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Type 1 Diabetes in the Dominican Republic: Aspects of Healthcare Accessibility

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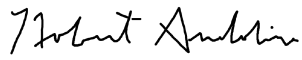

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Abstract

Beginning in 2001, the Dominican Republic experienced a series of healthcare reforms contributing to the current structure of the Dominican healthcare system, influencing access to specialized type 1 diabetes (T1D) care, affordable insulin and medications, and diabetes education. As type 1 diabetes is a misunderstood and understudied issue in the Dominican Republic, the goals of this research are twofold. First, this project situates T1D care in the context of the Dominican healthcare system, analyzing its impact on T1D patients. Second, it addresses how the Dominican Republic can better meet the health-related needs of its citizens who have type 1 diabetes through various T1D policies, programs, and investments. A comparison of case studies from the United States, Colombia, Ecuador, and a nine-country cross-regional analysis will highlight successful solutions that have increased access to T1D healthcare resources, providing alternative solutions applicable to the DR. Utilizing theories of healthcare accessibility defined by dimensions of approachability, acceptability, availability, and accommodation, affordability, and appropriateness, this thesis analyzes accessibility to T1D resources in the Dominican Republic, while simultaneously providing solutions for these gaps in care.

Keywords*: type 1 diabetes/juvenile diabetes/diabetes mellitus, endocrinology, Dominican Republic, healthcare accessibility, medication affordability, insulin affordability*

Introduction

As a disease that represents 5% of those with diabetes, there is little research and discussion surrounding type 1 diabetes (T1D) globally, especially within the context of the Dominican Republic. Since the 1990s, there has been no published data on T1D incidence rates in the DR, however, estimates based on global increasing trends suggest that the amount of youth and young adults diagnosed with type 1 diabetes is increasing in the Dominican Republic (Gutiérrez Martinez, et al., 2021). For context, T1D is an autoimmune condition in which the immune system attacks insulin-producing cells in the pancreas, leaving the body with no cells to naturally produce hormones, impacting metabolism, microbiome, genome, and immune systems in the body (DiMeglio, et al., 2018). T1D is unpreventable and incurable, and successful management requires constant monitoring of blood glucose levels through glucose testing and insulin injections or insulin pump therapy. Due to the complicated nature of care for individuals living with type 1 diabetes, compiling and understanding data specific to type 1 diabetes is integral, as patients with T1D are more likely than patients with type 2 diabetes to experience severe episodes of hospitalization, hypoglycemia, or DKA (diabetic ketoacidosis), along with long term health complications that burden both patients and health systems (Duska, et al., 2021).

As an issue with scarce research, it is important to provide an analysis that draws connections between the function of the Dominican healthcare system and its underinvestment, the impacts of chronic health conditions on medication affordability, endocrinologist access, geographic barriers, and overall high medication costs. With high health implications, costs, and impacts on economic well-being, it is important for research to emphasize the issues that type 1 diabetes patients are facing within the healthcare system. By examining which aspects of the Dominican healthcare system benefit T1D patients, this research can also identify which areas need improvements. This research will address the primary research questions: *How does the Dominican healthcare system impact Dominican patients living with type 1 diabetes (T1D)?* The following research will further analyze this issue and address *how the Dominican Republic can better meet the health-related needs of its citizens who have type 1 diabetes.*

The current healthcare system does not adequately support people with chronic conditions like T1D due to barriers to accessing care. The DR only invests 6.1% of its GDP into the healthcare system, less than the average investment in other Latin American countries (8%), and comparatively globally (9.9%) (Gutierrez Martinez et. al, 2021). From high out-of-pocket costs for medications to urbanized centers of care, patients that rely solely on the public health system in the Dominican Republic will not achieve target T1D goals in the same way that those with private health insurance and external resources outside of the public health system do. For people living with chronic health conditions like type 1 diabetes (T1D), inadequate care and higher out-of-pocket healthcare costs can result in lower quality of life, less adherence to treatment plans, and worsened long-term outcomes (Gutierrez Martinez et. al, 2021).

The structure of the Dominican healthcare system is not supportive of the healthcare needs of patients with type 1 diabetes due to high out-of-pocket costs for supplies, geographic barriers to care, and overall underinvestment in the DR healthcare system. This project will emphasize the specific barriers to accessing T1D care for T1D patients in the DR and additional analysis will expand on solutions that can provide better care to T1D patients. Solutions to these issues include the implementation and funding of diabetes education programs, the creation of primary care provider (PCP) training programs, and the implementation of virtual healthcare.

This paper will begin by examining the state of type 1 diabetes in the DR followed by a brief historical, political, and economic context of the Dominican Republic, in particular, highlighting the structure and function of the healthcare system. After understanding the conditions that create these inequities, an analysis of implemented solutions within other Latin American countries will aid in providing recommendations for policy initiatives or programs that the DR can implement to better serve their T1D population. This research draws on empirical studies on type 1 diabetes patients in the DR, as well as existing data from organizations like the World Health Organization and the World Bank, further complemented by analyses of the existing state of the Dominican health system. Case studies of Colombia, Ecuador, and the United States as well as a cross-regional comparison of diabetes care in nine Latin American countries, provide a robust analysis of potential solutions to these T1D care issues in the DR.

Academic Context

Research Design and Methods

This research addresses the subject of type 1 diabetes (T1D) healthcare within the Dominican Republic. T1D patient metrics of income and socioeconomic status, instances of hospitalization related to T1D, HbA1c values, and costs paid for T1D care are analyzed. This subject also includes the role of medical research, medical professionals, and education in type 1 diabetes care. The primary object of this study is healthcare accessibility, further defined by inequality in access to doctors/medical professionals, medical supplies, and essential treatments.

Three dimensions give additional focus to this case study. The first is the local-global continuum and its relation to the interconnectedness of type 1 diabetes care within the Dominican Republic and other countries globally. Local issues can be studied at any point almost anywhere in time on a global scale (Darian-Smith & McCarty, 2017, 183). While there are issues of T1D care that are specific to the Dominican Republic, they exist in other regions of the world as well. This further illustrates the interconnectedness and relatedness of this issue with much broader implications. A geographic dimension of this case study is the analysis of the rural-urban divide. While the Dominican Republic is a relatively small country geographically, location becomes an integral part of accessing healthcare. Similarly, socio-economic status or class as a socio-political issue becomes an impactful factor in determining the individual-factor levels that dictate access to care. With high costs associated with high levels of T1D care, supplies, and insulin, class and one's ability to afford healthcare greatly impacts healthcare accessibility in the DR.

