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The Evolution of Diabetes Care in the Rural, Resource-Constrained Setting of Western Kenya

Sonak D Pastakia, Rakhi Karwa, Charles B Kahn, and Jak S Nyabundi

For the past several decades, the international medical community has placed increased emphasis on addressing the immediate needs of patients infected with HIV who live in resource-constrained settings. While this concerted focus on HIV has helped save thousands of lives, there is concern that this has detracted from improving the infrastructure of the entire health-care system and has led to a decline in the level of care that patients with non-HIV-related diseases receive. However, it is hoped that the increased infrastructure being dedicated to HIV treatment can eventually be used to bolster the infrastructure of the entire health-care system.^{1,2} This transition is of significant importance considering that estimates from the International Diabetes Federation suggest an almost doubling of the population with diabetes in sub-Saharan Africa, from 12.1 million in 2010 to 23.9 million in 2030. The proportional increase in the number of patients in sub-Saharan Africa is more than double the percentage growth expected in the rest of the world. This unprecedented growth is expected to be due to a variety of factors, including increased urbanization of the continent, enhanced diagnostic capabilities, and a growing adult population. While current prevalence estimates suggest that only 3.5% of the Kenyan population has diabetes, there is a large burden of undiagnosed diabetes within the

BACKGROUND: The initial focused effort on addressing the HIV pandemic in sub-Saharan Africa has helped set the groundwork for addressing many of the other areas of the health-care system requiring support in resource-constrained settings. With the growing prevalence of diabetes in this setting, the US Agency for International Development—Academic Model Providing Access to Healthcare Partnership (USAID-AMPATH) has begun developing infrastructure to meet the growing need for diabetes care.

OBJECTIVE: To describe the evolution of diabetes care in the rural, resource-constrained setting of western Kenya and to analyze preliminary data on the current status of glucose control of patients.

METHODS: Through partnerships, USAID-AMPATH has facilitated the provision of basic modalities of diabetes care, including reliable stocks of insulin, hemoglobin A_{1c} (A1C) testing, and point-of-care glucose-testing supplies.

RESULTS: Through the introduction of A1C testing, the poor quality of diabetes care was revealed, as the average A1C for the clinic population was 10.4%, with insulin-dependent patients constituting the majority of individuals with markedly elevated A1C levels. To address this, a contextualized electronic medical record and a cell phone-based home glucose monitoring program were created to improve glycemic control, which has led to significant reductions in A1C levels.

CONCLUSIONS: Through the inclusion of clinical data within the electronic medical record, there is an ongoing effort to research various aspects of diabetes care in this understudied population, with the goal of addressing many of the unanswered questions surrounding diabetes care in sub-Saharan Africa. The lessons learned from this pilot program will be used to create sustainable infrastructure for diabetes care in partnership with the Kenyan government and will serve as a model for similar programs.

KEY WORDS: diabetes, electronic medical record, Kenya, private-public partnership, sub-Saharan Africa.

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rural western Kenyan community. Since the inception of our program, local faculty members have been attempting to address issues within the population that are not typically considered within these prevalence estimates.³⁻⁵

Since 1989, Indiana University School of Medicine, Moi University School of Medicine (MUSM), and Moi

Author information provided at end of text.

Teaching and Referral Hospital (MTRH) in Eldoret, Kenya, have worked together to provide care and develop leaders in health care for both the US and Kenya. In 2001, the partners joined forces to address the growing HIV epidemic. Now a formal partner with the US government, through the President's Emergency Plan for AIDS Relief (PEPFAR), the US Agency for International Development—Academic Model for the Prevention and Treatment of HIV/AIDS (USAID-AMPATH) partnership treats more than 120,000 HIV-infected patients at more than 50 clinical sites throughout western Kenya, as seen in Figure 1. With the USAID-AMPATH partnership's extensive experience in western Kenya and sustainable commitment to building health-care infrastructure, the program has rapidly evolved into one of the largest and most comprehensive care programs in sub-Saharan Africa.⁶⁻⁸

There is hope that this growth in partnerships will create opportunities to challenge the barriers that patients face. In this setting, there are many barriers that impede the provision of high-quality care, including limited resources, as 50% of the population makes less than \$2 per day, the lack of trained health-care providers, and for nearly one third of the population, food insecurity.⁹⁻¹² USAID-AMPATH has developed programs specifically designed to overcome these barriers by implementing clinical programs that provide protocol-based care, nutrition support (feeds >30,000 people per week), income-generating opportunities, home-based follow-up, door-to-door HIV screening, prevention of mother-to-child HIV transmission, an electronic medical records (EMRs) system with clinical decision support,

and a multinational research program that is investigating the many characteristics of the understudied sub-Saharan African patient population.⁶⁻⁸ With the continued success of the USAID-AMPATH partnership, members of the faculty have begun applying the many lessons learned from this comprehensive care model to other chronic diseases, such as diabetes. This article describes the gradual evolution of diabetes care in Eldoret, Kenya, including steps taken to improve patients' glucose control.

