The use of telemedicine in the management of chronic diseases in Small Island Developing States: Case study – Dominica

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List of abbreviations

C	Control
COVID	Corona Virus Disease
DM	Diabetics
EHR	Electronic Health Record
HIPPA	Health Insurance Portability and Accountability Act
HTN	Hypertension
ICT	Information and Communication Technology
IT	Information Technology
NCD	Non-Communicable diseases
SIDS	Small Island developing states
SDG	Sustainable Development Goals
WHO	World Health Organization
RBS	Random Blood Sugar
UTAUT	Unified Theory of Acceptance and Use of Technology

1. Executive summary

The relevance of this study was placed in the urgent need to recognize the importance of the relationships between health, technology and development. Over the years, the cost of health care and the number of individuals suffering with chronic diseases have increased. Uncontrolled diabetes and hypertension have been one of the leading causes of death in Caribbean Small Island Developing States (SIDS). This present phenomenon impacts sustainable livelihoods, economic activity, and the health of communities. Relying on the global response to medicine, particularly during the COVID-19 pandemic, the importance and utility of telemedicine was demonstrated. Telemedicine helps bridge the gap between emerging health care demands and restricted access to quality resources. Such provision of health services can proportionately improve the level of service delivery in rural areas and attainment of the Sustainable Development Goals (SDGs). Saving the aging population, reducing medical complications and even death of patients are benefits of this initiative. Considering the special geospatial and economic characteristics of SIDS, this study assumed the responsibility to demonstrate the importance of telemedicine in the management of diabetes and hypertension, making health care more accessible and affordable. The digitization of health care optimized and aided early diagnosis and disease monitoring and management during and post the COVID-19 pandemic. This report presented the overall satisfaction of patients in the management of hypertension and diabetes using a telemedicine platform. The study observed the need for improved connectivity, increased e-health medical devices, technological apparatus, and advocacy and education of telemedicine services in SIDS.

Key Words: Telemedicine; Chronic diseases; Digital inclusion; Digital resiliency; e-health

2. Introduction

2.1. Research background

The International Telecommunication Union's (ITU) Connect2Recover initiative organized a research competition with the objective to identify promising research proposals that will accelerate digital inclusion during the COVID-19 recovery globally. This research is one of the 15 research projects that was selected in the Connect2Recover research competition.

Great emphasis has been placed on the relationship between health, technology and development in the Caribbean (ECLAC, 2021). Declaration made at the Heads of Government meeting in Bahamas in 2001, stated that "The Health of the Region is the Wealth of the Region"; this address was prompted by the raising health problems among Caribbean people (CARICOM, 2001). Reflection was made on the impacts of rising health issues and its umbrella effect on which it weakens social and economic development and jeopardize the attainment of the Sustainable Development Goals (SDGs) (CARICOM, 2016). Additionally, the pledges made during the third United Nations General Assembly (UNGA) high-level summit on noncommunicable diseases (NCDs) are consistent with those espoused in the Small Island Developing States (SIDS) Accelerated Modalities of Action (SAMOA) Pathway earlier in 2014 (ECLAC, 2021).

In recent years, the disease burden caused by the 2019 coronavirus disease (COVID-19) has brought new attention to NCDs and their negative effects on not only health but also economic productivity. People who have underlying medical conditions such as hypertension and diabetes, are more likely to develop severe COVID-19 disease (WHO and UNDP, 2020). According to the World Health Organization (WHO), NCDs or chronic disorders are to blame for worldwide fatalities and mortality in low-to-middle-income countries (WHO, 2013, 2018a, 2018b; Kim & Oh, 2013; Bigna, & Noubiap, 2019; Prüss-Ustün, van Deventer, Mudu, et al., 2019).

SIDS in the Caribbean region are experiencing the same epidemiologic change as the rest of the world. Recent reports show that chronic diseases are impacting communities in Dominica; particularly the youth, working class and the elderly. In this small population, birth rates are seemingly decreasing and though the longevity indicator brands the country, Dominica has the highest amount of NCDs in the Caribbean region (CARICOM, 2014), which results in high cases of diabetes and hypertension. Many of these individuals with these diseases, and as a consequence of insufficient timely help, result in complications (Abdukadri *et al.,* 2009). Health is a critical aspect of our survival and resilience; as such, irritable long lines and waiting periods pose a threat on social resilience platforms and attaining the SDGs. The use

of telehealth is an increasingly common avenue for providing clinical care and consultation, performing research, and conducting public health interventions in the 21st Century, particularly in light of COVID-19 (Sharma D.; Bhaskar S. 2020).

At present, with the increase in COVID-19 cases, new hospital protocols state that mostly critical cases are accepted, and current lockdowns and curfews don't help the many victims suffering from those aforementioned diseases. Telemedicine facilitates disease prevention and control via virtual diagnosis, counseling, e-prescription, assessments, test and treatment. Telemedicine services to include virtual visits and chronic patient care are becoming the standard of care. The outbreak of COVID-19 illustrates the importance, the many benefits of telemedicine, and the need to implement technological solutions (Corbet *et al*.; 2020) to comprehensively track, diagnose, offer treatment and provide ongoing care for patients, remotely.