On a personal, ethical note, the researcher lives with type 1 diabetes and has personal experience with the healthcare system in the United States that may influence their view of type 1 diabetes healthcare systems globally. They have also volunteered in the Dominican Republic working in diabetes education camps with the non-governmental organizations AYUDA (American Youth Understanding Diabetes Abroad) and Aprendiendo A Vivir (AAV). Currently, the researcher is involved with the College Diabetes Network (CDN), JDRF (Juvenile Diabetes

Research Foundation), and T1International in volunteer capacities. None of this research was funded by these organizations nor influenced by them.

Demonstrating the relevance of this research outside of the Dominican Republic, multiple case studies are analyzed, examining the potential solutions for specific T1D issues. A brief nine-country comparison includes countries of Argentina, Chile, Colombia, Dominican Republic, Ecuador, Guatemala, Mexico, Panama, and Venezuela. This study examines the impact of diabetes education, self-management, health insurance, and glycemic control on type 1 diabetes patients. The United States and Ecuador will be compared through the lens of potential policy analysis, looking at solutions for primary care provider (PCP) training as a solution for rural T1D healthcare inequities in the DR. Colombia will be compared for its diabetes education programs and virtual training programs for T1D patients. While all countries may not be directly comparable based on government systems, healthcare systems, etc., a general geographic focus on the Latin American region is used. While the countries in this region are not necessarily directly comparable, in many ways, a comparison can be based on the geographic hemispheric location, *general* commonality of language, and other factors that create a more solid comparison than other regions in the world. This research aims to bring together the main issues that T1D patients in the DR face and discern whether external solutions implemented in other countries could positively impact Dominican T1D patients.

This case study will primarily use secondary data rather than primary data sources. The sources primarily are non-governmental research reports, studies from scholarly journals, governmental reports, and governmental websites (on healthcare resources). The data collected is primarily quantitative, highlighting patient demographics, statistics, and reports on the success (or failure) of various policies and programs addressing T1D care. Much of the quantitative data highlights income levels, instances of hospitalization, HbA1c values, types of insulin used, % of income used on T1D supplies, and other factors that expand on access to T1D care. The qualitative data used is from the Dominican government, such as the Dominican constitution, specific insurance and healthcare systems, and health policies. This data is used to supplement the quantitative data and create a deeper understanding of type 1 diabetes care situated within the Dominican healthcare system.

Addressing the impacts of the Dominican healthcare system on Dominican T1D patients requires an analysis of both quantitative and qualitative data. This data will first provide a base understanding of the specific issues within the DR (high costs, geographic barriers, high socioeconomic inequities, etc.), before comparing external cases and how other countries are increasing access to specialized type 1 diabetes professionals, diabetes education, and accessible and affordable insulin and supplies. This diversity in sources allows for a more robust, well-rounded analysis of T1D care, as a mix of both quantitative and qualitative data provides a deeper analysis of an understudied issue.

Since little T1D data in the DR exists, much of the data on type 1 diabetes is from three studies. Data about the healthcare system (outside of type 1 diabetes healthcare) complements this. Additionally, many sources that would provide patient data are not available online. Other limitations include the researcher's background, as while they have an understanding of type 1 diabetes and type 1 diabetes care in general, they are not medical professionals or a scientific researcher. Similarly, they are not Dominican and while proficient in Spanish, are not a native Spanish-speaker. While these limitations do not disqualify this research, they do highlight the potential for research that could further complement any findings.

Theoretical Framework

Conceptual Dimensions of Accessibility

Before discussing accessible healthcare in the Dominican Republic, it is important to provide a clear definition of what accessibility is. Defined through the concepts posited by Penchansky and Thomas in their original definition of the concept of access, and further expanded by Levesque, Harris, & Russell, accessibility consists of five dimensions. The overarching definition of accessibility is the opportunity for one to reach necessary healthcare services, yet it is further defined through dimensions of **approachability; acceptability; availability and accommodation; affordability, and appropriateness** (Levesque, et al., 2013). Further breaking down these components of healthcare accessibility, dimensions include the ability to perceive, ability to seek, ability to reach, ability to pay, and ability to engage (Levesque, et al., 2013). These dimensions of healthcare accessibility broadly apply to all healthcare

systems, including the current structure in the Dominican Republic. This idea is further illustrated in the diagram below (Diagram 1) with each of the five dimensions outlined highlighting the patient's ability to access health services.

