

INTER-AMERICAN DEVELOPMENT BANK

**SURINAME**

**HEALTH SERVICES IMPROVEMENT PROJECT**

**SU-L1054**

**MONITORING AND EVALUATION PLAN**

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## I. INTRODUCTION

This document describes the procedures, indicators and methodological basis of the Monitoring and Evaluation Plan for the Health Services Improvement Project (SU-L1054).

The objective of the program is to contribute to the reduction of the burden of disease in Suriname by improving access to high quality, integrated primary care services and enhancing the effectiveness of the health sector to address priority epidemiological challenges. The program will focus on financing strategies for NCD prevention and control and for malaria elimination and integration of services for other priority CDs within the MP.

- 1.1 **Component 1: Institutional strengthening of the MOH for evidenced-based policy-making (estimated US\$12.37 million).** This component seeks to improve the ICT and physical working environment platforms for the MOH to exercise core policy and technical functions.
- 1.2 **Subcomponent 1.1. Improved Health Information System (estimated US\$4.3 million).** This component seeks to improve the Health Information System in Suriname. Based on findings from the needs assessment (see ¶3.11), this subcomponent will finance: (i) technical assistance for updates to policies, standards and interoperability; (ii) design and implementation of data warehouse and dashboards; (iii) improved ICT infrastructure including servers, connectivity and hardware; (iv) design and implementation of the integrated clinical information system for expansion of the CCM and its respective costed maintenance plan; (v) Implementation and analysis of two rounds of the STEPS survey; and (vi) design and implementation of disease registries for CKD and cancer.
- 1.3 **Subcomponent 1.2. MOH headquarters and central services infrastructure (estimated US\$8.072 million).** This will consist of improvement to the physical working environment for the MOH to perform its core business functions, enhancing productivity and hence a more effective management of the health sector's priorities. All the MOH facilities will be concentrated in one site, located in Rode Kruislaan<sup>1</sup> which will be modernized to accommodate administrative and public health central services (i.e. vaccines, children with special needs, breastfeeding, health library). The works will include the reuse of abandoned/underused buildings and the construction of a new one, all incorporating green design criteria and climate change mitigation measures.<sup>2</sup> The subcomponent will finance: (i) the construction design of approximately 6,000m<sup>2</sup> and the landscape design of approximately 2.5 Ha; (ii) the retrofit of the existing buildings, new construction works and landscaping of the compound; (iii) the procurement of office furniture and equipment; (iv) the supervision of the construction works; and (v) the design of a costed maintenance plan.
- 1.4 **Component 2. Expansion of the CCM (estimated US\$3.84 million).** The objective of this component is to improve accessibility and quality of clinical pathways for non-communicable diseases. It will support improvement and expansion of an integrated, patient-centered healthcare model for diabetes in the

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<sup>1</sup> The selected site is property of the GOS, currently used for MOH facilities and located in an urbanized area.

<sup>2</sup> [Technical Analysis](#). Provides details on the infrastructure project, including assessment of existing conditions, architectural brief, program of space requirements and design criteria.

OSS of Paramaribo and Nickerie, and within approximately 18 RGD primary care facilities that already operate in these areas. Facilities will be selected based on results of a health care network demand and supply analysis. Financing will be provided for: (i) infrastructure upgrades and physical repairs; (ii) procurement of medical and non-medical equipment and supplies; (iii) design and implementation of a continuous quality improvement (CQI) strategy to optimize clinical and management processes related to the CCM; (iv) training of clinical personnel in core CCM protocols (i.e. footcare); (v) design and implementation of innovative patient education and activation strategies; and (vi) initial operating costs of equipment improvements to the CCM.

- 1.5 **Component 3. Increase access to priority services for communicable diseases in at risk population (estimated US\$1.5 million).** The objective is to sustain and improve the response to communicable diseases. This component will finance the following activities targeting the gold mining population: (i) design and implementation of culturally appropriate BCC strategies to reduce exposure to risk factors for malaria and HIV (i.e. promoting use of bed nets, increasing health seeking behavior) and improve adherence to treatment by at-risk population; (ii) specialized training for the MP and National Reference Laboratory personnel; (iii) training of MP personnel in BCC; (iv) equipment upgrades for the national reference laboratory and TropClinic surveillance; (v) technical studies; and (vi) training and laboratory and field equipment for HIV screening.
- 1.6 **Program Administration and Evaluation (estimated US\$1.665).** This budget line will support the operation of the PIU and project administration and evaluation activities, including the design and implementation of an impact evaluation.

## II. SUMMARY OF IMPLEMENTATION ARRANGEMENTS

The Borrower is the Republic of Suriname. and the Executing Agency (EA) will be the MOH. The Project Implementation Unit (PIU) established within the MOH will execute the project. The PIU will include a project manager and a specialist in each of the following areas: operations, procurement, financial management, architecture/construction, information technology, environmental health and safety, community liaison, and monitoring and evaluation. The PIU will strengthen the capacity of the Ministry of Health by working closely with assigned component technical leads from the Ministry of Health and will be responsible for financial management, procurement, and program management of the project. The PIU will be responsible for carrying out all the operational and fiduciary obligations (including procurement, financial management and social and environmental safeguards) necessary for program execution and for maintaining all formal communication with the Bank. Among other responsibilities, the PIU will be: (i) performing technical and operational coordination of the program; (ii) programming, approving and financing all projects and activities; (iii) supervising the formulation, execution, and evaluation all interventions; (iv) preparing and updating the Pluriannual Execution Plan (PEP), POA, Procurement Plan (PP), Risk Matrix (RM), and the Progress Monitoring Report (PMR); (v) preparing Terms of Reference, tendering and procurements of goods, construction works, services and consultancies; (vi) submitting disbursement requests and preparing financial statements; and (vii) contracting and supervising the program's mid-term and final evaluation. The detailed responsibilities of the PIU will be presented in

the Project Operations Manual (POM), which defines the rules, eligibility criteria, procedures and responsibilities during execution.