The following research questions were raised:
R1: Can telemedicine be effective in the management of chronic diseases in Small Island Developing States (SIDS) during and post the COVID-19 pandemic?

R2: Does the digitization of health care optimize the response to disease monitoring and management during a crisis?

R3: What are the challenges and recommendations towards the use of telemedicine in the management of diabetes and hypertension in Small Island Developing States (SIDS)?

2.2. Research scope

The study seeks to demonstrate the importance of telemedicine in the management of diabetes and hypertension, making health care more accessible and affordable in Small Island Developing States (SIDS) by 2023. Expected results include:
1) Health care access increased in SIDS,
2) Telemedicine promoted in the management of chronic diseases,
3) Health care services digitized and modernized in SIDS,
3) General physicians and medical specialist services to the remote parts of Dominica outreach improved, and
4) Service delivery time reduced in SIDS.

The telemedicine project intends to modernize health care and provides individuals with an opportunity to access affordable health care, particularly in remote areas. Digital inclusion in health care in small island developing states like Dominica, gives

an opportunity to improved data management systems and closes the information asymmetry gap.

Additionally, policy makers will have access to real time and up to date data for decision making purposes. Alternately, sustainable livelihoods will be recognized with the intent of a healthier society through reduced medical complications and the burden of health care costs.

The results will serve as a template to pilot future research in similar and or other areas for the development of telemedicine in small island developing states.

The study model and assumptions were created to alter how people obtain health care during and post the COVID-19 epidemic. All health stakeholders, including public and commercial organizations and medical professionals, have had to reinvent the way they give treatment, and patients have had to accept change that may result in dramatic behavioral changes.

The concept is based on existing scales that have been updated for teleconsultation. First, the following the Unified Theory of Acceptance and Use of Technology (UTAUT2) components were chosen: effort-expectancy (EE), social-influence (SI), performance-expectancy (PE), facilitating-condition (FC), habit (HT), and behavioral intention to use (Venkatesh *et al.,* 2012). (BIU). Hedonic-motivation and price-value were omitted from our model due to the research subject. Patients do not consult for fun, and the cost of a consultation is comparable to face-to-face consultations but is fully covered in France. The UTAUT2 theory was chosen because it is the most frequently referenced theory and is correct for the adoption of novel solutions, particularly in the health context for medical professionals (Alazzam et al., 2016; Owusu Kwateng et al., 2019) and patients (Baudier *et al*., 2020; Talukder *et al.,* 2020).

Hypothesis states:

H1: Telemedicine can support the management of chronic diseases in Small Island Developing States (SIDS) like Dominica during and post the COVID-19 pandemic.

H2: Patients with Chronic Diseases will attain greater response with disease monitoring and management during a crisis.

2.3. Research objectives/ aim

The study aimed to assess the effectiveness of telemedicine as an approach to manage chronic diseases in Small Island Developing States like Dominica.

2.3.1 General objectives:

To demonstrate the importance of telemedicine in the management of diabetes and hypertension, making health care more accessible and affordable in Small Island Developing States (SIDS) by 2023.

2.3.2 Specific objectives:

1. To evaluate the effectiveness of telemedicine as a tool in the management diabetes and hypertension.
2. To promote the use of telemedicine as an option in the management of diabetes and hypertension.

3. Literature review

3.1 Situation of ICTs and health care in SIDS

Many of the issues confronting SIDS can be mitigated by Information and Communication Technologies (ICTs), which can serve as the foundation for digitizing and diversifying the economy (ITU 2019). The Caribbean shares the same objective of improving their people's health and providing better health services. It is imperative for Caribbean SIDS to include technology in the development process of the health care system particularly amidst the high prevalence of NCDs.

Scientific research has proven that technology has helped to improve diagnosis and treatment for numerous illnesses and serious health conditions. Technology has been a propelling force for development in the health sector. ICT is one mode of innovation which is an essential enabler and effective driver for sustainable development. Access to ICT can help mitigate, build resilience and bridge many of the challenges affecting SIDS and provide a strong foundation for digitizing and diversifying the economy (Ezema, 2021). ICTs are contributing to the achievement of the Sustainable Development Goals (SDGs) in numerous ways and across different domains, with various technologies helping to improve health care. The emerging role of ICT has created a huge impact on health care. It enhances the

quality of care, increases patients' security and data protection, and reduces operating and administrative cost. The hospitals and medical clinics depend on ICT to revamp the challenges faced by the health care sector, which includes maintaining the hospital information system, medical equipment, storage of medical records, medication errors, to name a few.

The use of ICT in health care can be categorized into 4 main streams such as;

- Health and Education: The patients can have access, seek, learn, and communicate effectively making the information easily accessible within a quick span of time. Health education creates awareness among health professionals and the public about communicable diseases, health status, prevention measures and various current diagnostic and therapeutic procedures. This gives freedom to the population to choose the best hospitals, clinics and doctors to approach for treatment and to live healthier lifestyles.

- Hospital Management System: ICT helps the health management system to improve the safety and satisfaction of the patients. It helps hospitals to get updated to the latest technology, have a knowledge on population health and statistics, and keep track of government mandates.

