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An Analysis of the Applications of Technology to Health Care within the Caribbean and Latin America

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AN ANALYSIS OF THE
APPLICATIONS OF TECHNOLOGY TO
HEALTH CARE WITHIN THE
CARIBBEAN AND LATIN AMERICA

SCHOOL OF PROFESSIONAL STUDIES

Chineme Ezema
Spring 2021 - Capstone

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EXECUTIVE SUMMARY

This project aims to investigate and document the evolution of health technology applications and uses within the regions of Latin America and the Caribbean. Originally inspired by the Cayman Islands' thus far successful handling of the Coronavirus pandemic, I was eager to explore how the applications of technology to the field of healthcare have existed within the region currently and over time. With this foundation, I then explored the regions' trajectory in terms of technological growth and what the future may hold for these countries and communities.

CHAPTER 1: LITERATURE REVIEW

The applications of technology to the field of health care have been thoroughly investigated, with varying explorations of the advancements that have been made, their impacts on the quality of patient care, and discussions of how these advancements may shape the medical future.

Furthermore, there are many discussions of the different spaces and opportunities for the use of technology within health care. The literature that explores these themes within the context of LAC, take on a more nuanced tone of how technology can positively transform the region, especially against a backdrop of inequity and inequality.

Health Care and Technology

The research discussed here help to establish a precedence on the global standards on the application of health care to technology, relevant for the comparison to the LAC realities later on. Firstly, in Chapter 1 of “Advances in Healthcare Technology Shaping the Future of Medical Care” – “Advances and Trends in Healthcare Technology”, Gossink and Souquet explore, among other topics, some advances in healthcare technology, identifying major trends of the field. From this chapter we gain insight on what Gossink and Souquet describe as ‘technological drivers’; the key factors contributing to the major trend within healthcare. Most relevant, they name the growth in ‘Ubiquitous Electronics’, i.e., the trend of miniaturizing electronics, increasing computing speed while decreasing device size. These developments have “enabled progress in medical technologies over a wide field...”.

In Chapter 22 of the same book “Medical Information Technology”, the contributing authors continue the discussion of medical information technology by looking at recent advances and research trends. In the chapter they looked at how IT is currently positioned within IT and where it is projected to go. Relevant for our discussion, they establish that IT is actually necessary in solving some of the major health problems of today. They also provided a general classification of primary users (patients, researchers, and clinicians) and looked at some of the existing technologies directed at each of them. These included the Electronic Patient Record (EPR) and workflow management system and imaging devices (directed at clinicians), data mining exercises and bioinformatics (directed at researchers). Finally, the technologies directed to patients exist as means for them to manage their own health information and have more control over their own data, such as the Patient Health Record (PHR) or improve patients-physician relationship with features such as remote communication. However, it is in the subsequent chapter “Developments in Clinical Information Technology” (23) that the contributors go into further detail and highlight the Electronic Health Record (EHR) as an area where significant developments have been made, so much so that the EHR is a key component in any health system. As they go on to state, “the development of an Electronic Health Record (EHR) and the enabling healthcare IT infrastructure has enormous potential to improve the safety, quality, and efficiency of health care” (Spekowitz & Wendler, 2006). Despite an industry-wide understanding of the importance of EHRs and their recognition as a ‘standard’, there have been numerous challenges that have hindered the integration and deployment of HER systems. Within the US context, these challenges include a lack of investments, financial incentives and ‘semantic interoperability’¹/ standard adoption. This article is relevant to the greater discussion

¹ Spekowitz and Wendler define this as the ability for information shared by systems to be understood at the level of formally defined domain concepts, so that information is computer processable by the receiving system. They argue that semantic

because it helps to establish EHRs position as an industry standard while presenting the potential difficulties in adoption/implementation and adoption strategies. With this note we can view the LAC regions' adoption or lack thereof with a more critical lens and scope.