Chaired by the Director of Health of the MOH, a Technical Management Team will be established, comprising the MOH, OSS, BOG and RGD. This team will schedule quarterly meetings as part of the monitoring oversight mechanism for the project. These meetings will be the forum to monitor project progress, take relevant executive decisions and collectively resolve any coordination bottlenecks.

### **III. MONITORING**

The purpose of monitoring activities is to follow up program progress in achieving the expected results, as expressed in the Results Matrix (RM) and identify issues and problems during execution that can be corrected in due time. The monitoring program will be based on the RM, on the of activities described in the Annual Operating Plan (AOP), on the Multiyear Execution Plan (PEP), in the detail of the physical and financial performance of the products contained in the semiannual progress reports, and on the procurement procedures contained in the Procurement Plan (PP). The borrower will submit semiannual progress reports to the Bank. The borrower agreed to use the RM and the activities defined in the Program Monitoring Report (PMR), as the basis to monitor the program's implementation. Monitoring activities include also annual financial audits to verify the compliance with financial and administrative procedures required by the Bank.

#### **A. Indicators**

Monitoring activities will be guided by the indicators expressed in the program's Results Matrix, specifically those classified as output indicators. The following table includes these indicators, the planning of their expected progress, and source of verification.

**Table 1 – Output Indicators**

OUTPUTS		Estimate Cost (US\$)	Unit	Base line	Year					EOP	Verification source	
					2019	2020	2021	2022	2023			2024
	Component 1: Institutional strengthening of the MOH for evidenced based policy making											
Health Information System operational in MOH and CCM centers according to contract specifications (Phase 1)		2,000,000	System	0			1				1	Project annual monitoring reports and procurement documental evidence. Indicators for functioning will be defined in the TORS (ie. data generation, storage, processing and sharing)
Health Information System operational in MOH and CCM centers according to contract specifications (Phase 2)		2,000,000	System	0						1	1	
MOH and CCM units whose personnel has been trained in data analysis		500,000	Units	0			2	8			10	Training assistance reports
Steps survey administered		300,000	Survey	0		1			1		2	STEPS survey completion report and databases
Construction and landscape design developed according to TOR specifications		335,000	Design	0		1					1	Record of approval by PIU
Ruis existing buildings retrofitted according to contract specifications		1,1,750,000	M²	0		1,860	1,860				3,720	Records of delivery

OUTPUTS		Estimate Cost (US\$)	Unit	Base line	Year					EOP	Verification source		
					2019	2020	2021	2022	2023			2024	
MOH HQ building constructed according to contract specifications		3,540,000	M²	0				3,000			3,000	approved by PIU	
Landscaping works implemented according to contract specifications		1,200,000	Ha	0					2.5	2.5			
Maintenance plan delivered according to contract specifications		30,000	Plan	0					1		1	Document	
MOH work stations furnished and equipped according to contract specifications		900,000	Work stations	0				400			400	Record of delivery approved by PIU	
	Component 2: Expansion of the chronic care model												
Continuous Quality Improvement strategy implemented in CCM centers		300,000	CCM Centers	0				2	6			8	CCM centers with CQI: Action plan document, team established, and baseline indicators measured
CCM model guidelines updated		60,000	Guidelines	0	1							1	Guidelines documents
CCM centers with behavioral change and patient activation strategy implemented		170,000	CCM Centers	0					8			8	CCM centers
CCM centers with infrastructure upgrades completed		390,000		0	2		6					8	Reports of completion in accordance to contract specifications by the PIU
CCM centers with clinical equipment upgraded		900,000		0	2		6					8	
CCM centers with non-clinical equipment upgraded		420,000		0	2		6					8	

OUTPUTS	Estimate Cost (US\$)	Unit	Base line	Year					2024	EOP	Verification source
				2019	2020	2021	2022	2023			
CCM centers with clinical staff trained on guideline application	280,000		0				8			8	Training reports
CCM centers with supplies for equipment start up available	120,000					6				6	Reports of supply distribution
Primary care centers upgraded for CCM basic services provision (expansion phase 2)	1,200,000	Primary care centers	0						10	10	Record of delivery approved by PIU Upgrades for each center include minor infrastructure repairs and equipment installation according to needs assessment.
<b>Component 3: Increase the access to priority CD preventive services for targeted population</b>											
Communication and behavior change strategy designed	20,000	Strategy	0		1	1	1	1		4	Document approved by PIU
Communication and behavior change campaign implemented	492,000	Campaign	0		1	1	1	1		4	Campaign reports
MSD personnel trained for outreach activities	60,000	Training	0		1	1	1	1		4	Training reports
KAP surveys completed	90,000	Surveys	0			1	1	1		3	Study reports