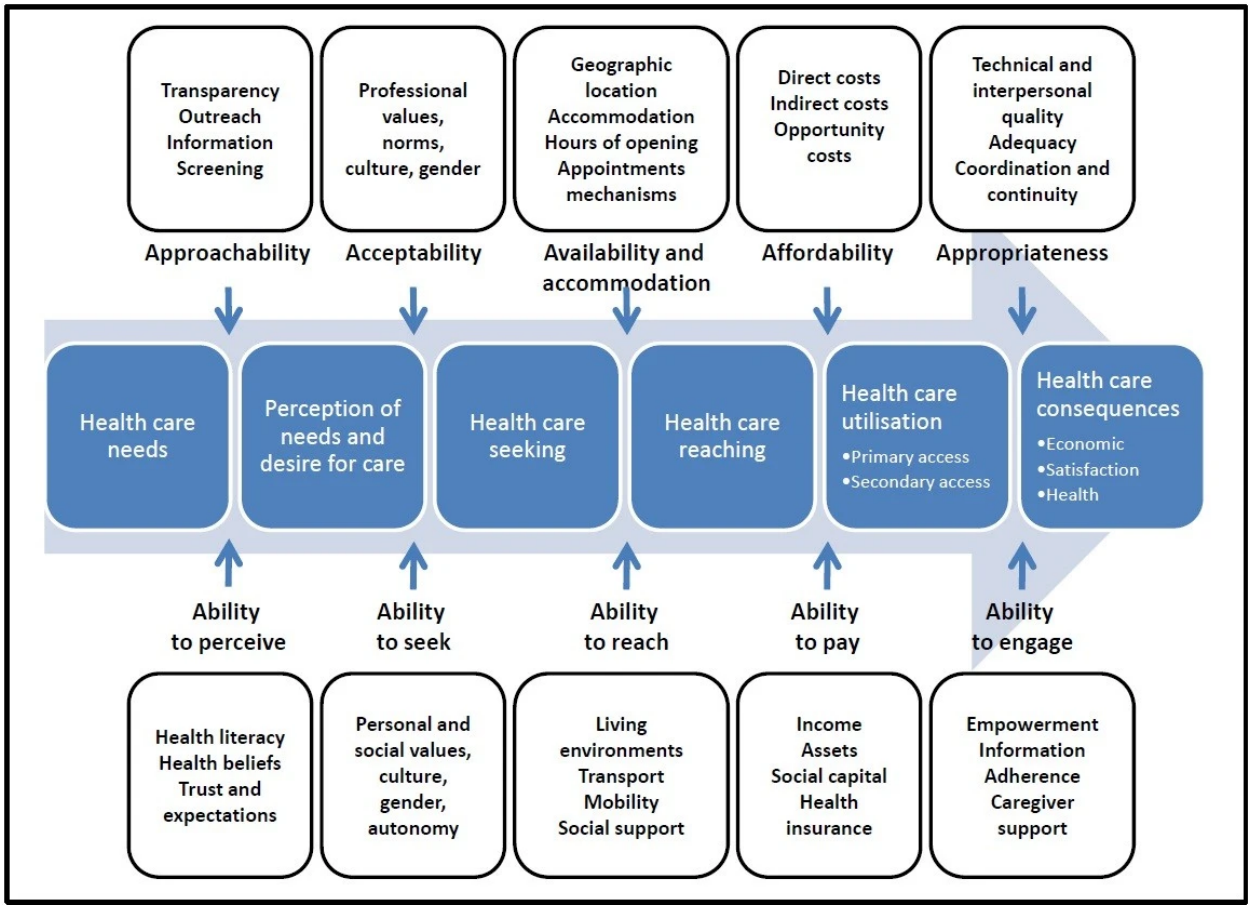

Diagram 1: Patient-centred access to health care: conceptualizing access at the interface of health systems and populations (Levesque, et al., 2013)

Approachability emphasizes the ability of patients to identify services that can be reached with an impact on the health of the individual (Levesque, et al., 2013). Depending on the patient's background, services may be more known or less known, with elements such as transparency and outreach that can make services more or less approachable to patients (Levesque, et al., 2013). It also relates to the patient's knowledge of systems and their trust or beliefs about them (Levesque, et al., 2013). **Acceptability** focuses on the patient's cultural and

social background and these individual-level factors that could impact both accessing care from the patient perspective and providing care from the medical professional perspective (Levesque, et al., 2013, Penchansky, et al., 1981). This concept is generally used to emphasize the relationship between providers and patients and their perceptions of one another, as providers may unconsciously prefer patients from some groups over others (i.e. not taking welfare patients), influencing their level of availability accordingly (Penchansky, et al., 1981). In accessing care, patients' perceptions of healthcare options, individual rights, and autonomy/capacity to seek care greatly impact their accessibility, particularly for those in socioeconomically disadvantaged and vulnerable populations (Levesque, et al., 2013).

Availability and accommodation refer to the act of reaching a health service (the physical space, providers themselves), in an efficient manner (Levesque, et al., 2013). Delineating both of these, availability would analyze the existing, available resources compared to patient needs, while accommodation is the relationship between ease of patient entry into health systems (appointment systems, hours of operation, geographic barriers, patient mobility, etc.) and the patient's ability to accommodate these aspects (Penchansky, et al., 1981).

Affordability is most often the aspect of accessibility discussed, as it is often the biggest barrier for people of all socioeconomic backgrounds, however, defined, affordability is the economic ability for people to spend resources using services (Levesque, et al., 2013). Expanding on this concept, affordability is specifically the relationship between costs of goods and services concerning insurance or co-pay requirements, and the patient's ability to pay (dictated by income, health insurance, etc.) (Penchansky, et al., 1981). Generally, measures of affordability include the price of care, time traveled to receive care, patient income, opportunity costs (for receiving care vs. not), quality of care, and provider behavior (Levesque, et al., 2013). One concept of affordability that is relatively unknown is the patient's perception of the worth of services relative to costs, as with higher costs, obtaining services becomes less worthwhile for patients with lower socioeconomic backgrounds (Penchansky, et al., 1981). Lastly, **appropriateness** is the fit between services offered and patient needs, efficiency, and the quality of care received (Levesque, et al., 2013). The quality of health services is measured in ways that provide integrated, continuous care, ensuring that patients have access to care that is

appropriate for the patient (Levesque, et al., 2013). Under this dimension, patients should be engaged in their care, empowered with support from the medical system while also receiving high-quality care (technical and interpersonal) (Levesque, et al., 2013).

Not an exhaustive list, each of these dimensions provides an aspect of accessing healthcare that highlights the individual-level, and system-level factors that dictate access. From high costs to geographic barriers, each of these issues intersect with one another to contribute to inaccessible or highly accessible levels of care. The theory from Levesque, et al., 2013, expands on previous theories, most notably from Penchansky, et al., 1981, to create an analysis of the accessibility framework through the timeline process for patients seeking care (as demonstrated in Diagram 1 above). The following research on type 1 diabetes in the Dominican Republic aims to rectify these issues of inaccessibility found in the DR through a combination of approaches primarily based on these five dimensions of access.

Type 1 and Type 2 Diabetes Literature

While type 2 diabetes is relatively well-studied in the Dominican Republic (DR), there is little existing research and discussion surrounding type 1 diabetes in the DR, especially when analyzing research that attempts a nuanced approach of policy and program analysis to improve health conditions for those living with type 1 diabetes. This research will highlight the little existing data on type 1 diabetes in the DR and will primarily analyze what factors contribute to the overall lacking care for type 1 diabetics in the DR.

In the Dominican Republic, there are two main issues surrounding diabetes data and research. The first is the aggregation of data on both type 1 diabetes and type 2 diabetes. Studies focusing on type 2 diabetes in the Dominican Republic have highlighted the prevalence rate of diabetes as 11%, or around 1 million of the DR's population (Dethlefs, et al., 2018), with complications of diabetes such as ischemic heart disease and cerebrovascular disease contributing to 57.87% of premature deaths in the DR (Dethlefs et al., 2019). While these studies highlight important diabetes statistics within the Dominican Republic, their data combines both type 1 diabetes and type 2 diabetes, contributing to an overemphasis on "diabetes" as type 2 diabetes and the continuation of research and support to highlight type 2

over type 1. When researching type 1 diabetes data sources, it is common to see footnotes that explain there is no separation between type 1 and type 2 diabetes (Wild, et al., 2004), which contributes to type 1 diabetes data being used inaccurately. For instance, findings will conclude that the "diabetes epidemic" will continue as obesity levels remain constant (Wild, et al., 2004), or that access to healthy food and exercise is a priority in lessening diabetes prevalence in the DR (Dethlefs, et al., 2018), however, these findings are based on type 2 diabetes, yet continue to aggregate both data sources to inform findings.