In the book Digitalization in Healthcare, Pascal Grüttner's chapter "Opening the Door for Digital Transformation in Hospitals: IT Expert's Point of View" explored the future of healthcare and digital transformation, emphasizing a focus on processes, and using IT to support said processes. When integrating IT systems, to any industry, company, or entity it is important to ensure that it is a collaborative effort, with input from stakeholders across the industry. This article is therefore relevant as it presents the contributions of IT experts on how IT and healthcare may not only coexist but support each other. Grüttner begins the article with recommendations of how to apply digital infrastructure, and which areas of activities should be focused, grouped by varying levels of prioritization. In terms of 'absolutely essential' activities, he identifies basic IT infrastructure, EMRs, improvements by digital processes and corporate digital spirit. 'Highly desirable' activities are cross-sectoral networking, rationalization of administrative areas, decision support systems and information platforms / learning management systems. Finally, for 'further development' he suggests the use of data and telehealth.

The research and analyses presented in the papers above help to present an industry-wide view of the role of IT in health and medicine, and how this role may continue to grow. Evidently, thus far the works discussed have been US centric, so in the subsequent sections, the discussion will be narrowed to the LAC region and its health sectors, and later on evaluated against the precedence set above.

interoperability is essential to identifying the actual value of HER clinical applications and has thus far been lacking because there is no standardized set of domain-specific clinical templates with standardize terminologies (as a result of no collaboration between healthcare professionals, the industry, and a standard development organization).

Latin America, The Caribbean, and Health Care Technology

The following works all discuss / assess health technology within LAC, and present varying discussions of where the region currently is, and where it is projected to go. Firstly, in “Health at a Glance: Latin America and the Caribbean 2020” presented by the Organisation for Economic Co-operation and Development (OECD), the organization discusses health and health systems within LAC, particularly in terms of equity, health status, determinants of health, health care resources and utilisation, health expenditure and financing, and quality of care. Of particular relevance is the chapter on health spending, and the discussions on the health technology assessment, a tool that “ensures that public financing is prioritised and made available for those drugs, devices and procedures that have demonstrated effect in improving health and other outcomes.” This publication is also important because it helps to contextualize the region, helping the reader to remove biases and evaluate the regions status and projection with a more rounded lens. In terms of health, technology and LAC, David Banta via the International Journal of Technology Assessment in Health Care briefly summarizes the region’s growing adoption and promotion of health technology assessment (HTA). In his article he identifies how the Pan American Health Organization (PAHO) (the regional office of the World Health Organization (WHO) for the Americas) has been promoting HTA for years, and how various countries have been slowly developing and integrating offices dedicated to actively institutionalizing HTA. On a related note, the United Nations document “e-Health in Latin America and the Caribbean: progress and challenges” looks extensively at how the region has been tackling the use of technology to “maximize their potential for enhancing the quality of health care for their

populations”. Throughout the chapters, the authors examine the progress and challenges in e-Health and telemedicine in 12 Latin American countries and 8 Caribbean countries. Rodrigues and Risk in their article “eHealth in Latin America and the Caribbean: Development and Policy Issues” similarly explore eHealth deployment within the region, but emphasize how eHealth solutions, typically designed for industrialized countries and large organizations, may operate differently given the characteristics of the region and their health-sector organizational preparedness and technological infrastructure. With this discussion they then continue to suggest policy and organizational actions to help in the development of eHealth solutions within LAC. Finally, Bastias-Butler and Ulrich in their report “Digital Transformation of the Health Sector in Latin America and the Caribbean” summarized the 2018 Inter-American Development Bank’s Regional Policy Dialogue conference and the various panels / workshops dedicated to exploring the “lessons learned and success stories in EHR implementation and digital health transformation” with a focus on the LAC region.