OUTPUTS	Estimate Cost (US\$)	Unit	Base line	Year					2024	EOP	Verification source
				2019	2020	2021	2022	2023			
Longlasting bednets distributed to target population	109,000	Bednets	0			20,000				20,000	Bednet distribution report
Specialized trainings for data collection, processing and analysis at the national reference laboratory delivered	268,000	Trainings	0	1	3	2	3	1		10	Training reports
TropicClinic equipped with software and hardware for data analysis and processing	60,000	Equipment	0		1					1	Record of equipment receipt and installation
Parasitological microscopes available at selected locations	20,000	Microscopes	0		8					8	Record of microscopes delivery
Quality Assurance and Quality Control Guide developed	65,000	Guide	0	1						1	Guide document approved by PIU
Portuguese language training provided to Medical Mission clinics personnel located near mining areas	36,000	Training	0		1	1	1	1		4	Training completion reports
National strategy for provision of health services for priority infectious diseases to migrant populations elaborated	15,000	Strategy	0	1						1	Strategy document approved by PIU
Baseline prevalence study in migrant populations (HIV/Leishmaniasis, TB/Leprosy) completed	63,000	Study	0		1					1	Study report approved by PIU
Migrant study on population size, migration, turnover and health priorities completed	30,000	Study			1					1	
TropClinic HIV staff in and national counterparts trained annually	36,000	HIV TropClinic staff		1	1	1	1			4	Training assistance reports



[illegible]

## **B. Data Collection Instruments**

The data on the program outputs will be collected as indicated in Table 1, and consolidated by the PIU in the program's Administrative Information System (AIS), which will be financed by the loan as part the budget for Program Administration and Evaluation. The information for monitoring program progress will be provided to the Bank following the formats and indicators included in the Results Matrix (RM), Procurement Plan (PP), Multiyear Execution Plan (PEP) and AOP.

Most information will be generated by either: (a) acceptance of works documents presented by contractors to the PIU; (b) direct inspection visits by PIU personnel; and (c) certification of consulting works presented by consultants to the PIU for their corresponding payment. This information will be consolidated by the PIU in the program's AIS and reported semi-annually to the Bank. Annually, the information will be included in the AOP presentation and discussion process with the Bank. This will allow periodic evaluations to compare progress in achieving RM goals, including explanations whenever any variation is identified.

## **C. Progress Reporting**

The PIU will present periodic monitoring reports, based on consolidated information gleaned from the program's AIS. Reports based on this information will be used to update the Semi-Annual Progress Report and the Bank's Program Monitoring Report (PMR). A midterm evaluation will be undertaken. It will include: (i) the outcomes of the physical-financial execution; (ii) the degree of fulfillment of targets in the results matrix; (iii) the degree of fulfillment of environmental requirements and works maintenance; (iv) a summary of the results of the audits and of the improvement plans; (v) a summary of the main lessons learned. The midterm evaluation will be conducted in the second six months of the third year of implementation. The costs of preparing these products are included in the Program Administration Costs, used to pay for PIU personnel, auditing and program evaluation. See Monitoring Work Plan Table 2 below.

The borrower shall submit to the Bank annual Audited Financial Statements (EFA) within 120 days of the close of each fiscal year, duly audited by an independent auditing firm and semiannual progress reports prepared by the auditing firm hired.

The PIU will prepare and send to the Bank a final evaluation report which will serve as input for the Completion Report Project (Project Completion Report-PCR), 90 days counted from the date 90% of the loan has been disbursed.

## **D. Coordination and Monitoring Work plan**

The PIU will hire a Monitoring and Evaluation Specialist who will be responsible for the general program's monitoring activities, which include: (i) to develop, maintain and update the data regarding monitoring indicators; (ii) coordinate the collection and processing of information on program actions and prepare semiannual progress reports; (iii) identify problems, delays and external factors affecting the program proposing, where appropriate, remedial measures; and (iv) support monitoring internal meetings and program evaluation and supervision missions and evaluation of the Bank.

The Bank and the PIU will hold meetings twice a year to monitor jointly the progress in implementing the operation. Also, the PIU, in conjunction with the Bank, will hold official inspection visits at least once every quarter to assess the progress of the program. In addition, the Bank will meet with the Ministry of Health Technical Management Team at least once every quarter to assess general progress on the project.

When inspection visits identify delays in physical and financial implementation, appropriate measures will be established to identify: (i) the main difficulties in implementation, (ii) actions to overcome the difficulties; and (iii) the time and costs thereof.

**Table 2. Monitoring Work Plan**

Monitoring Activities	Year 1				Year 2				Year 3				Year 4				Year 5				Responsible	Source / Cost US\$('000)
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		
Technical Inspection Visits with PIU personnel																					PIU	Program/PIU staff support allocation
Consolidation of Information and presentation of semi-annual reports																					PIU	
Annual Operation Plan discussion with IDB Staff																					PIU/IDB	
Joint IDB/PIU Meetings																					PIU/IDB	
Bank Meetings with Technical Management Team for reporting on general Program progress.																					PIU/IDB	
Financial Audits																					PIU/consultancies	Program/US\$100
Midterm evaluation																					PIU	Program/US\$40
Project completion Report (PCR)																					PIU/IDB	Program/US\$50

#### IV. EVALUATION

Unlike most other groups of diseases, NCDs require management and control for extended periods of time, with high level of involvement of patients, and participation and coordination of multiple healthcare providers (Glassman et al, 2010). The full range of care for management of NCDs includes strategies from primary prevention (preventing the onset of disease by reducing exposure to risk factors), secondary prevention (preventing the full development of disease in patients by detecting early symptoms and treating diagnosed cases), treatment and rehabilitation of acute cases (e.g. cardiac surgery), and palliative care (improving quality of life for patients in life-threatening conditions). Given high costs treatment of acute cases, successful approaches to management and control of NCDs emphasize primary and secondary prevention, and patient involvement is particularly important at these stages (Demaio et al, 2014). In the case of Suriname, the rising incidence of type 2 diabetes mellitus has made its management and control a priority of its health system (Krishnadath et al, 2015). Table 3 below indicates the prevalence of diabetes in 2012, by province, according to the STEPS survey report.