The aggregation of type 1 and type 2 diabetes is a prominent issue because type 1 diabetes is not caused by a lack of exercise, diet choices, or other lifestyle factors, but is an autoimmune condition that is unpreventable and incurable. While type 2 diabetes can be prevented by lifestyle choices and the impact of the disease can be lessened by medication and lifestyle habits, people with type 1 diabetes must rely on insulin for the remainder of their life as their pancreas no longer functions at all. People with type 2 diabetes generally can still produce insulin and with the assistance of a medical team and further education, can lessen the impact of the disease. This care is, therefore, significantly different from the level of care type 1 diabetics receive, and the care that people with T1D require is often much more comprehensive and intensive. By combining these data sources in existing research, individuals with type 1 diabetes are being overlooked, and do not receive adequate care when data is being used to inform health programs and policies that will impact people with type 1 diabetes. This research will address this issue by first only focusing on type 1 diabetes and the issues it poses in the Dominican Republic, and second, by providing solutions to gaps in care that address the unique issues facing type 1 diabetics in the Dominican Republic.

The second issue within existing research is not the aggregation of type 1 and type 2 diabetes (T2D) data, but the overall lack of type 1 diabetes-specific research to begin with. Most likely because type 1 diabetes comprises only 5-10% of those with diabetes in the Dominican Republic, as well as the nature of the disease being unpreventable, researchers tend to focus on the disease (T2D) that is more prevalent and preventable. Within existing literature, researchers can determine recent incidence rates of type 2 diabetes in the DR (there is none for T1D available since the 1990s), and there is available research on other intersecting issues such as

diabetes-related stress in the rural Dominican Republic (Gonzalez Rodriguez, et al., 2019), or the effectiveness of specific type 2 diabetes programs in poorer regions of the DR (West-Pollak, et al., 2014). Many of the issues that are analyzed would be important issues under a type 1 diabetes lens as well, however, this research simply does not exist in the abundance that type 2 diabetes research does.

Both of these issues; the aggregation of type 1 and type 2 diabetes data, and the lack of specific type 1 diabetes research in the DR, have significant implications when pursuing policies and programs that improve the level of care people with type 1 diabetes receive. Because poor self-management of T1D can lead to adverse health outcomes, it is necessary to minimize these through increasing access and communications with comprehensive care teams, incorporating technology into treatment plans and providing affordable access to medication and procedures for monitoring glucose levels (Duska, et al., 2021). However, if type 2 diabetes remains the focus of research, these solutions will either cater to people living with type 2 diabetes with an asterisk of type 1 or will entirely disregard the type 1 population in favor of serving the larger population of diabetics. The solutions proposed in most literature on type 2 diabetes or "diabetes" in general emphasize weight loss, exercise, diet, and additional medications, which all refer to people living with type 2 diabetes.

Proposed programs include increasing access to healthier foods through community gardens, or collaborating with small neighborhood stores to increase fresh food options (Gonzalez Rodriguez, et al., 2018). Other solutions based on this literature include intervention programs that train Dominican community members to advise others on issues such as healthy nutrition, weight loss, and physical activity relating to diabetes or other "lifestyle modification" programs (West-Pollack, et al., 2014). These programs are beneficial to Dominicans with prediabetes or type 2 diabetes, but they do not provide solutions for individuals living with type 1 diabetes. While type 1 diabetics do need to maintain a good balance between nutrition and exercise, this is in conjunction with insulin therapy, blood glucose monitoring, and other complex topics that cannot be managed by community advisors or controlled with the addition of community gardens. The existing literature primarily focuses on type 2 diabetes, and therefore solutions to type 2 diabetes management and prevention. The current level of

literature and data on type 1 diabetes is insufficient and does not allow for the same level of analysis and interpretation that type 2 diabetes literature does. This research will fill in gaps in existing type 1 diabetes literature and provide an analysis of potential improvements to the current Dominican health system through a type 1 diabetes lens, as opposed to generalizing all subsets of diabetes or adapting existing structures of type 2 diabetes care to fit the very different needs of type 1 diabetics.

Healthcare and Society

The Dominican Republic guarantees quality healthcare to all Dominicans through Article 61 of their constitution under the "Right to health" (Dominican Republic's Constitution). The article states that all Dominicans should have access to "means for the prevention and treatment of all sicknesses, ensuring access to quality medication and giving medical and hospital assistance for free to those who need it" (Dominican Republic's Constitution). While the Dominican Republic guarantees access to healthcare, many Dominicans do not have access to the quality providers, services, and medications they were promised. This lack of quality, affordable, accessible care particularly impact patients who have chronic health conditions, as conditions like type 1 diabetes require constant self-management and a lifelong reliance on the healthcare system.

The structure of the Dominican healthcare system is complex and has been experiencing a series of reforms throughout the last few decades aimed at achieving universal healthcare for all citizens. Aiming to meet the United Nations Millennium Development Goals (MDGs), much of these reforms focus on issues of equity, such as providing widespread primary care health resources, improving accessibility to low-cost, high-quality medications, and increasing health insurance coverage (Pan American). Following the passage of the General Health Law in March of 2001, a series of reforms created the National Health System (NHS) alongside the Social Security System, allowing the regulation of health activities by the State (Pan American). These reforms develop principles of universal coverage and established organizational bodies including the Bureau of Occupational Health and Safety (SISALRIL), the National Health Insurance Authority (SENASA), and the Bureau of Consumer Information and

Protection (DIDA), which began operations in 2002 (Pan American). Following these original reforms, in 2005, a Strategic Agenda and Critical Roadmap for Health Reform was developed, strengthening the Ministry of Public Health and Social Welfare (SESPAS), the organization of public health programs and public health networks as well as ensuring principles of equity and universal coverage for disadvantaged populations (Pan American). Since these reforms in the early 2000s, healthcare coverage has increased to almost 70% of the population, from 21% in 2002 (Pan American). The most recent re-structures of the system aim to achieve universal coverage through compulsory enrollment, comprehensive care, and gradual implementation (Pan American).