- Health Research: ICT helps in possible monitoring, prevention, diagnosis, and treatment by being cost and time effective which shall ultimately reduce the morbidity, as well as, mortality through basic or advance treatment, and also helps in replacing the old existing mode of treatment with the new models which benefit the health care. In addition, it accommodates telemedicine collaborations among doctors and regions; and its combination with other technologies to give real time support. For instance, virtual reality simulations.

- Health Data Management: The data can be stored as electronic medical data, which can be retrieved by the physician or other health personnel for consultation. The data stored can also help the physician for rational prescription of drugs and gain an accelerated information exchange, receive latest updates and foster transparency. This improves the generation of medical reports and supports referrals or legal submissions expeditiously.

3.2 The opportunity for telemedicine in SIDS

The basic problem in SIDS is the current status of the pandemic, highly contagiousness of the diseases in small but open populations and the insufficient

number of experienced physicians along with the ageing transformation of the society. The limitations like population dwelling in the remote islands possessing decent medical trends worsen the situations especially in emergency conditions where the patient seeks urgent health care. Telemedicine can be used to deliver medical services regardless of distance and time via information and communication technologies.

According to the National Institute of Health National, 2022, telemedicine is described as the use of communication technology for the distant delivery of health care services, including virtual encounters between physicians and patients and remote monitoring. This section outlines the feasible benefits and opportunities of telemedicine.

- Cost Reduction – One of the main objectives of digital technology integration is to provide better services at lower cost. In the case of telemedicine, several operational costs such as traveling can be reduced as the patients are able to get medical services online wherever they are located. Telemedicine can thus be considered as a platform to establish diagnosis and treatment methods in several cases; and these services can be used in emergencies. Moreover, hospitals benefit from applying telemedicine. Hospital beds or space occupancy and resource utilization can be improved as patients receive medical care at any place and anytime.

- Preventive Medicine Promotion – People sometimes have symptoms which can be prevented. One of the key benefits of practicing preventive medicine is to decrease feasible illnesses. It can be conducted by several levels ranging from governmental agencies to individuals. Health monitoring concepts together with telemedicine are the main driver of applying preventive medicine. In order to obtain the real-time vital sign readings, wearable devices available in the market can be used to sense and transmit the readings to the medical staff. Preliminary diagnosis and following procedures are performed by using telemedicine. Possible illnesses can thus be prevented or found at an early stage.

- Medical Education – Apart from telemedicine being a medical treatment platform, telemedicine can be used as a continuing medical education where medical staff and professionals meet, learn and exchange their knowledge and experiences.

- Health care Equality – Limitations of distance and time are tackled by information and communication technologies. Telemedicine is built on top of such technologies in order to provide medical services. Families in remote areas

can therefore access the services as soon as they are connected to the Internet. Medical services are not only delivered by local physicians. Professionals residing in other areas can provide diagnoses and treatments. Local or novice physicians are capable of learning from medical specialists. In order to achieve health care equality, collaboration, regulation and standardization are required.

- Service Diversity – With an advancement of recent digital technology, data delivery and processing are considerably improved. Instead of basic data type, multimedia streaming over the Internet is now more efficient. Processing power is also remarkably increased while the hardware price is continually decreased. Such improvements support a variety of medical services and enable real-time applications. A variety of telemedicine services such as tele-pathology, tele-dermatology, tele-nursing and tele-surgery and their performance acceptance are addressed. The key consideration on offering new service is to select a set of suitable tools and technologies (Ittipong, 2019).

3.3. Benefits of telemedicine

According to the Telemedicine Report to Congress in 1997 written by Joint Working Group on Telemedicine, the following are benefits for the use of telemedicine: 1) It allows real time two way interactions. The Physician actually receives the medical history and current condition directly from the patient or health aid provider. 2) The physician can have improved access and quick diagnosis can be interpreted, and hence, can tailor the treatment accordingly. 3) The provider has the opportunity throughout the examination to ask questions and learn from each and every consultation. The continual education of health aid provider via medical consultations is an immeasurable benefit to all patients. 4) Improved quality of care through increased consultation and collaboration and increased patient involvement. 5) Reduced professional isolation and the promotion of collaborative consultation partnerships. 6) Reduced costs from the centralization of resources, reduced travel, and the avoidance of duplication of services. 7) Accessibility of health information (Hjelm, 2005).

3.4 Barriers to adopting to telemedicine

There is a need to upgrade skills for applying digital technologies to developmental challenges and ensure better coordination between ICT specialists and different sectors of the economy. Digital technologies and applications, particularly social media, also pose risks, for example in terms of false information and misuse of personal information. Forward-thinking strategies and appropriate regulatory policies in areas such as data protection and regional cooperation, provide consistency and bargaining power when dealing with stakeholders, and are

essential in order to anticipate and mitigate these dangers. The barriers can mainly be classified under categories of Ethical, Educational, Regulatory, Sociocultural, Technological and Evidence-related Barriers.