**Table 3 – Prevalence of diabetes in Suriname according to STEPS survey, 2012.**

		Wanica	Sipali-wini	Sara-macca	Parama-ribo	Para	Nickerie	Maro-wijne	Coronie	Comme-wijne	Broko-pondo	Total
% population with diabetes		13.5	3.1	9.9	10.3	9.5	16.3	6.4	6.3	14.1	2.4	11
population		118,222	37,065	17,480	240,924	24,700	34,233	18,294	3,391	31,420	15,909	541,638
# persons with diabetes		15,960	1,149	1,731	24,815	2,347	5,580	1,171	214	4,430	382	57,778
Male	15-24	169	12	18	263	25	59	12	2	47	4	611
	25-34	609	44	66	947	90	213	45	8	169	15	2,204
	35-44	971	70	105	1,509	143	339	71	13	269	23	3,514
	45-54	1,416	102	154	2,201	208	495	104	19	393	34	5,125
	55-64	764	55	83	1,187	112	267	56	10	212	18	2,764
	65-80+	1,160	83	126	1,803	170	405	85	16	322	28	4,198
Male Total		5,087	366	552	7,910	748	1,779	373	68	1,412	122	18,416
Female	15-24	310	22	34	481	46	108	23	4	86	7	1,121
	25-34	453	33	49	705	67	158	33	6	126	11	1,641
	35-44	1,133	82	123	1,762	167	396	83	15	314	27	4,101
	45-54	1,006	72	109	1,565	148	352	74	13	279	24	3,643
	55-64	1,138	82	123	1,769	167	398	83	15	316	27	4,119
	65-80+	2,475	178	268	3,847	364	865	182	33	687	59	8,958
Female Total		6,514	469	706	10,129	958	2,278	478	87	1,808	156	23,583

While guidelines and protocols of clinical interventions have already been thoroughly developed in the literature and there are effective pharmacological treatments for most cases (McGuire et al, 2016), successful treatment also depend that patients adhere to prescribe treatment taking pills regularly, monitor basic health indicators such as weight and blood sugar levels, maintain a healthy diet and engage in physical activity, and abstain from smoking and excessive alcohol consumption (NICE, 2017). In this case, effective

interventions have been less documented in the literature, especially in the context of the Caribbean region. Therefore, the evaluation component of the current project will focus on behavioral change for risk factors for NCDs, particularly type 2 diabetes mellitus.

### **A. Existing evidence base**

On providing high quality services, evidence indicates that health systems that adopt the Chronic Care Model (CCM) within primary health care are more effective and efficient in managing and controlling NCDs (Hansen et al 2015; Bodenheimer et al 2002). The CCM's principle is patient-centered care, meaning patients are treated holistically (i.e., considering context, all health problems and needs), and are supported in learning self-management of their condition (Mahomed et al, 2015). Healthcare teams develop patient-centered treatment goals, plans, and interventions, implementing them across the full care pathway. The delivery network is set up to provide multidisciplinary primary care that covers the entire population, serving as a gateway to the system which integrates and coordinates health care across levels, including the community (Scholl et al 2014).

Evidence shows that in this supported context, interaction between informed, engaged patients and proactive primary care teams sustainably and consistently improves clinical results (Cramm and Nieboer 2014). To achieve the largest improvements in health outcomes, the literature and country experiences point towards actions in the following specific areas for CCM development: (i) digital information systems (electronic records, disease registries); (ii) tools for planning and quality improvement; (iii) decision support tools for providers (guidelines); (iv) integration of services (multi-disciplinary care delivery, care coordination mechanisms); (v) self-management support for patients (education, behavior change incentives); and (vi) creation and leverage of community resources (Gaudreault and Muhire, 2014).

Research shows digital tools make important contributions to the provision of chronic care and the CCM at scale, when patients and providers are connected through a complete feedback loop to share data and information about the patient, compare this information to knowledge and wisdom found in evidence-based standards, provide personalized and timely care to the patient, and monitor results through regular feedback and interaction.<sup>3,4</sup> The use of mobile health (mHealth) tools, such as SMS messages, medication reminders, symptom monitoring, educational tools, and facilitated patient-provider communication to increase adherence targeting low-income, elderly, and minority groups have been found to lessen the burden of travel to a care provider for elderly patients. Additionally, mHealth tools have facilitated better management and improved patient confidence to monitor chronic diseases, making the patients feel in control and strengthening coping mechanisms.<sup>5</sup> Telehealth, or the remote diagnosis and treatment of patients by means of telecommunications technology, has been especially effective in the management of chronic diseases, and has demonstrated improvement in outcomes (diabetes), empowerment and self-management (diabetes and high-risk dialysis patients) and is

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<sup>3</sup> Gee, P. M., Greenwood, D. A., Paterniti, D. A., Ward, D., & Miller, L. M. S. (2015). The eHealth enhanced chronic care model: A theory derivation approach. *Journal of Medical Internet Research*, 17(4), e86. <https://doi.org/10.2196/jmir.4067>

<sup>4</sup> Based on lessons learned from SMI, this includes intentionally designing information flows back down the system to encourage not only quality and timely reporting, but for use at the front lines.