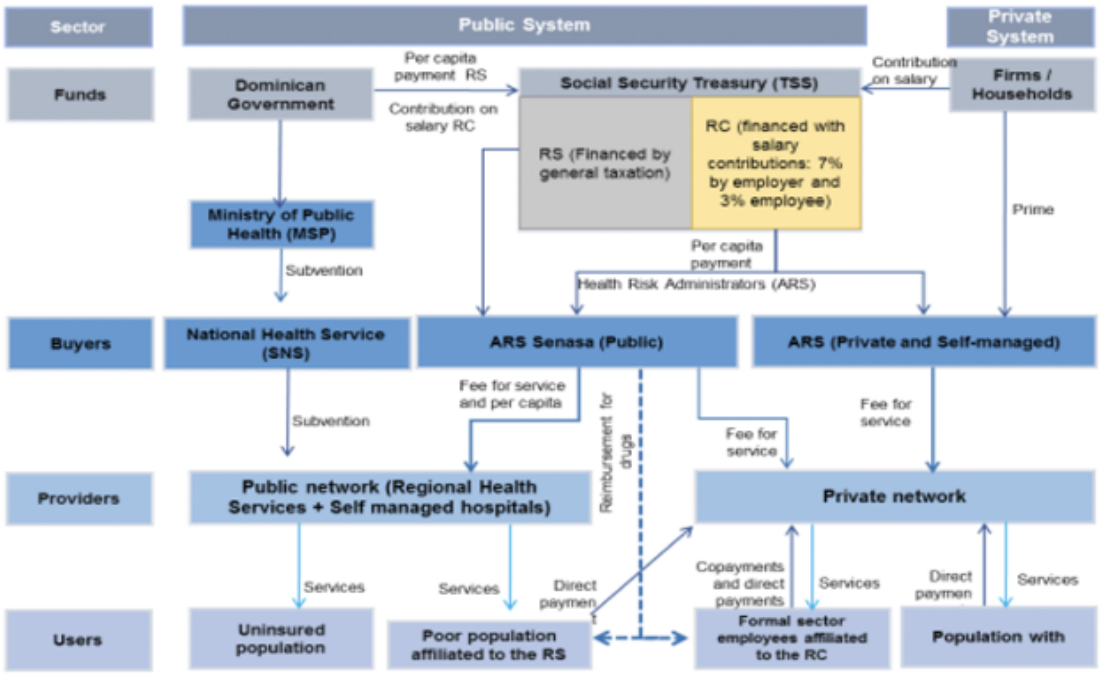

Figure 2: Health System in the Dominican Republic (Rathe, 2018)

These healthcare reforms have created the Régimen Subsidiado, and the Regimen Contributivo, or the Subsidized Regime and the Contributory Regime. The structure of the system can be analyzed in Figure 2: Health System of the Dominican Republic, a map of the healthcare system pictured above (Rathe, 2018). This diagram demonstrates the private and public portions of the Dominican healthcare system and elaborates on its complexities. As demonstrated in this diagram, the health system is split into two sections, private and public. These are then further delineated by the next level of the Social Security Treasury (TSS) which

finances both private and public health services. The low-income population is served via the National Health Insurance Authority/National Health Service which purchases services (i.e. pays for healthcare) from the public network (on the left side of the diagram) which is subsidized by the Ministry of Public Health (Pan American). Aiming to insure the entire population, health insurance is extended through public and private actors known as Health Risk Administrators (ARS) (located in the middle and right side of the 'Buyers' diagram). ARS guarantees quality, and timely care and aims to create efficient levels of care through contracts with health service providers, both publicly and privately (Pan American).

The Subsidized Regime is subsidized through general taxes which contribute to a common fund of Family Health Insurance that provides care to the lower-income populations (Rathe, 2018). Whereas, the Contributory Regime is contributed to by individual firms and households, usually through salary contributions from employees and by the employer. In addition to the Social Security Treasury (TSS) within the public system, the private system can be directly contributed to, to access only the private network as well.

While all Dominicans are guaranteed healthcare, the underinvestment in the public system and network has led to the creation of a robust private healthcare system to fill these gaps in care. Because the Dominican government has not significantly invested in their healthcare system at the same level as both global and Latin American investments, many Dominicans needed quicker, higher quality, and more accessible care that was not being supported by the public sector. This need was filled by the private healthcare sector. In terms of healthcare facilities, the majority of facilities in the DR are private (74%) (Ortiz, 2017), and the private sector remains the preferred option for most patients due to the level of services and options it provides (Rathe, 2018). For type 1 diabetes patients, in particular, supplies like insulin pumps, continuous glucose monitors, and multiple daily injections are generally not available within the public sector due to high costs, however, these management types provide superior care to the management options in the public sector (fixed-dose management). This means that regardless of one's socioeconomic status and ability to pay, if one wants the best level of T1D care, at the current care coverage and costs, they must invest in private healthcare.

While health insurance coverage is provided to almost 70% of its citizens through the Family Health Insurance plan, around three million people (27% of the population) were uninsured in the DR in 2016 (Rathe, 2018). Many within the uninsured population are considered vulnerable, yet do not meet the official poverty criteria to qualify for social benefits due to their positionality within the informal sector (Rathe, 2018). Unable to qualify for employer-based health insurance or state-subsidized programs, this gap in coverage leaves many without access to the healthcare system (Rathe, 2018). This is a significant issue for the DR, as most of those who cannot qualify are workers in the informal sector, and with around 47% of the working-age population acting as informal labor (ENFT), many workers are left uninsured. Since healthcare coverage is greatly impacted by one's socioeconomic status and income, the healthcare system inequitably serves patients with higher incomes, who can afford the high out-of-pocket costs or premiums. There have been some proposed reforms to address the uninsured population, however, nothing substantive has occurred because of the proposed reforms.

Arguments and Evidence

Type 1 diabetes is a chronic, autoimmune, lifelong condition, and those living with T1D are heavily involved in the healthcare system. Successful T1D management includes regular appointments with care teams, necessary education on how to inject insulin and test blood glucose levels, and the required medical supplies and prescriptions. Therefore, a responsive, well-funded, high-quality healthcare system is necessary to provide the support that those living with T1D need to successfully manage their condition. However, currently, T1D patients in the Dominican Republic are not receiving appropriate care to successfully manage their type 1 diabetes with high costs associated with care, geographic barriers, and overall underinvestment in the Dominican healthcare system.

High Costs & Socioeconomic Implications

Globally, type 1 diabetes is one of the most expensive diseases to manage, with high costs as a barrier to receiving care from endocrinologists and T1D care teams, as well as

expenses related to insulin, supplies (syringes, glucose testing strips/meters), and T1D technology (insulin pumps, continuous glucose monitors (CGMs)). There is a prominent connection between socioeconomic status and one's ability to regularly access medications like insulin, and studies have highlighted how living with T1D in the DR has a detrimental impact on T1D treatment adherence and quality of life (Gutiérrez Martinez, et al., 2021).