Early Beginnings of Diabetes Care in Eldoret, Kenya

The first organized effort to address the growing problem of diabetes was undertaken in 2001 by 2 dedicated Kenyan physicians and a nurse trained in diabetes care, through a partnership with the Kenyan Diabetes Association. Many patients requiring oral medications were able to obtain somewhat reliable access to care. However, patients receiving insulin were unable to sustain consistent care with positive outcomes due to the high cost of insulin (>\$20/vial) and lack of laboratory support. Laboratory parameters used to adjust insulin doses included only a single, point-of-care, random blood glucose measurement, which may have had a low likelihood of accurately describing the patient's glucose control. While the clinic lacked resources, it represented a much needed first step in providing some level of care for patients with diabetes who previously had no access to any services.



Figure 1. Distribution of Academic Model Providing Access to Healthcare Partnership satellite clinics throughout western Kenya; red dots indicate health-center-based clinics; white dots indicate remote satellite clinics supported by health centers; the star indicates the main coordinating site of all activities, based in Eldoret.

PARTNERSHIPS FOR ACCESS

To address the needs of HIV care in Kenya, USAID-AMPATH developed a consortium of partners from North American academic medical centers (America/sub-Saharan Africa Network for Training and Education [ASANTE] Consortium). As USAID-AMPATH continued to build the infrastructure to provide HIV care throughout western Kenya, additional partners joined the effort to address the needs of both HIV and non-HIV patients in this resource-constrained health-care system. Partnership with the Purdue University College of Pharmacy helped create reliable infrastructure for medication distribution, allowing for the capacity to manage a multimillion dollar donation of insulin from Eli Lilly and Company (Indianapolis, IN).¹³ To ensure that the insulin went directly to patients unable to afford the cost, dispensation was handled by the diabetes nurse, who was keenly aware of the socioeconomic conditions of the patients enrolled in the clinic through her frequent interactions with them.

Within the ASANTE consortium, the Warren Alpert School of Medicine at Brown University provided onsite guidance of HIV-related care, in addition to sending members of the endocrinology faculty. Through the financial support of the Miriam Hospital Medical Staff Association, where many of the Brown University faculty members practiced, the program was able to improve diabetes care immediately by providing hemoglobin A_{1c} (A1C) testing to give providers a better understanding of glucose control between visits. Positioning the point-of-care A1C machine in the waiting area for the clinic enhanced access to this service. Every 6 months, patients were offered this test as they waited for their visit with clinicians.

While A1C testing provided much needed clinical information, it also highlighted the poor glucose control of patients; the average A1C of the population was 10.4%. Table 1 represents all A1C results from the first 1.5 years of availability of A1C testing at the main diabetes center at Moi Teaching and Referral Hospital. This table highlights

the elevated A1Cs seen among insulin-dependent patients with diabetes.

To address these care deficiencies, full-time, onsite faculty from the ASANTE Consortium and local Kenyan physicians collaborated to develop a comprehensive diabetes care program that was geared toward enhancing access to previously unavailable care modalities.

Development of an Organized System of Care

CREATION OF AN ELECTRONIC MEDICAL RECORD

With evidence consistently supporting the need for organized care in optimizing diabetes outcomes, faculty members developed an EMR customized to manage diabetes in a resource-constrained sub-Saharan setting.^{14,15} This mobile EMR was designed to ensure access at both the central site in Eldoret and at rural sites by scanning all paper-based encounter forms and filing the copy within each individual clinic's paper-based records system. The scanned images are taken to the main center for storage within the patient's EMR and are subsequently entered into the database. The database is shared on portable laptops, which are accessible at clinic sites. This information is accessed prior to each patient encounter to generate customized summary sheets that detail all relevant aspects of his or her diabetes history. Through the use of standardized encounter forms and protocols, patients receive care consistent with the current standards set forth by the International Diabetes Federation.¹⁶ Scanning all documents and leaving paper copies in the file helps to ensure that clinicians at the rural sites always have access to the patient's vital medical records while limiting complete reliance on the EMR, as power outages are a frequent occurrence. Developers are working on a system that will facilitate direct data abstraction via scanning to eliminate the need to enter data into the database from scanned paper copies. To ensure continuous quality improvement, the database is also used to generate

performance reports designed to monitor concordance with standards of care and attainment of process and outcome targets such as provision of A1C testing, A1C reductions, blood pressure reductions, and provision of biannual monofilament testing. In addition, local community workers without formal health-care education have been trained and incorporated into the program to provide education and follow-up and to manage data entry.