<sup>5</sup> Hamine, S., Gerth-Guyette, E., Faulx, D., Green, B. B., & Ginsburg, A. S. (2015). Impact of mHealth chronic disease management on treatment adherence and patient outcomes: A systematic review. *Journal of Medical Internet Research*, 17(2). <https://doi.org/10.2196/jmir.3951>

viewed as a powerful resource for improving health outcomes, health care quality, and to promote patient engagement.<sup>6</sup> As mobile-cellular subscriptions are high in Suriname (141.3 per 100 inhabitants)<sup>7</sup> mHealth and telemedicine may provide an opportunity to improve patient adherence and aid in follow-up. To our knowledge, no rigorous evaluation of the impact of self-care support component of the CCM on type 2 diabetes in the context of the Caribbean region has been published in the peer-reviewed literature so far. Elsewhere, a recent review (Baptista et al, 2016) has identified ten studies that addressed user empowerment for patients who manage their own care. A few of these studies have identified impacts on relevant clinical outcomes, but the evidence is still inconclusive. Recent publications have begun to tap into other sources of innovation for diabetic care, namely the use of information and communication technology (ICT) and insights from behavioral economics. In this context, three promising lines of interventions to promote behavioral change and improve patient empowerment are described below.

First, telemedicine for patient education on primary and secondary prevention of diabetes and other NCDs has been identified as a promising strategy to deliver of education sessions for patients via videoconferences linking primary care centers and specialized reference centers (Warmington et al, 2017; Powers et al, 2015). These types of intervention could be the design and implementation of a patient-education course, or adaptation of existing courses with more specific messages.

Secondly, telemedicine for patient-physician communication (e.g SMS or websites) that allows for reporting of blood sugar levels and medication adjustment. Literature suggests that methods to improve communication of patient and doctors for adjustment of medication is a promising strategy to improve clinical outcomes (Faruque et al, 2017). This intervention could be the design of a shorty message service (SMS, WhatsApp, or any other text service channel), or a webpage service that can help improve the flow of communication between doctors and patients for simple questions related to medication adjustment for patients who need to constantly monitor their blood sugar levels.

Thirdly, the literature on behavioral economics has provided important insights for improved prevention and management of diabetes. Potential approaches have been suggested in the literature, as identified by Kullgren et al (2017): (a) financial incentives - for example, offering a financial reward to people who achieve a physical activity goal; (b) choice architecture modification - for example, using color-coded labeling and increased visibility to encourage healthier food choices; and (c) commitment devices - for example, asking people who want to lose weight to put money into a "deposit contract" in which they will lose their deposit if they do not achieve a weight loss goal.

## **B. Evaluation design**

### **a. Evaluation Questions**

The evaluation will test the use of mHealth, telemedicine (teleconference, SMS, videos, apps) and behavioral economics (incentives, messaging, gamification) to improve patient activation, adherence to appointments and treatment and health outcomes related to diabetes. The following questions will be addressed:

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<sup>6</sup> See above.

<sup>7</sup> Digital health in the Americas. PAHO, 2017

1. What is the impact of mHealth/telemedicine on patient activation?
2. What is the impact of mHealth/telemedicine on adherence to diabetes treatment?
3. What is the impact of mHealth/telemedicine on clinical outcomes associated with diabetes?

#### **b. Evaluation's Outcome Indicators and Data Sources**

The section below describes the main indicators to be used across the three domains of the evaluation: (i) Patients with skills, knowledge and motivation; (ii) Adherence to diabetes treatment; and (iii) Clinical Outcomes associated with diabetes.

##### **i. Patients with skills, knowledge and motivation**

- **Patient Activation Measure (PAM):** According to Hibbard et al (2013), "patient activation is defined as understanding one's own role in the care process and having the knowledge, skills, and confidence to take on that role", and the PAM is a validated assessment of thirteen items that ranks patients according to four different levels of activation. Evidence indicates that patients with higher scores are associated with lower costs (Hibbard et al, 2013) and better health outcomes (Greene et al 2015).

**Data sources:** PAM requires the application of a specific questionnaire to recruited patients.

##### **ii. Adherence to diabetes treatment**

- **Compliance to self-monitoring of blood glucose (SMBG):** There is evidence that SMBG can improve metabolic control in patients with type 2 Diabetes Mellitus, reduce complications from the disease, and it has been recommended by guidelines issued by several professional organizations. Compliance to SBMB has been measured in the literature as the average weekly frequency over 90 days, and poor compliance can be assessed in comparison with physician recommendations for each case (Hu et al, 2017).
- **Regular use of prescribed medication:** Medication adherence is a validated determinant of health outcomes in patients with chronic to diabetes, and it is associated with lower probability of hospitalization, lower costs to the health care system, and lower mortality rates. Given the difficulty in assessing whether patients actually have taken prescribe medication, medication possession ratio (MPR) has been used in the literature as a proxy measure, which relies on prescription refill patterns (Kirkman et al, 2015).
- **Attendance to regular check-ups:** Attendance to regular checkups has been shown to improve diabetes management (Wagner et al 2001). International guidelines generally agreed that diabetic patients should have 4 consultations per year, and four HbA1c tests per year (Renard et al 2013).