The consequences of these high costs, both with and without health insurance, result in lower use of recommended diabetes technology like insulin pumps, continuous glucose meters (CGM), and necessary supplies like insulin (Gutiérrez Martinez, et al., 2021). Depending on one's socioeconomic status, this under reliance on medical supplies is even more noticeable, as patients whose income is less than 700 USD a month do not seek out as much medical attention as they should due to high costs and are more likely to ration insulin (Gutiérrez Martinez, et al., 2021). These high costs result in patients using their income instead of health insurance to buy T1D supplies, with over half of patients claiming they had rationed insulin due to cost and over two-thirds that had checked blood glucose less often than recommended due to costs (Gutiérrez Martinez, et al., 2021). Rationing insulin, checking blood glucose less than recommended and being unable to utilize technology like insulin pumps or CGMs (continuous glucose meters) all contribute to worse type 1 management, leading to long-term health complications and costs for both the patients and the healthcare system.

While there are few studies on the exact costs of insulin, the World Health Organization estimates that for the Spanish Caribbean, the cost of insulin is around USD 159.50 (Barcelo, et al., 2003). Similarly, the costs for fixed-dose management to insulin pump therapy range from 72.74 USD/month to 996.07 USD/month, resulting in an increased economic burden on patients (Gutiérrez Martinez, et al., 2021). This impact of high costs is especially prevalent for patients with lower incomes, as if family income is less than 40,000 DOP (Dominican Pesos), patients experience less access to supplies, lower administration of insulin doses, less use of glucose monitoring, and more cost-related factors that limit seeking medical attention (Gutiérrez Martinez, et al., 2021).

Table 3 below further elaborates on the costs associated with different T1D treatment regimens in the DR. FD (Fixed-Dose), which is the most affordable option for both private and

public healthcare, is the only option for management within the public sector (Gutierrez Martinez et. al, 2021). Fixed-dose regimen requires a specific amount of insulin to be given at specific points during the day (such as meals), but the dose amount does not change depending on carbohydrates, patients must instead manage their carbohydrate intake and decrease or increase it depending on their range. This method is considered one of the least flexible methods of management and compared to insulin pump therapy and multiple daily injections (MDI), provides worse type 1 diabetes outcomes. Differing from the public sector, the private sector offers fixed-dose (FD), multiple daily injections (MDI), and continuous subcutaneous insulin infusion (CSII/insulin pump therapy). While the private sector provides the three main methods of T1D management, these methods have different costs associated with them. CSII is the most expensive, at almost USD 1000 a month, compared to $271 for MDI and $84 for a fixed-dose regimen (Gutierrez Martinez et al., 2021). CSII has been shown to improve T1D outcomes because it allows for more convenient and precise insulin dosing, yet it is extremely costly in the DR, around 540% of the national minimum wage and 143% of the mean household income (Gutierrez Martinez et. al, 2021).

Healthcare sector	Treatment regimen	DOP	USD*	Percent of NMW[b]	Percent of M
Public	**FD**	$4,222.00	$72.74	39.46%	10.48%
	MDI [a]	N/A	N/A	N/A	N/A
	CSII [a]	N/A	N/A	N/A	N/A
Private	**FD**	$4,882.00	$84.11	45.63%	12.11%
	MDI	$15,829.50	$271.05	147.94%	39.28%
	CSII	$57,812.00	$996.07	540.30%	143.45%

DOP: Dominican pesos; **USD:** United States dollars; **FD:** fixed dose; **MDI:** multiple daily injections; **CSII:** contin subcutaneous insulin infusion; **NMW:** national minimum wage, **MHI**: mean household income
The average minimum prices for each product were utilized
[a] Not commercially available at public sources
[b] NMW= 10,700 DOP
[c] MHI= 40,300 DOP
* USD= 58.04 DOP as of January 27, 2021

Table 3: Total monthly cost of treatment (Gutiérrez Martinez, et al., 2021)

Underinvestment in the Dominican Healthcare System

Related to high medication costs, the issue of private vs. public health insurance is prominent in the type 1 diabetes community. Analyzing the use of private and public health insurance, patients with type 1 diabetes who were using private health insurance were still paying out-of-pocket costs, with less than 25% of supply coverage by insurance (Gutiérrez Martinez, et al., 2021). Household out-of-pocket medical spending is high, especially for T1D patients, and there remains a limited utilization of primary care centers, with specialized hospitals and centers (Rathe, 2018). This underinvestment of the healthcare system arises through the DR's 6.1% of GDP investment in the healthcare sector, which compared to other Latin American countries (8%) and globally (9.9%), is low (Gutiérrez Martinez, et al., 2021). It was originally this underinvestment that spurred the private health sector in the DR, which now disproportionately serves wealthier patients who can afford private healthcare.

T1D patients in the Dominican Republic are currently not receiving the level of care necessary for successful self-management, especially highlighting the lack of clear, comprehensive diabetes education programs upon diagnosis. When patients receive diabetes education from trained professionals, they learn about insulin adjustments, carbohydrate counting, use of glucose meters and other types of technology, and other critical aspects of patient education that allow patients to self-manage their T1D to prevent serious health complications (DiMeglio, et al., 2018). Yet, in the DR, only 29% of T1D patients are well educated on type 1 diabetes, the lowest education rate out of nine countries surveyed across Latin America (Gagliardino, et al., 2019), and studies have highlighted patients' overall low self-monitoring skills of their diabetes, potentially due to a lack of communication between patients and care teams (Duska, et al., 2021). This lack of education is almost as dangerous as a lack of access to insulin, supplies, and medical teams, as self-management is key to patients' ability to manage insulin dosing and adjustments, carb counting, or glucose checks.

The current structure of the Dominican healthcare system forces T1D patients to choose between paying high costs in the private sector and receiving higher levels of care or relying solely on the public system using the FD regimen and compromising treatment flexibility and

potentially long-term health outcomes. Further reforms of the healthcare system should reflect changing this inequality in costs and choices, especially as the DR commits to providing high-quality care for all citizens, regardless of their situation.

Geographic Barriers

Since very few studies on type 1 diabetes in rural regions in the Dominican Republic exist, most research on geographic barriers examines type 2 diabetes, due to its high prevalence rates in the DR. This research still holds merit when analyzing levels of care for type 1 diabetics, as although the methods of management and care will differ between the two types of diabetes, access to medications (like insulin), medical supplies, and medical professionals are necessary for both type 1 and type 2 diabetics. By analyzing type 2 diabetes patients in rural regions of the DR, this data highlights specific issues type 2 diabetic patients face, signaling the potential for these issues to also be applied to type 1 diabetic patients in the DR.