According to Scott Kruse *et al*.; (2018), the following can be the list of barriers/ issues which affect telemedicine: 1) limitations with performing comprehensive physical examinations, possibilities for technical difficulties, security breaches, and regulatory barriers, 2) may adversely affect continuity of care, 3) faces many legal and regulatory hurdles including large variations in rules, regulations, and guidelines for practice, 4) concerns about patients' privacy or confidentiality, 5) lack of perceived clinical usefulness, 6) lack of consultation between the clinicians and the IT experts, 7) lack of suitable training in the field with respect to the use of equipment, 8) lack of user-friendly software, 9) negative attitude, 10) perceived increase in the workload, 11) data accuracy can be another potential barrier, 12) raises many questions regarding malpractice liability including informed consent, practice standards and protocols, supervision requirements for non-physician providers, and the provision of professional liability insurance coverage (Gajarawala and Pelkowski, 2020).

4. Methodology

4.1. Sample and data description

A standardized questionnaire was developed to evaluate the various research objectives. This was administered from April to June 2022. The research was a randomized controlled intervention study of two diagnostic groups of diabetes (DM) and hypertension (HTN) which is classified as chronic diseases. The inclusion of 100 participants in the study began in March - June, 2022. The study was approved by the Dominica National Ethics Committee (NEC) and was carried out according to the NEC guidelines.

The study consisted of a heterogeneous mixture to include the indigenous group; 25% youth, 52% adults and 22% geriatrics. There were 79% female and 21% male. The population was composed of women, men, persons with disabilities, children and the elderly. Prospective participants were selected by multi-stage random sampling stratified into 3 classifications.

Table 1: Associated conditions

	Telemedicine consultation			
Variable	DM Diabetes	HTN Hypertension	Diabetes + Hypertension (DM + HTN)	Control (C)
n	50	50	50	50

100 randomly selected individuals were offered the telemedicine service upon eligibility and consent. Random and general community screenings and clinics were realized prior to adoption of individuals into the study. Patients were categorized according to conditions and associated risk factors. Familiarization of the patient's vaccination status was taken into account upon screening.

A telemedicine platform with Health Insurance Portability and Accountability Act (HIPPA) certification was used. All specifications are in accordance with the American Telemedicine standards.

4.1.1. Data collection

4.1.2. Model and analysis technique

Data was entered into the Microsoft Excel and appropriately coded after which it was transferred to the SPSS for both descriptive and inferential statistical analysis. Descriptive statistics included means plus standard deviations, percentages, and charts.

Paired sample t-tests were conducted to determine any statistical differences in the means of variables (weight, blood pressure, RBS) before and after interventions among the various groups (Control, DM, HTN, DM+HTN). Analysis of variance (ANOVA) was utilized to determine any statistical difference in the means of weight difference (Weight1-Weight2) between groups (DM, HTN, DM+HTN, Control), and also for determining any statistical difference in the means of these disease groups for the variables of Connectivity and Overall Patient Satisfaction.

A Mann-Whitney U test was conducted to assess any statistical differences in the means of groups (Gender, Vaccination status) for the variable Overall Patient

Satisfaction. A similar test was performed for the Quality of Service variable based on the Retention Category. A Kruskal-Wallis test was used to determine any statistical differences in the means of Overall Patient Satisfaction, Impact on Health Care, and Age Group, based on the Ethnicity groups.

Spearman rank correlational studies were conducted to determine any relationship between the following ordinal variables: Impact on Health Care vs Overall Patient Satisfaction, Quality of Service vs Overall Patient Satisfaction, Distance from Health Services vs Overall Patient Satisfaction, Waiting Time vs Overall Patient Satisfaction, Average Consultation Time vs Overall Patient Satisfaction, Age Range vs Level of Education, Level of Education vs Overall Patient Satisfaction, and Level of Education vs Impact on Health care.

A Pearson correlational analysis was utilized for the continuous variables and Overall Patient Satisfaction, relating to Access: Cost of Call vs Overall Patient Satisfaction, and Average Cost of Physical Consultation vs Overall Patient Satisfaction.

A multiple linear regression was run to determine the impacts of the independent variables on the dependent variable Overall Patient Satisfaction.

To ensure credibility of results, the various assumptions of t-tests, ANOVA and regression were observed. For instance, Pearson correlation was used for continuous variables; Spearman rank correlations were utilized for ordinal variables; t-tests and ANOVA were used when the dependent variable was continuous. Mann-Whitney U and Kruskal-Wallis tests were utilized for ordinal variables. Moreover, multicollinearity tests were conducted. Likewise, tests for normality and linearity using histogram and P-P plots were also conducted.

All the information obtained in the survey was coded and reviewed by the same interviewer and research team. All survey questionnaires were computerized. All entries were checked for errors. Subsequently, the maximum, minimum and mean values permitted for each variable will be reviewed to detect anomalous values and revise them in the originals with the respective correction. Sample weights for the interview were constructed based on selection probability, the non-response rates at the various stages such as (sectors, compact segments, households, individuals) and the composition by age and sex of the population residing in the selected sites. A second weight calculation was done for those who had blood sample and anthropometrics measures using the same methodology.