CHAPTER 2: RESEARCH PROBLEM

Key Terminology

EHR – Electronic Health Records

EMR – Electronic Medical Records

EPR – Electronic Patient Record

HITECH – Health Information Technology for Economic and Clinical Health

HTA – Health Technology Assessment

LAC – Latin America and the Caribbean

Rationale and General Introduction

Health provision and the access to it has been an essential part of communities and societies since the dawn of time and human existence. With incredible advancements in technology, this industry has been revolutionized, leading to great improvements in both the quality and the effectiveness of health care. Health Information Technology as a whole has been shown to promote individual and public health while increasing the accuracy of diagnoses. However, these advancements have been disproportionate in how they have been utilized in nations across the world, and particularly in regions that have been historically disenfranchised and positioned as ‘Lesser Economically Developed’. This paper is an exploration of how technology has been used within healthcare in the Latin American and Caribbean region, and where the region may be

headed next. It is my hope that an analysis on where we as a region have been can lead to more productive discussions on where could be going, all with the aim of better serving our communities.

Ray Kurzweil's hypothesized Law of Accelerating Returns suggests that technological change is exponential, in the sense that within the 21st century alone, we may experience even 20,000 years of progress (as opposed to 100 years alone). While his theory was in reference to the rate of change in a wide variety of evolutionary systems (including but not limited to the growth of technologies), the statement establishes a foundation for our exploration of the advancements within healthcare in the past few decades. The medical technology that exists today as compared to 100 years ago are the result of revolutionary advancements, ultimately contributing to the increased quality of care and provision we see today.

Brief History of Technology in Healthcare

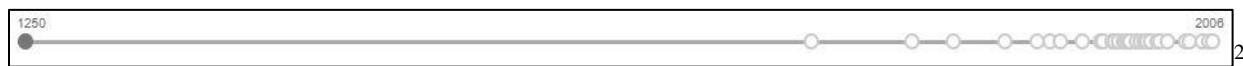


Figure 1.1
Timeline of
Milestones
in Medical
Technology

In this section we will explore some historical milestones, establish the industry standard, and discuss how it has evolved over the years. Despite society's global advancement in technology, the health sector is known to be slow in adapting to new technologies, often lagging behind other industries. The timeline in the image above depicts the distribution dates of some major milestones in medical technology up to 2006. Some of these milestones include the 1895 invention of the X-Ray by the German physicist Wilhelm Conrad Röntgen. Medical X-Rays have subsequently become a staple in the industry in generating images of tissues and structures inside the body. Similarly, Dr. Willem Einthoven of the Netherlands' creation of the first

²Timeline of Milestones in Medical Technology (Bakalar, Barrow, Huang & Parker, 2012)

practical electrocardiogram resulted in his awarding of a Nobel Peace prize in Physiology or Medicine in 1924. The 1950's and 60's also saw some major developments with the invention of the first mechanical heart (1952, Henry Opittek), the Heart-Lung Bypass (1953 - Dr. John Heysham Gibbon), the Pacemaker (1958 - Dr. Seymour Furman), first fetal ultrasound (1958 – Dr. Edward Hon) and the first artificial heart (19623 – Paul Winchell) to name a few. The 1978 invention of the M.R.I (Dr. Raymond V. Damadian) was ground-breaking in cancer research and development, and the 1992 invention of the automated DNA sequencing technique (Dr. Leroy E. Hood) was similarly revolutionary for the industry.

This list of innovations and inventions that have advanced health care in terms of diagnostic technologies is endless, but a major milestone in terms of IT and health

“In terms of Information Management, in health care we jumped directly from manual pen and paper to EHR!”