**Data sources:** Compliance to SMBG, regular use of prescribed medication (measured as MPR) and attendance to regular check-ups is routinely collected

clinical data, and therefore, they can be extracted from clinical histories. Due to the absence of electronic health records in the country, these data need to be collected from individually at each participant clinic.

### iii. Clinical Outcomes associated with diabetes.

- **Levels of HbA1c:** Glycated hemoglobin (HbA1c) is a standard and widely accepted measure of blood sugar levels for managing diabetes and is used to diagnose diabetes and to identify people at risk (Diabetes Prevention Program Research Group, 2015). National guidelines will be used to assess levels of HbA1c.
- **Avoidable hospitalizations for diabetes:** Several studies have identified potentially avoidable hospitalizations for conditions that could have been prevented with better management at the primary health care level. According to Purdy et al (2009), the following codes from the international classification of diseases, tenth revision (World Health Organization, 2016), all refer to avoidable complications from diabetes: Diabetes mellitus (E10.0-E10.1), Type 2 diabetes mellitus (E11.0-E11.1), Malnutrition-related diabetes mellitus (E12.0-E12.1), Other specified diabetes mellitus (E13.0-E13.1), Unspecified diabetes mellitus (E14.0-E14.1).
- **Complications of uncontrolled diabetes:** Previous studies have identified five major types of severe complications of uncontrolled diabetes: lower-extremity amputation, end-stage renal disease, acute myocardial infarction, stroke, and death from hyperglycemic crisis (Gregg et al, 2014).

**Data sources:** Levels of HbA1c is also regularly collected clinical data, that can be extracted from patient's histories at each participant clinic. Avoidable hospitalizations for diabetes and incidence of complications of uncontrolled diabetes are regularly collected epidemiological data that can be extracted from hospital discharge records and from death certificates.

### c. Evaluation Methodology

As indicated previously, component 2 will support improvement of an integrated, patient-centered CCM that currently exists in two "One Stop Shop" (OSS) clinics for diabetes in Paramaribo and Nickerie, and expand it to 28 primary care facilities of the RGD. Patients who have been diagnosed with type 2 diabetes mellitus are referred to these services, where they are expected to receive a comprehensive package of continuous management and control of their condition. Table 4 below describes the current network of RGD, where the CCM/OSS approach will be implemented.

**Table 4 – Current network of RGD (total n = 56)**

	<b>Health Center (n = 11)</b>	<b>Mid-sized clinics (n = 35)</b>	<b>Small clinics (n = 10)</b>
Blood glucose punctures	X	X	X
Possibility for DM counseling	X	X	X



Possibility for HIV counseling	X	X	X
Possibility of consultation bureau	X	X	X
Provide care for schools	X	X	Yes, but in collaboration with the larger clinics
Pharmacy	X	Pharmacies and/or childbirth-units and/or Ambulance, but never all 3	Some have a small pharmacy with limited opening hours
Childbirth Unit	X		---
Ambulance	X		---
Specialist care (internists, pediatrician/gynecologist), including admission capacity	Under discussion	---	---

To provide a causal estimate of the effect of the expansion of the CCM on primary outcomes in the results matrix a first approach will be to perform a Difference-Difference (DID) strategy at the RGD catchment area level, exploiting the variation in timing and location of the program's start. The data sources include the administrative and clinical data described previously in addition to the results of the STEPS surveys to be financed by the program. STEPS surveys are nationwide study on NCDs and their risk factors, that use a stratified multistage cluster sample of households to select respondents, the last one performed in 2012 included 5700 participants aged 15-65.

As a second approach to evaluation, a three-arm randomized control trial is proposed to test effectiveness of the telemedicine/Mhealth and behavioral economics interventions. A random sample of at least 300 patients will be recruited at each of the 8 participating health centers, yielding a total expected sample of 2,400 patients. Patients will be randomly assigned with probability of 1/3 to one of the following groups:

- (1) Treatment 1: Offered telemedicine intervention for education of primary and secondary prevention of diabetes + care following standard clinical guidelines
- (2) Treatment 2: Offered behavioral economic interventions for prevention and treatment of diabetes + care following standard clinical guidelines
- (3) Control group: offered care following standard clinical guidelines

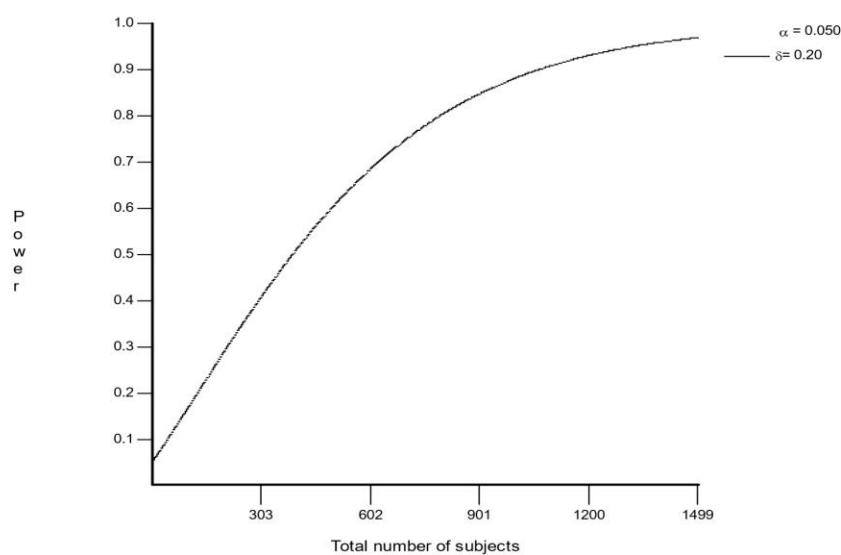
#### **d. Sample Selection and Statistical Power**

The sample will be randomly selected from patients who were diagnosed with type 2 diabetes mellitus or pre-diabetes, according to national guidelines and protocols, and referred to one of the 28 centers where the OSS/CCM has been implemented, according to the design of the program. Sample size will be calculated to obtain 90% statistical power at the 5% significance level, considering minimum detectable effects, and intracluster correlation for patients.