The prevalence of undiagnosed diabetes was calculated using the blood sample weights. The total prevalence of diabetes was calculated by combining participants with diagnosed diabetes (interview weights) and all participants whose diabetes

status was assessed by the lab (blood sample weights). Databases were merged and cleaned in a central location at the A-MEDIC Clinic.

The prevalence of the primary variables (diabetes and hypertension) and associated major risk factors (obesity, hypercholesterolemia) was calculated by age and sex groups. Prevalence was adjusted for the proportion of non-responses and standardized by the age and sex stratification of the target population for the most recent year available. The analyses of the data included descriptive statistics of the variables. For continuous variables, the average and standard error (SE) were reported. For prevalence or proportions, tests of the analysis of variance (ANOVA) and $\chi 2$ were made to identify possible differences between groups and associations between variables. All prevalence estimates include a 95% confidence interval (CI). The standard error was adjusted to take into account the design of the survey by clusters. The statistical analysis was carried out using Stata 9 (Stata Corporation, Texas, USA) and SPSS for Windows (SSPS, Inc., Illinois, USA).

5. Results

5.1 Telemedicine is effective in the management of chronic diseases in small island developing states (SIDS) during and post the COVID-19 pandemic.

Small Island Developing States adopt telemedicine services to facilitate the management of chronic diseases in light of inadequate health professionals, infectious nature of the COVID-19 disease, and scarce resources. Given the remoteness of many communities, inadequate and unreliable national and private transport system in certain areas, access to a digital device in the household, and the availability of telecommunication services, the study was realized. The study was implemented in 48 communities including the city. Telemedicine was promoted as the use of technology to provide treatment from a distance, and the Dominican population agreed to the same.

5.1.1 Respondents demographics

Table 2: presents a demographic summary of 100 participants in the telemedicine study.

Demographics		**Number of Respondents (N= 100)**	**Percentage**
Gender	Female		71
	Male		29
Age	<20	0	0
	20-39		25
	40-64		53
	>65		22
Education	Primary		33
	Secondary		41
	Tertiary		26

5.1.2 Reasons for non-acceptance by participants

The frequency table in Table 1 shows that 91% of participants accepted to be part of the telemedicine study; whereas 9% dropped out from the study. Participants showed interest in the use of the new technology, since it is innovative, affordable, and user friendly.

Figure 1 presents the overall satisfaction of the management of chronic diseases. Patients in the two diagnostic groups of DM and HTN were all satisfied with the use of telemedicine platform. The control group reported as the most satisfied grouping. Participants of the study increased their awareness and knowledge in keeping track of their health status, educating and updating patients on new approaches to managing the diseases. Additionally, health professionals were exposed to the digitization of health records and increased access to e-health management systems.

Table 3: Patient acceptance and non-acceptance of telemedicine in the management of DM and HTN connectivity

Acceptance Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Non-acceptance	9	8.8	9.0	9.0
	Acceptance	91	89.2	91.0	100.0
	Total	100	98.0	100.0	
Missing	System	2	2.0		
Total		102	100.0		

5.2 The digitization of health care optimizes the response to disease monitoring and management during and post the COVID-19 pandemic.

5.2.1 Perception of telemedicine application in the management of DM and HTN in SIDS

The reviewed articles described that telemedicine improved diabetes, hypertension, and rheumatoid arthritis care, particularly when telemedicine consultation and telemonitoring were employed. Telemedicine reduced negative feelings and enhanced medication adherence in rheumatoid arthritis patients while also improving systolic blood pressure in hypertension patients (Yue *et al*., 2022).

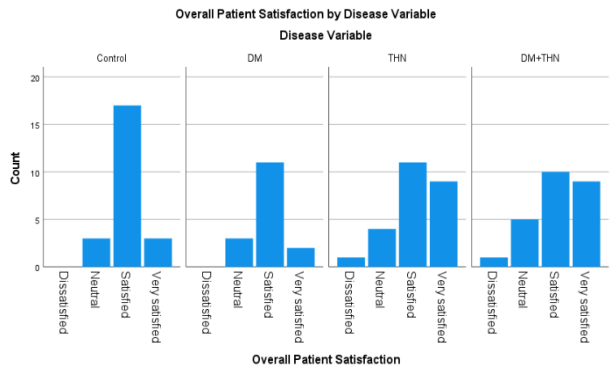

Figure 1: Participants perception of the telemedicine influence on the management of DM and HTN in SIDS

This study has indicated that telemedicine can indeed be useful in treating patients with diseases such as diabetes and hypertension. The paired sample t-test results, for example, showed that the differences in means between the BEFORE and AFTER telemedicine intervention were statistically significant. The mean Weight-2 for the DM patients (184.29, SD = 35.45) is less than Weight-1 (189.19, SD = 36.83) and the difference is statistically significant (p = .006). There is also a reduction in the Random Blood Sugar (RBS) values, though the difference in means was not statistically significant (p>.05). These results indicate that telemedicine care with the use of appropriate medications could have led to the observed reduction in weights and RBS values. Similar reduction in weights and RBS were also observed in the DM+HTN group,

though the means were not statistically significant. Shea *et al.*, (2006); Shea *et al.*, (2009) employed telemedicine consultation and telemonitoring as interventions for diabetes home unit management and nursing case management. The results revealed that the experimental group's anthropometric indices improved.