CONTEXTUALIZED CARE

Through the combined efforts of clinical staff (pharmacists, physicians, clinical officers, nurses, social workers) and community workers, patients are provided setting-appro-

Table 1. A1C Readings at Moi Teaching and Referral Hospital: June 2007-January 2009

Parameter	Readings, n	Readings in Specified Range, %	Readings for Pts. on Insulin, n	Pts. on Insulin, %
A1C >14%	188	29.06	119	63.30
A1C 10.1-14%	160	24.73	97	60.63
A1C 7.0-10%	165	25.50	72	43.64
A1C <7%	128	19.78	29	22.66
A1C readings, N	641		317	49.45
A1C average, %	10.4			
Average age, y	43.7			
Age range, y	2-88			
A1C = hemoglobin A _{1c} .				

appropriate instructions on self-management of diabetes and awareness of complications as they wait for clinic appointments. Setting-appropriate education includes addressing dietary differences and food insecurity as well as storage of insulin, since most patients are without refrigeration capabilities. All educational materials have been translated into Kiswahili and other local languages to ensure patient understanding. Also, because approximately 65% of Kenyans own cell phones, community health workers are able to provide cell phone-based support to patients on nonclinic days to address any immediate diabetes-related concerns.¹⁷ All of these activities are carried out according to clearly defined protocols, under the supervision of diabetes-trained staff. This contextualized mobile care program has been implemented in 2 rural sites (Webuye and Kitale) and provides care for more than 2100 patients with diabetes.

HOME GLUCOSE MONITORING

Despite advancement in the organization of care and data storage, the program still needed to provide basic treatment modalities, which were too expensive for most patients. To decrease the excess morbidity and mortality seen with hyperglycemic crisis, Abbott Laboratories had been providing glucose and ketone testing supplies to facilitate intensive monitoring for patients admitted to the inpatient wards. Abbott's continuous support of the care program in western Kenya has led the company to expand its donation of testing supplies to the outpatient setting. Through this program, patients identified by clinician-created protocols as being at high risk for complications are enrolled in the home glucose monitoring program and allowed to borrow a glucose monitor and glucose testing strips. Community health workers contact these patients weekly via cell phones, complete a standardized encounter form, and enter the information into the shared database. A summary sheet of all blood glucose values and insulin adjustments is generated from the database, and the information is used by clinical staff to facilitate rapid titration of insulin doses. Community workers then call the patients with the revised doses and address any additional questions. Data from the first subset of evaluable patients ($N = 43$) show that those enrolled in the program had a baseline A1C of 13.18% (95% CI 12.83 to 13.53), which decreased to 10.5% (95% CI 9.86 to 11.13; $p < 0.001$) after 3-6 months in the program.

Future Steps

There is an ongoing effort to research this patient population and care model to provide guidance for the understudied sub-Saharan African population with diabetes. Although care has been greatly improved within the main

referral center at MTRH, there remains an overwhelming burden of untreated diabetes and chronic diseases in the rural areas of western Kenya. USAID-AMPATH recently expanded its focus to become a comprehensive primary health-care program for all conditions. To signify this shift, AMPATH has changed its name to the Academic Model Providing Access to Healthcare. It is within this transition to provide primary care to more than 2.5 million Kenyans residing within western Kenya that the benefits of the diabetes program will be advanced to rural areas where diabetes care was never thought possible. Through the preliminary collection of data on the barriers to effective care delivery through the EMR, it is anticipated that many of the innovative programs developed to support the provision of comprehensive HIV care will be able to directly address many of the challenges to the delivery of diabetes care. This includes the provision of nutrition support, home-based screening and care, income generating opportunities, gestational diabetes screening and care, and research to identify the unique features of diabetes in sub-Saharan Africans, and best approaches for management. This program will also continue to follow the example of successful programs in similar settings by task shifting to community health workers and nurses to help control the costs of care and address the limitations in availability of specialized health workers.¹⁸⁻²⁰ As additional partnerships form, the diabetes program will serve as a care, teaching, and research center for additional sites throughout sub-Saharan Africa. As the feasibility of providing these diabetes care modalities is tested, there is a concerted effort to develop a sustainable plan for the continuation of activities demonstrating benefits in care. With the expansion of diabetes care, the program is enhancing partnerships with the Kenyan government to decrease dependency on foreign donors and build government-subsidized care programs that require copayments from patients with the ability to pay. This approach is being employed in the 2 rural clinics where health facilities and patients bear the cost of all medications, laboratory testing, home glucose monitoring, and staff salaries through government funding and patient copayments. As part of the partnership with the Kenyan government, we are expanding the pilot program to establish this care model in 5 additional sites over the next 2 years. Upon completion of the expanded pilot program, we intend to learn from our experiences and expand diabetes care throughout our western Kenyan catchment area. The transition of USAID-AMPATH from an HIV-centered program to a comprehensive chronic disease program serves as an example of the potential gains that can be achieved for additional aspects of the health-care system in resource-constrained settings, through the initial focus on the HIV pandemic in sub-Saharan Africa.

