of the importance and effectiveness of this discovery. Morton enjoyed the endorsement of the MGH staff in his mission to collect fees and regulate the use of ether anesthesia.

As ether anesthesia became more accepted, Jackson wrote two letters to a friend in Paris claiming that he discovered ether anesthesia and introduced it into surgery, and that it had been thoroughly tested and accepted at MGH. These letters were presented to the Académie des Sciences, and the European scientific community accepted Jackson’s claims. Morton learned of Jackson’s letters and collected evidence to refute his claims, but Jackson’s connections in Europe had more influence. He continued to enjoy the support of his international friends from Paris and London.

Horace Wells also challenged Morton’s claims. After Wells’ failure with nitrous oxide at MGH, he returned to Hartford and became so seriously ill that his practice was ruined. In December 1846, his friends advised him to publish a statement in the Hartford Courant. He claimed that he should have rights to the discovery based on the fact that his nitrous oxide experiments used the same principles as Morton’s ether discovery.

Morton’s patent was soon ignored all over America and Europe, as surgeons used a sponge instead of Morton’s specialized inhaler. The United States Army and Navy broke his patent with their widespread use of ether during the Mexican War in 1847. Morton’s efforts to collect fees and regulate anesthesia failed and his dental business was ruined. In 1849, Morton petitioned Congress to recognize his claims and to compensate him. After three appeals, Congress finally agreed to reward Morton with a $100,000 award in 1852. Jackson’s and Wells’ supporters objected, and Crawford Long was persuaded to submit a claim in 1854. All the proposed bills were rejected due to the excessive number of claimants, and no one received any reward.
Afterward

Of the four figures involved in the ether controversy, only Crawford Long’s life wasn’t destroyed by the desire to gain prestige and monetary reward. After the Congressional debates of 1854, he gave up and continued his practice in Georgia until his death. As a hero of the South, his successful use of ether is commemorated by Doctor’s Day every March 30.5

Horace Wells’ attempts at recognition failed, and he left his family unsupported in Hartford, returning to New York City to resume experiments. He became addicted to chloroform and committed suicide after being incarcerated for throwing sulfuric acid on prostitutes. Twelve days later, the Paris Medical Society gave him the honor of being first to use vapors or gases to make surgery painless.5

Charles Jackson became an uncontrollable megalomaniac. When he came across Morton’s grave in 1873, Jackson developed a severe psychotic illness. He was placed in an institution for the insane outside of Boston and remained there until his death in 1880. He was buried just a short distance from Morton at Mount Auburn.5

Morton became obsessed with financial reward and recognition for his contribution to anesthesia. However, none of his schemes were successful, and he was ruined by them. His creditors ignored him; he lost his home, and was censured by the American Medical Association. In the summer of 1868, Morton journeyed to New York City to refute a new publication by Thomas Jackson claiming credit for ether anesthesia, but Morton suffered heat stroke during a heat wave.5

The discovery of ether anesthesia revolutionized surgery and dentists had the most important influence on this discovery. Many surgeries that save or improve lives are now readily possible. Although their motives may have been suspect, it was their drive, courage, and innovation that led to this important discovery. Because of the bitterness and peculiarities of the ether controversy, it is fitting that no individual receives credit. The Boston Public Garden is home to the Ether Monument commemorating the discovery of ether anesthesia as a treatment rather than an individual.8

References