Studies highlight that the main issues within rural regions in the DR are inaccessible medications, supplies, and fewer medical professionals. Unaffordable medications impact around 25% of rural communities, which is critical for patients living with type 1 diabetes who need access to insulin and other medical supplies (Castro, et al., 2018). Regional inequalities also highlight the distribution of most healthcare resources concentrated in the urban area of Santo Domingo (Rathe, 2018). While the Dominican Republic has a typical ratio (2.1) of physicians, this ratio does not take into account the rural and urban differences in care (Rathe, et al., 2017). Since the ratio in the urban center of Santo Domingo is 5.1, the national average is skewed, highlighting the distinct inequalities in care between rural and urban areas (Rathe, et al., 2017).

In general, all Dominicans living in rural regions of the country receive worse care than their urban counterparts. Since type 1 diabetics rely heavily on access to medications and medical professionals, a lack of access for all Dominicans will greatly impact type 1 diabetics in particular. The main issue impacting rural Dominicans seeking healthcare resources is the lack of healthcare facilities in rural regions of the Dominican Republic (Carman, et al., 2003). Individuals in rural Dominican regions are traveling twice as long to reach public healthcare facilities as

their urban counterparts, and around four times as long to reach private healthcare facilities (Thind, et al., 2003). This gap in care for rural Dominicans impacts patients living with type 1 diabetes in particular, as most access private care to maintain high levels of T1D management, yet private care is even more unattainable in rural regions than public care. Overall, Dominicans in rural regions don't have the same level of access to medical facilities, professionals, and medications and supplies that patients in Santo Domingo do, forcing patients to either overcome these geographic barriers or receive less adequate or frequent care.

Case Studies

Attempting to address the issue of how the Dominican Republic can better meet the health-related needs of its citizens with type 1 diabetes, comparable case study countries were examined to better understand the impact of specific proposed solutions. Highlighting the United States, Ecuador, Colombia, and a brief 9-country study, each case study emphasizes the potential success of specific programs, policies, and investments to increase accessibility to T1D care in the DR. The main solutions outlined include training of primary care providers (PCP) to act as diabetes specialists in remote regions, virtual healthcare options, and diabetes education programs.

PCP Trainings: Ecuador and the United States

As geographic location presents a large barrier for T1D patients in rural regions of the Dominican Republic, solutions to these barriers include programs such as virtual healthcare or telehealth, expanding the availability of T1D specialists, or training existing medical professionals. Since primary care providers are generally untrained in the endocrine system, most T1D patients must visit a T1D specialist or an endocrinologist, yet this can be inaccessible for patients in rural regions or at medical centers with fewer resources. The training of PCP providers can occur virtually or in person and provide ways for rural T1D patients to still receive quality care.

In Ecuador and the United States, researchers analyzed the role of primary care providers (PCPs) in providing enhanced T1D management for patients. The implementation of

the Project ECHO (Extension for Community Health Outcomes) model aims to increase confidence in primary care providers' management of complex T1D cases (Cuttriss, et al., 2021, Walker, et al., 2021). In the United States, Project ECHO was implemented in 'high need' areas of two states, with participating centers offering weekly virtual support in complex T1D decision-making, a diabetes support coach, and online diabetes resources (Walker, et al., 2021). Following the implementation of Project ECHO, PCP participants indicated high satisfaction with the program with overall improvements in diabetes knowledge and confidence (Walker, et al., 2021). As a recent program, the ECHO pilot program was successful in highlighting the proof of concept for T1D PCP training programs to serve rural communities with scarce access to these specialists.

Similarly in Ecuador, researchers used Zoom to recruit and train medical workers at 8 different primary care centers associated with the Ecuadorian public health system (Cuttriss, et al., 2021). The same program, Project ECHO was implemented in each of these centers and was the first pilot program to adapt the U.S. project to a Latin American country. Implemented in 2019, this program was unexpectedly suspended before the final collection of results due to the COVID-19 pandemic. However, the participation of medical centers and professionals in conjunction with the use of telemedicine highlights the existing interest in Ecuador. Additionally, the success of Project ECHO in the U.S. emphasizes the pre-established success of this program in reaching rural T1D patients, replicable in the Dominican Republic.

Virtual Healthcare/Telemedicine: Colombia

Ensuring type 1 diabetes healthcare is accessible to widespread T1D populations, virtual healthcare/telemedicine provides alternative options of care for T1D patients who cannot see medical providers in person. Researchers in Colombia analyzed this type of care through an analysis of a virtual training program for patients upgrading to a hybrid closed loop (HCL) system on insulin pump therapy (Gómez, et al., 2021). Implemented as a way for patients to receive continuous care safely during the COVID-19 pandemic, this virtual training was conducted via

Zoom and Medtronic's CareLink System[1]. Since transitioning from a typical insulin pump to a closed-loop system requires in-depth training by qualified medical professionals and data follow-up appointments, COVID-19 presented a challenge to training T1D patients. Instead of physical, in-person training and follow-up appointments, researchers conducted virtual sessions on T1D education, and pump data interpretation skills provided by diabetes physicians, and education/nutrition teams (Gómez, et al., 2021). Following these training sessions, patients overall, experienced blood glucose levels in range, highlighting the success of virtual programs as measured through health indicators, as well as the broader implications of patients not needing physical, in-person training to achieve T1D goals (Gómez, et al., 2021). While this case in Colombia specifically highlights the success of virtual insulin pump training, virtual healthcare can be applied much broader to all types of type 1 diabetes care.

Diabetes Education: Colombia & 9-Country Comparison

While access to medical supplies and professionals is critical to proper T1D management, well-rounded type 1 diabetes care includes high-quality education and training. As a measurement of overall T1D healthcare access, researchers in Colombia analyzed the health conditions of patients following the completion of diabetes education courses. Out of the sampled patients, all recieved training on the use of insulin pumps, while around three-fourths recieved additional training on diabetes basics such as carbohydrate counting, use of basal rates, CGM data, etc. (Gómez, et al., 2013). Through this study, researchers found that beginning insulin pump therapy improved T1D outcomes, but most importantly, lower A1C levels were also improved with the completion of additional training on the devices and other management skills (Gómez, et al., 2013). Overall, patient education in Bogotá in conjunction with the use of diabetes technology led to reductions in HbA1c levels unachievable with insulin pump therapy alone. This study in Colombia highlights the importance and effectiveness of diabetes education in addressing health disparities in type 1 diabetic Dominicans.

[1] Medtronic is a medical device company that manufacteres insulin pumps and diabetes technology. Medtronic CareLink is software that analyzes raw data from insulin pumps, continuous glucose monitors, and blood glucose meters.