Assuming a rate of non-compliance and attrition no greater than 30%, the sample is powered at the 90% level (significance 0.05 and assuming individual level random assignment) to detect a standardized effect size of 0.2 standard deviations on primary outcomes in pairwise tests. Under this sample design, each treatment arm will offer

participation to 800 patients, under the expectation that at least 560 participants (186 patients per treatment arm per site) successfully complete the intended treatment assignment.

Figure 1. Power and number of patients recruited (2-armed study), with 8 sites and patient level random assignment (pair wise comparison).



### C. Ethical Considerations and Protection of Research Subjects

The design of the evaluation is subject to review and approval by the Institutional Review Board of the Academic Hospital Paramaribo (AZP, or Academisch Ziekenhuis Paramaribo), associated with the Anton de Kom University. Given the use of individual registries and sensitive health information, protection of human subject data will follow strict ethics and privacy protection protocols, according to the laws of Surinam and best international practices. Informed consent will be requested from participant patients, and any publish results will be reviewed to ensure anonymity of individual data. Finally, the experiment will be registered under an international database of randomized trials, such

as the one maintained by the National Institutes of Health of the United States of America (clinicaltrials.gov).

#### **D. Evaluation Work Plan**

The final evaluation will be conducted in the final 24 months of program implementation. The evaluation will be contracted to an independent consultant who may hire a research team to conduct specific data collection activities. The evaluation activities carried out by a consultant individual or firm will be carried out in direct coordination with the Bank and the PIU and will include:

1. Design and implement the selected interventions and the survey instruments and fieldwork strategy.
2. Arrange and supervise survey implementation.
3. Write an evaluation report that answers the evaluation questions substantiated by data
4. Hold meetings with Bank / PIU and the main actors involved in the design and execution of the operation to obtain the necessary information to carry out the evaluation and to keep them informed of the its progress, results and findings

Tables 5 and 6 describe a tentative budget and timeline.

**Table 5 Impact Evaluation Budget Summary**

<b>Activity</b>	<b>Cost</b>
Consultancy for design and analysis	\$65,000
Baseline surveys	\$50,000
Follow up surveys	\$50,000
IRB	\$1,000
Publications and Dissemination	\$9,000
<b>TOTAL</b>	<b>\$175,000</b>



## V. REFERENCES

- Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness. JAMA [Internet]. 2002 Oct 9 [cited 2012 Jul 26];288(14):1775–9. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/12365965>
- Chung F, Herceg A, Bookallil M. Diabetes clinic attendance improves diabetes management in an urban Aboriginal and Torres Strait Islander population. Aust Fam Physician [Internet]. 2014 Nov [cited 2018 May 28];43(11):797–802. Available from: <https://www.racgp.org.au/download/Documents/AFP/2014/November/201411Research-Chung.pdf>
- Demaio AR, Nielsen KK, Tersbøl BP, Kallestrup P, Meyrowitsch DW. Primary Health Care: a strategic framework for the prevention and control of chronic non-communicable disease. Glob Health Action [Internet]. 2014 Dec 4 [cited 2017 Aug 28];7(1):24504. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4122819/pdf/GHA-7-24504.pdf>
- Diabetes Prevention Program Research Group. HbA1c as a predictor of diabetes and as an outcome in the diabetes prevention program: a randomized clinical trial. Diabetes Care [Internet]. 2015 Jan;38(1):51–8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25336746>
- Eggli Y, Desquins B, Seker E, Halfon P. Comparing potentially avoidable hospitalization rates related to ambulatory care sensitive conditions in Switzerland: the need to refine the definition of health conditions and to adjust for population health status. BMC Health Serv Res [Internet]. 2014 [cited 2018 May 28];14. Available from: <http://www.biomedcentral.com/1472-6963/14/25>
- Faruque LI, Wiebe N, Ehteshami-Afshar A, Liu Y, Dianati-Maleki N, Hemmelgarn BR, et al. Effect of telemedicine on glycosylated hemoglobin in diabetes: a systematic review and meta-analysis of randomized trials. Can Med Assoc J [Internet]. 2017 Mar 6 [cited 2018 May 4];189(9):E341–64. Available from: <http://www.cmaj.ca/content/cmaj/early/2016/10/31/cmaj.150885.full.pdf>
- Glassman A, Gaziano T a, Bouillon Buendia CP, Guanais de Aguiar FC. Confronting the chronic disease burden in Latin America and the Caribbean. Health Aff (Millwood) [Internet]. 2010 Dec [cited 2012 Mar 10];29(12):2142–8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/21134914>
- Gregg EW, Li Y, Wang J, Rios Burrows N, Ali MK, Rolka D, et al. Changes in Diabetes-Related Complications in the United States, 1990–2010. N Engl J Med. 2014;
- Guo F, Moellering DR, Garvey WT. Use of HbA1c for Diagnoses of Diabetes and Prediabetes: Comparison with Diagnoses Based on Fasting and 2-Hr Glucose Values and Effects of Gender, Race, and Age. Metab Syndr Relat Disord [Internet]. 2014 Jun [cited 2018 May 28];12(5):258–68. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4088353/pdf/met.2013.0128.pdf>
- Hansen J, Groenewegen PP, Boerma WGW, Kringos DS. Living In A Country With A Strong Primary Care System Is Beneficial To People With Chronic Conditions. (Appendix).