-Dr. Onah-Ezema MD

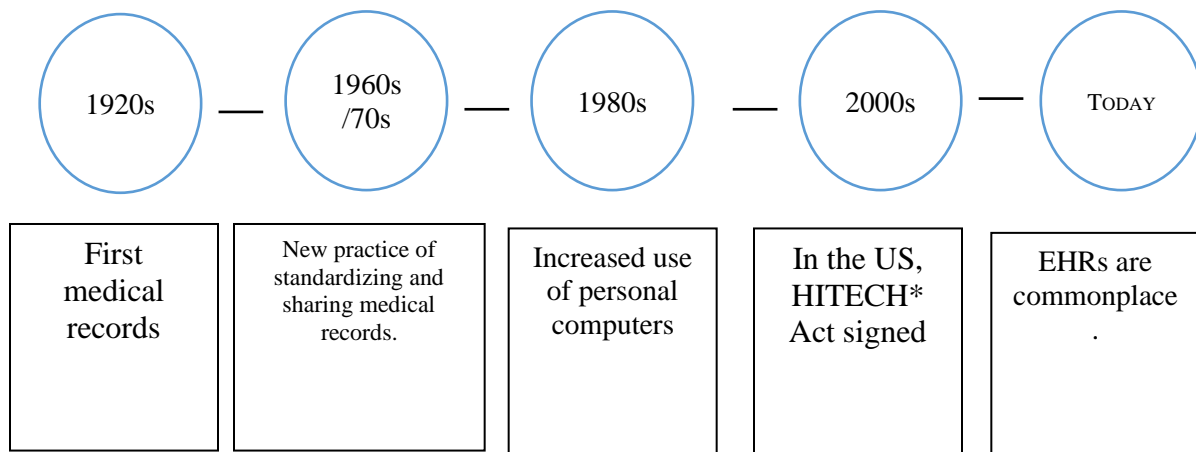
care came with the invention and widespread adoption of Electronic Health Records (EHR). I believe that the health sector was revolutionized when more advanced information management was introduced, with EHR becoming a key player in the collection, storage, and transmission of medical information. EHRs are electronic records of health-related information on an individual that conforms to nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across more than one healthcare organization (Gliklich, Dreyer & Leavy, 2014). The EHR platform provides storage, and links various arms of healthcare so that a majority of a patient's information is readily accessible to different providers.

Health Information Management as a discipline can be traced to the 1920s when healthcare professionals used medical records to document their processes and outcomes in patient care.

“Healthcare providers turned to integrated electronic health record systems because of the federal mandate and the incentive reimbursement. The impetus behind the federal programs includes the need to create access to integrated systems that would then promote better decisions, a reduction in medical errors, as well as decreasing duplication of costly services.”

However, with the increased prominence and accessibility of computers in the 1980s healthcare information technology turned to the more modern age known now. At this point the computers were used primarily for billing and scheduling

as opposed to digitizing medical records. With Tim Berners-Lee’s 1990 establishment of the World Wide Web the web and browser technology established an expectation of how to access, share and navigate information. By 2010 the use of EHRs in had become industry norms (more economically developed countries), with 2015 seeing a nearly double increase in use, resulting in 96% of hospitals and 87% of physician practices adopting the use ("The History of Healthcare Technology and the Evolution of EHR", n.d.).



Latin America, The Caribbean, and Healthcare Technology

It has been established that the health sector often trails other sectors in adopting new technology and advancements. It must also be pointed out, that thus far we have only discussed this phenomenon within the context of the American health industry, however we must now begin to apply this framework to LAC, a region that given its history of colonialization and its lingering

“Although the health sector is key to the welfare of the population and the formation of human capital, the sector has not kept pace with the momentum of change that the region has experienced in recent years in other areas of economic, political, and social life.”

-(Rodrigues & Risk, 2003)

(and highly impactful) legacy has seen an even slower rate of adopting new technologies and advancements in all areas of life, but particularly so in the health sector. As pointed out by Roberto Rodrigues and Ahmad Risk in their 2003 contribution to Journal of Medicine Internet Research, within Latin America and the Caribbean, the regions' health sectors have not maintained a parallel or comparable pace with the momentums of change experienced within other sectors in the region. In many countries the health sector is underfinanced and under supported which relates to the level of technology use rate of health technological advancement seen now. In many Caribbean countries, solid ICT initiatives in relation to the health sector only begin in the early to mid 2000s. For example, in 2010 Trinidad and Tobago launched an e-Health card system pilot project that was meant to operate as an extension of a patient management