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La Evolución del Cuidado de Diabetes en el Escenario Rural, Limitado en Recursos de la Provincia Occidental de Kenya

SD Pastakia, R Karwa, CB Kahn, y JS Nyabundi

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EXTRACTO

TRASFONDO: Los esfuerzos iniciales realizados para ayudar en la pandemia de VIH en África subsahariana, ha servido de base para atender muchas otras áreas del sistema de salud que requieren apoyo por ser escenarios con recursos limitados. Con el aumento en la incidencia de diabetes en éste escenario, la Agencia de Estados Unidos para el Desarrollo Internacional se ha asociado con el Modelo Académico Habilitación del Acceso a la Salud (USAID-AMPATH) y han comenzado a desarrollar la infraestructura para atender esta gran necesidad.

OBJETIVO: Describir la evolución del cuidado de diabetes en un escenario rural al oeste de Kenya con limitados recursos, y analizar los datos preliminares sobre el actual control de glucosa de los pacientes.

METODOLOGÍA: Mediante esta asociación, USAID-AMPATH ha logrado facilitar ofrecer las modalidades básicas de cuidado de diabetes, incluyendo la disponibilidad de cantidades confiables de insulina, la utilización de la prueba de hemoglobina glucosilada (A1c) y el uso de productos para tomar niveles de glucosa.

RESULTADOS: Con el uso de la prueba de A1c, se ha podido demostrar la pobre calidad del cuidado de diabetes, ya que el promedio de A1c en la población de la clínica fue de 10.4%. La mayoría de los pacientes con niveles elevados significativos en A1c fueron los pacientes insulino-dependientes. Para atender esta situación se desarrolló un programa que contextualiza electrónicamente el expediente médico del paciente y provee seguimiento mediante teléfono celular a los pacientes cuyos niveles de glucosa se obtienen en el hogar. Este programa ha resultado en una disminución significativa en los valores de A1c.

CONCLUSIONES: Mediante la inclusión de datos clínicos en el expediente médico electrónico, se están haciendo esfuerzos para investigar varios aspectos del cuidado de diabetes en una población que no ha sido bien estudiada con la meta de obtener respuesta a muchas de las preguntas relacionadas con el cuidado de diabetes en el área subsahariana de África. Las lecciones aprendidas a través de este estudio piloto se utilizarán para desarrollar una infraestructura sustentable en diabetes, en coordinación con el gobierno de Kenya que pueda servir de modelo para programas similares.

Traducido por Mirza Martinez

L'Évolution de la Prise en Charge du Diabète dans une Population Rurale de l'Ouest du Kenya

SD Pastakia, R Karwa, CB Kahn, et JS Nyabundi

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RÉSUMÉ

OBJECTIF: Les efforts dirigés contre la pandémie du VIH-sida en Afrique subsaharienne ont aidé à établir certaines balises pour la prise en charge de d'autres problèmes de santé dans cet environnement où les ressources sont limitées. Une agence américaine œuvrant dans le domaine du développement international (USAID -AMPATH) a initié l'implantation d'une infrastructure pour répondre aux besoins grandissants dans le domaine du diabète. Le but de cette étude était de décrire l'évolution des soins offerts aux patients diabétiques qui vivent dans une zone rurale de l'ouest du Kenya et de procéder à l'analyse des données préliminaires des valeurs glycémiques de ces patients.

DEVIS EXPÉRIMENTAL: Avec l'aide de partenaires, l'agence américaine a facilité la prestation des soins de base aux patients diabétiques, notamment par un approvisionnement fiable en insuline et par la mise en disponibilité d'équipements et de fournitures médicales pour les mesures de l'hémoglobine glyquée et de la glycémie.

RÉSULTATS: L'introduction des mesures de l'hémoglobine glyquée a permis de documenter la pauvre qualité des soins aux patients diabétiques. En moyenne, l'hémoglobine glyquée était de 10.4% et la majorité des patients ayant de hautes valeurs de ce marqueur étaient des diabétiques de type I. A la lumière de ces résultats, un dossier médical électronique a été constitué et un programme téléphonique de contrôle des valeurs de glycémie à domicile a été mis en place. Un tel programme a permis de réduire de façon significative les valeurs d'hémoglobine glyquée chez la population à l'étude.

CONCLUSIONS: L'intégration des données cliniques dans un dossier médical électronique constitue une étape dans la recherche de solutions pour aider à mieux gérer la prise en charge du diabète en Afrique subsaharienne. Les résultats préliminaires de ce projet pilote permettront l'établissement d'une infrastructure durable en partenariat avec le gouvernement du Kenya.

Traduit par Sylvie Robert