Moreover, there is a negative correlation between the age range and level of education (r = -.502) and it is statistically significant (p = .001). This means that the younger participants were more knowledgeable about the benefits of telemedicine than the older participants. There is a negative correlation (r= -.013) between level of education and overall patient satisfaction but it is not statistically significant (p = .904). This is a weak correlation and it showed that those who were more technologically inclined appeared to show more satisfaction, though not statistically significant. It clearly proved that telemedicine satisfied the needs of the participants who took part in the study.

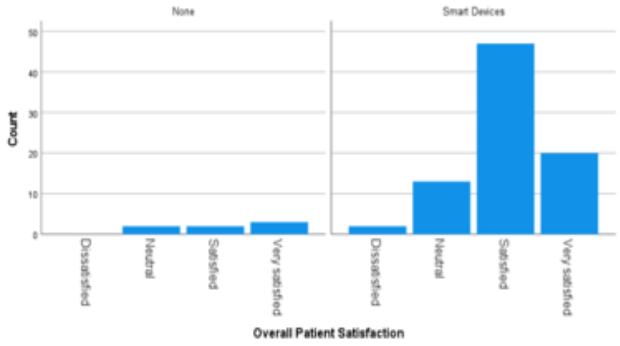

Figure 2: Participants' perception of the telehealth influence on the management of DM and HTN by connectivity

Participants of the study had equal access to health care despite their place of residence. Figure 2 presents the level of satisfaction of patients using telemedicine as a medium to manage DM and HTN via teleconferencing using smartphones and in some cases in the absence of a smart device or poor connectivity, a telephone call was made.

According to Schultz, (2018), the telemedicine platform requires a reliable source of Internet, telecommunication systems and smart devices for connectivity. This therefore, influences the patients' confidence in the use of the technology to manage their condition. Figure 2 shows that patients with smart devices have an increased access to health care and simultaneously, there is no advantage between patients. Patients battling with the chronic diseases, DM and HTN have improved access due to telemedicine.

In Figure 3, participants demonstrated their perception of the telehealth influence on the management of DM and HTN by waiting time and distance waiting time. This study shows that, participants who faced waiting time of more than 7 weeks for an appointment and who had distance from a health facility that is less than 30 mins were most satisfied with the use of the telemedicine platform to manage DM/ HTN.

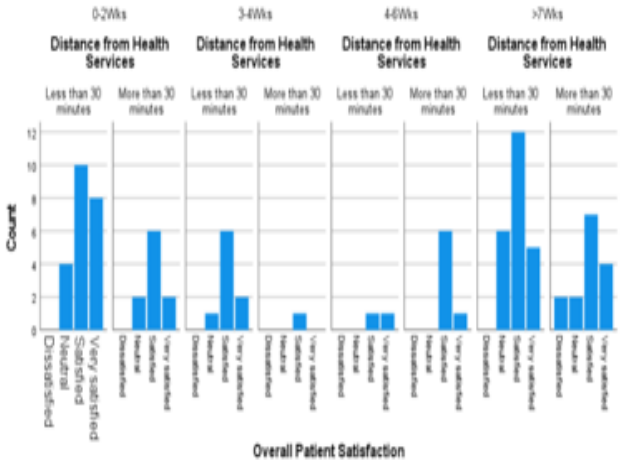

Figure 3: Participants demonstrated their perception of the telehealth influence on the management of DM and THN by waiting time and distance waiting time

Additionally, satisfaction was received from patients whose waiting time were less than 2 weeks and whose distance from a health facility is less than 30 mins.

5.3 Impact of telemedicine in the management of chronic diseases

The study showed that telemedicine used in the management of DM and HTN reduces waiting time and limited discrimination among patients. Irrespective of the participant's residence, telemedicine was proven successful. The competitive edge of the telemedicine platform allowed using a smart device increased their ability to consult a physician in a shorter time. Silven (2020), argued that telemonitoring minimizes the frequency of visits and hospitalizations, allowing precious medical resources to be used more efficiently.

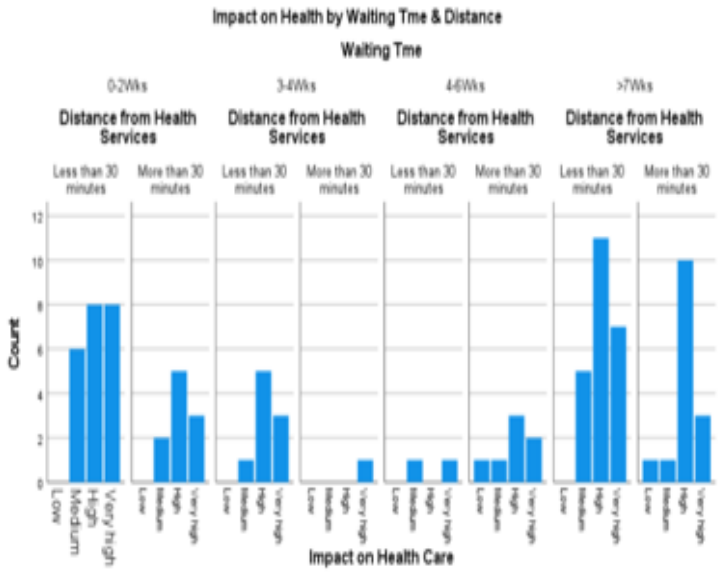

Figure 4: Impact of telemedicine in the management of DM and HTN by waiting time and distance from health services