Focusing on a cross-regional analysis, a study across 9 Latin American countries (Argentina, Chile, Colombia, Dominican Republic, Ecuador, Guatemala, Mexico, Panama, and Venezuela), examined the impact of diabetes education, self-management, and glycemic control on type 1 diabetes patients in Latin America. In addition to accessible medical supplies and professionals, diabetes education similarly, had a positive impact on overall T1D management, as T1D patients in this sample who recieved this education were more likely to meet their HbA1c target goals (Gagliardino, et al., 2019). Following diabetes education, patients can self-manage blood glucose and insulin intake, in addition to increasing knowledge in skills like optimizing the use of T1D supplies and managing T1D throughout life events (Gagliardino, et al., 2019). Increasing access to both widespread health coverage and diabetes education was concluded to increase T1D care in Latin America, which can be more narrowly applied to the Dominican Republic, which has one of the lowest diabetes education rates in the region (Gagliardino, et al., 2019).

Implications and Recommendations

Type 1 diabetes patients in the Dominican Republic are experiencing lower levels of care due to various factors, including high out-of-pocket costs for supplies, geographic barriers for rural patients, and fewer resources from the Dominican government. Addressing these issues of care, case studies in Colombia, Ecuador, and the United States highlight potential policy solutions, programs, and investments that could be applied in the Dominican Republic. First, a broader recommendation involves a restructuring of the Dominican healthcare system. The current system has left around ⅓ of its population uninsured and therefore unable to receive subsidized care. This impacts all Dominicans, but especially those who live with chronic conditions like type 1 diabetes, as it requires high out-of-pocket costs that many type 1 diabetics may not be able to afford. Secondly, even within this 70% of the population who are insured (public, private, etc.), many patients still must pay exorbitant amounts for medical supplies and insulin pump therapy. Addressing these issues, the Dominican government must look at a larger restructuring of the system to insure this uninsured gap, in addition to more robust funding for the public sector, making it more comparable to the private sector.

Within this restructuring of the healthcare system, creating specific programs to address gaps in T1D care would also aid in increasing accessibility and affordability. The first recommendation is a standardized national type 1 diabetes education program that could be offered both in-person and virtually for patients. Type 1 diabetes education programs are a relatively low-cost and efficient way to increase overall T1D health and provide the skills patients need to successfully manage their T1D. Since the Dominican Republic currently has one of the lowest diabetes education rates in Latin America, increasing access to diabetes education is the first step in increasing overall T1D care (Gagliardino, et al., 2019).

The second recommendation is to address the high costs of medical supplies and out-of-pocket co-pays for patients with public and private health insurance alike. While this could be partly addressed through the restructuring of the health system as addressed above, specifically subsidizing high-cost treatments such as insulin pump therapy or fast-acting insulin could increase supply access for T1D patients with lower incomes. Currently, patients with low incomes on public health insurance only have access to lower-quality T1D treatments, which only perpetuates health inequalities between Dominicans with higher and lower incomes. Since treatments like insulin pump therapy result in better overall T1D outcomes, providing more affordable access to these resources would create a more equitable medical system for type 1 diabetics.

The third recommendation is to reimagine medical provider visits and training, looking to innovative solutions such as PCP training and virtual appointments/training to address gaps in diabetes specialists and endocrinologists. With gaps in access due to geographic barriers, income levels, and insurance types, training primary care providers on T1D management would both increase the number of existing medical providers for T1D patients, but would also create more accessible routes of care. Using programs like Project ECHO to train medical professionals would increase provider confidence in managing cases, and allow patients to see medical professionals that are geographically close to them. Additionally, providing options for virtual training and care through telehealth platforms allows for similar growth in accessibility, especially for patients in rural locations. Virtual training and appointments became increasingly

popular during the COVID-19 pandemic, and since then, have provided a relatively affordable, efficient way for providers to meet with patients.

Each of these recommendations addresses specific components of type 1 care inequities in the DR, however, a combination of all approaches would provide the most robust solution for these gaps in care. Each solution has its limitations, specifically in addressing the feasibility of the program or policy. Primary care provider training will primarily target rural health communities but will also require access to the internet and stable technology for medical professionals to receive weekly training. This solution, therefore, requires adjustments for rural areas that may not have high levels of technology and internet access. Second, virtual healthcare is a solid solution for those who cannot travel to receive in-person care, but again, relies on technology access which will consistently favor the wealthy. The incorporation of virtual healthcare options would then necessitate additional ways for Dominicans with lower incomes and fewer resources to still access virtual care, or utilize a different route of in-person care. Lastly, while diabetes education does not need stable technology, it does require travel to a specific location, and pre-existing knowledge and access to the medical system that provides this education. Since each of these recommendations has limitations in terms of feasibility in the DR, it is necessary to combine multiple approaches to address each specific need.

Conclusion

While the Dominican Republic has continually implemented healthcare reforms since the early 2000s, the current system still does not fully support patients living with type 1 diabetes in the Dominican Republic. Largely due to high out-of-pocket costs for supplies, geographic barriers to care, and overall underinvestment in the DR healthcare system, type 1 diabetes patients are both underserved and under-researched within the country. With severe long-term health implications for substandard T1D care, it is integral both in the short-term and long-term, that T1D patients have equitable access to affordable care and supplies.

Addressing T1D care in the DR requires further reforms of the existing healthcare system, in addition to the implementation of T1D-specific programs and policies. These strategies to increase T1D care include widespread type 1 diabetes education curriculum and

programs, further training of primary care providers on type 1 diabetes specifically, and the addition of telehealth as an option for routine T1D appointments and training. Moving forward, the Dominican Republic must explore the implementation of these recommendations to ensure they are providing access to high-quality medication and medical assistance to all, as is decreed in the country's constitution.

Lastly, limitations to this research include an overarching lack of data and research on recent type 1 diabetes trends, treatments, and prevalence rates in the Dominican Republic. Most research in the Dominican Republic focuses on the general topic of "diabetes" which combines both types of diabetes or specifically type 2 diabetes, making research specifically on type 1 diabetes difficult. Other limitations include the lack of primary data from type 1 diabetes patients in the Dominican Republic, as collecting this data, either quantitative or qualitative would provide a more robust understanding of the complexities of type 1 care in the DR. Moving forward, additional research is necessary to better understand the situation of T1D care in the DR, specifically regarding prevalence rates and trends, demographics, and other key individual-level factors that may impact one's access to care. Secondly, more research on the effectiveness of the recommended programs (PCP training & Project ECHO, virtual healthcare, and diabetes education) is necessary to understand what solutions provide the most efficient routes of care and should be further expanded for T1D patients in the Dominican Republic.

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