system. In 2008, Belize was the first country in the Americas to be given technical support priority when they were chosen for the Assessment of the Health Information System led by the Health Metrics Network (HMN). With this priority they secured a recognized support PAHO to strengthen their health information systems. According to the e-Health in Latin America and the Caribbean – Progresses and Challenges report, Belize's current status is good (despite high costs). Launched in 2008, Belize's Health Information System (BHIS) is a comprehensive national system with computerized and centralized health records, was integrated using systems already operating in the country, and is reported to already achieving high degrees of security and reliability. In 2008, St. Lucia was also making great strides in advancing ICT within health care, when they started working on a system based on Unix technology (open architecture), however the project had to be halted due to a lack of funding. On the other end, some countries have been further along (historically) in their development and deployment of eHealth initiatives. In 1986, Argentina had their first initiative and attempt for better communication between health centres, but due to a lack of support and funding was not implemented. Later on, by 1989 Argentina had connected all of its institutions and created a user-friendly software (PCCORREO).

On the other hand, many countries have illustrated the use of ICT not directly within health provision / direct patient to clinician relations but rather in other areas of the health sector. In the Dominican Republic, the incorporation of ICT into health that receives the most funding is the AIDS Programme, in which a management information system based on SIAI software, designed using NET and SQL Server 2009 as the database has been used to treat AIDS patients. The tool monitors processes which affect indicators of the Provincial Epidemiological Surveillance Directorate, regional healthcare services and specialist centres (CEAS).

CHAPTER 3: TRAJECTORY

Given our understanding of where the region currently is and has historically been in terms of health and IT, we can begin to explore what the future holds at the intersection of technology and medicine.

Firstly, as suggested by Pascal Grüttner, the future of IT applications within healthcare should have an emphasis on supporting and revitalizing processes. He highlights that digitization, especially in terms of patient care should primarily be to

“Emerging eHealth applications are oriented to professional networking, integration of the clinical care process management, and the provision of Web-based health information and patient care, including remote monitoring and health care.”

-(Rodrigues & Risk, 2003)

support the processes that already exist, for example, not just transform physical data to a digital form, but approach and address the whole experience of patient care and the interactions that occur, then integrate IT systems into that. Grüttner also suggests that further development of health and IT can be the use of telehealth / telemedicine, recommending that “any IT department should help the hospital to realize the value of telehealth.” Telehealth in Brazil has enabled videoconferencing, diagnosis and formative second opinions, as well as continuous education, by linking family health teams and specialists based at universities” (NU. CEPAL Comisión Europea, 2011). In 2006, the country formed a university network (Rede Universitária de

Telemedicina (RUTE)) that has really streamlined the connectivity and success of telemedicine initiatives throughout the country, with over 75 institutions incorporated as of 2009. While this is a success story, other countries within LAC still face barriers of poor telecommunications infrastructure, a limited number of Internet Service Providers (ISPs), lack of access to international bandwidth, and lack of affordable Internet-access costs (Rodrigues, Risk) to overcome. For example, while Chile and Colombia leading the LAC region in terms of bandwidth and having 100% of their municipalities connected, other countries such as Paraguay have major connectivity issues and face problems transferring large amounts of data. These are major impediments that have restricted a successful strategy of connecting the most disconnected.

Other (feasible) integrations of health and IT include the use of EHRs. Although previously established as an industry standard across the board, countries of the region have made slow progress in the implementation of EHRs. In his keynote address for the 2018 Regional Policy Dialogue (hosted by the Inter-American Development Bank) David Eaves addresses presents the myth of a singular nation-wide HER system as a contributor to the failure of many digital transformation projects. However, he also suggests that before creating an EHR, countries need to set up a strong and a core digital infrastructure. While ideal, negotiating the reforms necessary to establishing this infrastructure can be difficult. The conference also presented different pathways countries may take to successfully implementing their own EHR system, as illustrated by international examples Estonia and Canada. Estonia's successful deployment were driven by "the clear governance of Estonian e-health services by the Estonia Health and Welfare Center, legal clarity, an existing e-services infrastructure, pre-established online identification numbers

for each citizen, agreement on access rights, and standardization” (Inter-American Development Bank, 2019).