Observations were made in Figure 4 that patients who had to wait for more than 7 weeks for a physical consultation were more satisfied irrespective of their distance from the health facility. A positive (r=.452) is a statistically significant (p<;.001) correlation between the Impact of Health care and the Overall Patient Satisfaction. A positive (r=.411) is a statistically significant (P <;.001) correlation between Quality of Service and Overall Patient Satisfaction were also observed.

As indicated in Figure 4 above, there is a weak negative (r=-.056) or a non-significant correlation between Distance from Health Services and Overall Patient Satisfaction. In other words, it appears that the longer the distance, the less the satisfaction.

There is a weak negative (r=-.162) correlation between Cost of Call and Overall Patient Satisfaction, though the correlation is not statistically significant (P>;.05). It appears that the higher the cost, the less the patient's satisfaction. Gaikwad and Warren (2009), explain that telemedicine is a cost-effective technique of long-term care.

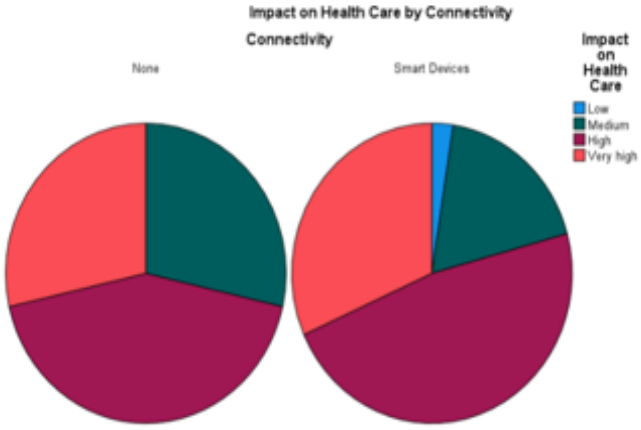

Figure 5: Impact of telemedicine in the management of DM and HTN by connectivity

Telemedicine had a very high impact on health care by connectivity. Observations have shown that inclusion of technology to advance health care is of paramount importance, particularly in managing chronic diseases. The study has proven that telemedicine supports the existing health care framework, working in conjunction with physical consultations or follow-ups.

The results of linear regression analysis indicates that Quality of Service (B= .267, p= 0.017) and Impact on Health Care (B = .302, p = .003) contributed significantly to the regression model; the other independent variables showed weak contributions, and Cost of call, Average cost of physical consultation, and Waiting time) showed weak negative contributions.

While Quality of Service (B= .267, p= 0.017) and Impact on Health Care (B = .302, p = .003) contributed significantly to the model, the other independent variables showed weak contributions, and Cost of call, Average cost of physical consultation, and Waiting time) showed weak negative contributions.

6. Discussion

6.1 Summary and discussion of main findings

H1: Telemedicine can support the management of chronic diseases in Small Island Developing States (SIDS) like Dominica during and post the COVID-19 pandemic.

This study aimed to confirm that telemedicine is an effective medium which can be used in the management of chronic diseases in Small Island Developing States (SIDS) during and post the COVID-19 pandemic. By connecting families with health professionals, telehealth in Brazil has permitted videoconferencing, diagnosis, and formation of second views, as well as continuing education (NU. CEPAL Comisión Europea, 2011). Rho *et al.*, (2015) stated that telemedicine is an excellent technology, especially for addressing blood sugar management and lowering diabetic complications. Several research have increased the use of telehealth and provided guidance on how to mitigate the negative effects of COVID-19 (Doraiswamy *et al.,* 2020, Albahri *et al.,*2021, Hirko *et al.,*2020).

Whilst telemedicine is new to the Caribbean, the study approached four groups of individuals – those who are diagnosed with hypertension, diabetes, and both diseases, and the control group. This innovative approach was simply to determine the satisfaction and impact of the said technology. This study reports that there was great acceptance of the technology in the management of diabetes and hypertension. The reasons for non-acceptance were scrutinized by Zhou *et al.* (2019), and observations were made that only one participant had exposure to telemedicine prior to the study. Khodadad-Saryazdi, (2021) explains that when testing a new technology among human subjects, barriers are anticipated in the adoption. This study reports that 91% of participants supported the study.

Rutledge C.M., *et al*., (2017) stated that, telehealth technologies are increasingly being accepted and deployed as an efficient and cost-effective method of delivering and receiving high-quality health care services and results. Other authors have scrutinized the acceptance of telemedicine. Zhu *et al*., (2018) and Meng *et al.,* (2019), state that the age of the respondent may influence the adoption of technology. It is argued that it will affect trust levels of many respondents (Zhao *et al.,* 2018); Fan *et al*., 2018). This study has demonstrated that privacy was the number one priority. Though digitization is the new normal, privacy concerns and proof of safety is a general concern debated by Iizuka and Ikeda, (2021).