- Health Aff (Millwood) [Internet]. 2015 Sep;34(9):1531–7. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26355055>
- Haroon Mahomed O, Asmall S. Development and implementation of an integrated chronic disease model in South Africa: lessons in the management of change through improving the quality of clinical practice. [cited 2017 Sep 6]; Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4628546/pdf/IJIC-15-2015038.pdf>
- Hu Z-D, Zhang K-P, Huang Y, Zhu S. Compliance to self-monitoring of blood glucose among patients with type 2 diabetes mellitus and its influential factors: a real-world cross-sectional study based on the Tencent TDF-I blood glucose monitoring platform. *mHealth*. 2017;
- Kim H-K, Bae S-J, Choe J. Impact of HbA1c Criterion on the Detection of Subjects with Increased Risk for Diabetes among Health Check-Up Recipients in Korea. *Diabetes Metab J* [Internet]. 2012 [cited 2018 May 28];36:151–6. Available from: <http://e-dmj.org>
- Kirkman MS, Rowan-Martin MT, Levin R, Fonseca VA, Schmittiel JA, Herman WH, et al. Determinants of adherence to diabetes medications: Findings from a large pharmacy claims database. *Diabetes Care*. 2015;38(4):604–9.
- Knowler WC, Edelstein SL, Goldberg RB, Ackermann RT, Crandall JP, Florez JC, et al. HbA1c as a predictor of diabetes and as an outcome in the diabetes prevention program: A randomized clinical trial. *Diabetes Care*. 2015;38(1):51–8.
- Krishnadath ISK, Nahar-van Venrooij LM, Jaddoe VW V, Toelsie JR. Ethnic differences in prediabetes and diabetes in the Suriname Health Study. *BMJ open diabetes Res care* [Internet]. 2016 [cited 2018 May 28];4(1):e000186.
- Kullgren JT, Hafez D, Fedewa A, Heisler M, Author C. A Scoping Review of Behavioral Economic Interventions for Prevention and Treatment of Type 2 Diabetes Mellitus HHS Public Access. *Curr Diab Rep* [Internet]. 2017 [cited 2018 May 4];17(9). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5619648/pdf/nihms902729.pdf>
- McGuire H, Longson D, Adler A, Farmer A, Lewin I. Management of type 2 diabetes in adults: summary of updated NICE guidance. *BMJ* [Internet]. 2016 Apr 6;i1575. Available from: <http://www.bmj.com/lookup/doi/10.1136/bmj.i1575>
- Mesa MS. Health Care Disparities Between Men and Women With Type 2 Diabetes. *Chronic Dis* [Internet]. 2018 [cited 2018 May 28];15. Available from: [www.cdc.gov/pcd/issues/2018/17\\_0120.htm](http://www.cdc.gov/pcd/issues/2018/17_0120.htm)
- National Institute for Health and Care Excellence. Type 2 diabetes: prevention in people at high risk [Internet]. London, UK; 2017 [cited 2018 May 28]. Available from: <https://www.nice.org.uk/guidance/ph38/resources/type-2-diabetes-prevention-in-people-at-high-risk-pdf-1996304192197>
- Powers MA, Bardsley J, Cypress M, Duker P, Funnell MM, Hess Fischl A, et al. Diabetes Self-Management Education and Support in Type 2 Diabetes: A Joint Position Statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. *J Acad Nutr Diet* [Internet]. 2015 Aug [cited

2018 May 4];115(8):1323–34. Available from: [https://jandonline.org/article/S2212-2672\(15\)00549-3/pdf](https://jandonline.org/article/S2212-2672(15)00549-3/pdf)

Renard LM, Bocquet V, Vidal-Trecan G, Lair M-L, Blum-Boisgard C. Adherence to International Follow-Up Guidelines in Type 2 Diabetes: A Longitudinal Cohort Study in Luxembourg. Herder C, editor. PLoS One [Internet]. 2013 Nov 11 [cited 2018 May 28];8(11):e80162. Available from: <http://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0080162&type=printable>

Sapkota S, Brien J-A, Greenfield J, Aslani P. A Systematic Review of Interventions Addressing Adherence to Anti-Diabetic Medications in Patients with Type 2 Diabetes—Impact on Adherence. Marengoni A, editor. PLoS One [Internet]. 2015 Feb 24 [cited 2018 May 28];10(2):e0118296. Available from: <http://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0118296&type=printable>

Warmington K, Flewelling C, Kennedy CA, Shupak R, Papachristos A, Jones C, et al. Telemedicine delivery of patient education in remote ontario communities: Feasibility of an advanced clinician practitioner in arthritis care (ACPAC)-Led inflammatory arthritis education program. Open Access Rheumatol Res Rev. 2017;

Wilson PM, Kataria N, Mcneilly E. Patient and carer experience of obtaining regular prescribed medication for chronic disease in the English National Health Service: a qualitative study. BMC Health Serv Res [Internet]. 2013 [cited 2018 May 28];13. Available from: <http://www.biomedcentral.com/1472-6963/13/192>