In my opinion, while these two examples of the application of IT to healthcare are realistically feasible for the LAC region, they would require a great deal of structural transformation in order to create the foundation needed for longevity and enduring success. The region is by no means homogenous, and some nations have already established this foundation and are making great strides in exploring future applications. For example, the Cayman Islands have been implementing sophisticated examples of medical technology for some time and had been incorporating telemedicine practices even prior to the Covid19 pandemic. However, I believe that the region as whole can make tremendous strides and achieve great progress in the intersection of health and IT.

It must also be stated that the future of IT in healthcare can and does go beyond supporting processes. While telehealth and the use of EHRs can be highly impactful, existing, and upcoming inventions are incredibly innovative. The current trajectory seems to be towards Artificial Intelligence and Machine Learning. Within the health sector, an example of the application of AI could be to provide more personalized patient care while cutting waiting times and costs, or even personalizing treatment in terms of selecting appropriate or generating optimal therapies from the context of a patient’s disease, their genetic content and other molecular or cellular analysis (Glauner, Plugmann & Lerzynski, n.d.). For example, Brazilian machine learning researcher

Rafael Figueroa, CEO of Portal Telemedicina has created an online platform that uses AI to diagnose patients in rural Brazil.

“The platform was created in response to the challenge of insufficient doctors in remote areas of the country. Using Portal Telemedicina’s platform, diagnostic images, such as a CT scan, can be uploaded from a remote clinic in the Amazon. An algorithm then compares that image against historical clinical data to suggest a proposed diagnosis, which is then verified by a radiologist in Sao Paulo.

This diagnosis can then be sent back to the original clinic within the same day. This method costs only \$4 per test and takes a maximum of 24 hours, while the conventional method required patients to wait 30 days on average for test results that cost hundreds of dollars.

- (Inter-American Development Bank, 2019)

The future of IT and healthcare is both bright and boundless. While there seems to be some trend and emphasis on data collection/management, and using Big Data to streamline health care provision, there is also a trajectory of great innovation as seen above. Other examples of where medical technology is headed include improving the use of robotics in patient care, remote patient monitoring, molecular imaging and therapy, computer aided detection and quantification and much more. There is much to the imagination, and much to do in improving how we care provide care for each other. It is undeniable that technology and innovation will continue to play a major role in that.

CONCLUSION

The history of technology in healthcare is filled with stories of remarkable innovation and its subsequent impact on society. The future of this field is by no means any different and will only have more tremendous impacts from here. The Latin American and Caribbean region, while on average a bit behind the global north in terms of adopting technological advancements, particularly in relation to the health sector is in a great position and has been making incremental adjustments to establish the needed foundation for a successful ICT x Healthcare future.

Future Research / Explorations

Having contextualized the region with its technological history, and technological future, what can we say for the regions handling of the 2019- Coronavirus pandemic? As we have seen thus far, by no means is the region homogenous, therefore future research and academic contributions can explore how each country / territory was positioned for their successful (or unsuccessful) approach to the pandemic, and particularly the use of telehealth / telemedicine in that approach. Furthermore, one can explore the growing ethical concerns of applying IT and the massive technological advancements to a field as people based, intense and critical as healthcare.

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APPENDIX

Original Project Charter

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Project Charter
THE EVOLUTION OF TECHNOLOGY
APPLICATIONS WITHIN HEALTH CARE IN
THE CAYMAN ISLANDS

Project Overview

Introduction

This project aims to investigate and document the evolution of health technology applications and uses within the Cayman Islands. Inspired by the Cayman Islands' thus far successful handling of the Coronavirus pandemic, I hoped to document the role technology has played in the country's disaster (specifically health-related) response, contextualized by its' technological history. I also hope to discuss Cayman's current trajectory in terms of technological growth, and what the future may hold for these three islands.