H2: Patients with Chronic Diseases will attain greater response with disease monitoring and management during a crisis.

The digitization of health care optimized the response to disease monitoring and management during and post the COVID-19 pandemic. The study allowed patients to take a proactive step towards the management of diabetes and hypertension. By using the telemedicine platform, it increased the capacity for the health system to better manage diabetes and hypertension. The study encourages the transformation of physical health records to e-health records.

The study monitored blood pressure, blood sugar levels and bodyweight. A total of 100 participants with hypertension or diabetes and the control group had the opportunity to participate in the telemedicine study in the comfort of their homes. The telemedicine consultation included diagnosis, routine check-ups, follow-ups, and remote patient monitoring. Yaron *et al*. (2019) examined the means of telemedicine's efficacy, safety, acceptance, and cost-efficiency in patients battling with diabetes. Four of the five studies reviewed revealed that patients had good opinions about the utilization of telehealth (Rahimpour *et al*., 2008; Sanders *et al.,* 2012; Seto *et al.,* 2010; Hall *et al.,* 2014).

Testing the technology was realized during the study. The literature cites several reasons that telemedicine can achieve identical outcomes. However, the presentation of the technology to the Dominican public presented several limitations. Inadequate telecommunication services in remote areas which hindered connectivity, bearing in mind the topography and vegetation of the small island state. Technical support for geriatrics was necessary for the realization of telemedicine consultations. Observations were made that the elderly require additional support due to limited access to technological knowledge or skills, and many experienced hand tremors, which impeded their ability to type and coordinate. Geriatrics are restricted, since many do not possess digital devices, may have to share with a family member, or are handicapped by other ailments, for example, stroke arthritis, and visual, speech or hearing impairment. The adoption of telemedicine is likely to face barriers (Khodadad-Saryazdi, 2021) as it relates to trust (Zhao *et al.*, 2018; Fan *et al.*, 2018), age (Zhu *et al.,* 2018; Meng *et al.,* 2019), privacy concerns, and proof of safety (Iizuka and Ikeda, 2021).

According to Azad A, Charles A., & Ding Q. (2020), the digital divide is the gap between people who have access to computers and the Internet and those who do not. The digital gap is further divided into four sorts of access: (i) motivational, (ii) physical, (iii) skills, and (iv) usage. Cho *et al*. [24] considered the barrier that older persons could not successfully use manual Internet-based telemedicine and evaluated the usefulness and practicality of an Internet-integrated device that automatically uploads patient data for diabetes management.

7. Conclusions

Telemedicine is a novel technology that was introduced in SIDS, and particularly in Dominica to improve health services and to broaden the geographic reach of health care services and enhance access to diagnosis and treatment. This study has proven that telemedicine can be used as a platform in the management of chronic diseases, specifically diabetes and hypertension. Patients who participated in the study have cited ease, efficiency, communication, privacy, and comfort as essential factors in using telemedicine. The telemedicine intervention has proven satisfactory and supports the management of diabetes and hypertension in SIDS. Telemedicine has improved access and secured equality to health care. Telemedicine has the potential to significantly enhance the quality of disease management (McLean *et al.,* 2013).

The insights gathered from assessing this platform critically guided and informed the implementation of similar services and/ or technology in Dominica. Furthermore, it guided the management of eyecare services, as indicated by the literature review, there is a close correlation between chronic diseases and vision impairment. The study placed a particular emphasis on studying the role of telemedicine during and post pandemic and future health crisis in treating and effectively managing diabetes and hypertension.

The study stimulated and challenged the thinking of the adolescent, youth, working men and women and geriatrics in Dominica to reflect on their health and the critical role that they must play to maintain good health.

Though the study was successful, there were many limitations. Limitations to the study in investigating the use of telemedicine in the management of chronic diseases in Small Island Developing States (SIDS) included: 1) inadequate connectivity in rural and urban areas, 2) lack of home medical monitoring devices, 3) inadequate education of telemedicine services and chronic diseases management, 4) patients response to the management of chronic diseases are reactive rather than preventive medicine, 5) distractions encountered during consultation, 6) privacy and data security concerns were presented, and 7) cultural taboo impacted negatively towards telemedicine services.

Caribbean SIDS have a higher incidence of NCD risk factors; nonetheless, a behavioral intervention programme to treat NCD risk factors at the community level is urgently needed. This study would like to present recommendations towards the use of telemedicine in the management of chronic diseases in Small Island Developing States (SIDS): 1) the need to upgrade broadband services for improved connectivity of telemedicine services and incorporate satellite and GPS systems in health care, 2) the need to increase the accessibility and availability of e-health

medical devices and technology for improved diagnostics, transfer and record of information, 3) to improve public/private partnerships in the development of telemedicine, and 4) to increase advocacy and education of telemedicine services in SIDS.

Despite the inclusion of new technology in health care in Caribbean SIDS, the issuance of necessary policies and strategies are required for the smooth adoption and implementation of the of the said technology.

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