Throughout this project I will explore Cayman's history, and utilize various stakeholders / related individuals as primary resources. It is my hope, that upon the successful completion of this project, I can present to the leaders of government and/or the Health Services Authority a body of work that effectively documents and highlights Cayman's achievements over the past few decades, and subsequently used as a tool in future decision making in regard to enhancing Cayman's technological growth and evolution.

Major Stakeholders

- Richard Aroian – Capstone Advisor
- Cayman Islands Health Services Authority (HSA)– Cayman's principal healthcare facility
- HSA IT Department

Project Goal and Scope

Project Goal (*Define the high-level goals of the project*).

1. Identify key moments in Cayman Islands' evolution in regard to the application of technology to health care.
2. Make quality predictions on the country's trajectory.
3. Evaluate the role Cayman's technological history played in its positioning for its successful Covid19 response.

Project Scope

In Scope:

- An in-depth analysis on the country's technological history, ideally with a focus on the last 30 years, specifically related to health care and provision.
- Utilize the primary (and secondary) sources available.
 - Meet with relevant stakeholders, and individuals in HSA and IT leadership to provide concrete context and information.
 - Identify resources available at the public library that may provide further context.

Out of Scope:

-

Assumptions

- I am able to identify and get in contact with relevant individuals that may support this project.
- There is adequate documentation of Cayman's history, specifically technological history

4. Constraints

- Time
- Irregular schedules to meet with stakeholders.
- Access to sensitive / private information

5 Risks (*Risk is any unexpected event that might affect the people, processes, technology, and resources negatively or positively by the project*)

- Schedule conflicts
- Unexpected restrictions / blocks

Measures of Success

Project Outcomes	Measure of Success
Identify key moments in Cayman Islands' technological evolution specifically in relation to health care.	Identified at least three pivotal moments in history
Evaluate the role Cayman's technological history played in its positioning for its successful Covid19 response	Able to present a concrete argument that technology has (or has not) played a key role in Cayman's Covid19 response
Make quality predictions on the country's trajectory	Able to present at least three predictions, or theories as to where the country is going next, technologically, with feedback / input from stakeholders supporting the theories

Stakeholder Sign-off

(For capstone thesis/case study students only capstone advisor signature is required)

This project charter has been signed off by the client, capstone advisor and project team members.

Chineme Ezema Thesis Student _____
 Name Title Date

Richard Aroian Advisor _____
 Name Title Date

Status Report One



Capstone Status One Page Report

Capstone Project Name: The Evolution of Technology Applications Within Health Care in the Cayman Islands

Student(s) Name: Chineme Ezema

Date: March 29th, 2021

Accomplished to date:

- Identified some relevant works on technology use and application within health care.
- Started Literature Review
- Established a ranking / hierarchy of how technology has been used and is forecasted to be used within the industry.

Issues/Concerns:

- It was expected, but I am having trouble finding specific information on Cayman's technological history. I am looking into the best individuals to contact for more information as the public library did not have much to offer.

Plans for next 30 days:

- Identify and get in direct contact with relevant individuals to gather more specific information.
- Solidify report outline.
- Have a rough draft ready for submission.

Status Report Two



Capstone Status One Page Report

Capstone Project Name: The Evolution of Technology and its Applications within the Caribbean and Latin America

Student(s) Name: Chineme Ezema

Date: April 25th, 2021

Accomplished to date:

- Identified some relevant works on technology use and application within health care.
- Started Literature Review
- Established a ranking / hierarchy of how technology has been used and is forecasted to be used within the industry.
- Redefined project scope and aim
- Solidified report outline and structure
- Began first draft.

Issues/Concerns:

- I was having troubles with my original scope and idea for the project, so within these past few weeks I have decided to redefine my scope and aim for the project. Instead of focusing on the Cayman Islands in particular, I am expanding to address the technological growth and changes throughout the Caribbean (and somewhat Latin America).
- Because of the change I fell behind on completing my first draft as hoped and have had to look for more resources and papers to review.

Plans for next 30 days:

- Remove unnecessary/ irrelevant literature, and narrow resources and analyses accordingly.
- Complete and submit research paper.