Original research

Content, participants and outcomes of three diabetes care programmes in three low and middle income countries

Josefien Van Olmen[a,b,*], Ku Grace Marie[a], Darras Christian[c], Kalobu Jean Clovis[d], Bewa Emery[d], Van Pelt Maurits[e], Hen Heang[e], Van Acker Kristien[f], Eggermont Natalie[h], Schellevis François[b,g], Kegels Guy[a]

[a] Institute of Tropical Medicine, Department of Public Health Antwerp, Belgium
[b] Department of General Practice & Elderly Medicine, EMGO, Institute for Health and Care Research, VU University Medical Center, Amsterdam, The Netherlands
[c] Memisa, Brussel, Belgium
[d] Memisa, Kinshasa, People's Republic of Congo
[e] MoPoTsyo, Phnom Penh, Cambodia
[f] Algemeen Ziekenhuis Heilige Familie, Reet & Centre de Santé des Fagnes, Chimay, Belgium
[g] NIVEL (Netherlands Institute for Health Services Research), The Netherlands
[h] Universitair Ziekenhuis, Vrije Universiteit Brussels. Belgium

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ABSTRACT

Aims: To improve access and quality of diabetes care for people in low-income countries, it is important to understand which elements of diabetes care are effective. This paper analyses three diabetes care programmes in the DR Congo, Cambodia and the Philippines.

Methods: Three programmes offering diabetes care and self-management were selected. Programme information was collected through document review and interviews. Data about participants' characteristics, health outcomes, care utilisation, expenditures, care perception and self-management were extracted from a study database. Comparative univariate analyses were performed.

Results: Kin-réseau (DR Congo) is an urban primary care network with 8000 patients. MoPoTsyo (Cambodia) is a community-based peer educator network, covering 7000 patients. FiLDCare (Philippines) is a programme in which 1000 patients receive care in a health facility and self-management support from a community health worker. Content of care of the programmes is comparable, the focus on self-management largest in MoPoTsyo. On average, Kin-réseau patients have a higher age, longer diabetes history and more overweight. MoPoTsyo includes most female, most illiterate and most lean patients. Health outcomes (HbA1C level, systolic blood pressure, diabetes foot lesions) were most favourable for MoPoTsyo patients. Diabetes-related health care expenditure was highest for FiLDCare patients.

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* *Corresponding author at:* Institute of Tropical Medicine, Department of Public Health Antwerp, Belgium. Tel.: +31 643751253; fax: +32 32476258.

E-mail addresses: jvanolmen@itg.be, josefienvanolmen@gmail.com (J. Van Olmen).

Conclusions: This study shows it possible to maintain a diabetes programme with minimal external resources, offering care and self-management support. It also illustrates that health outcomes of persons with diabetes are determined by their bio-psycho-social characteristics and behaviour, which are each subject to the content of care and the approach to chronic illness and self-management of the programme, in turn influenced by the larger context.
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1. Introduction

The problems with access to and quality of care for patients suffering from diabetes mellitus in low- and middle-income countries (LMIC) are widely recognised [1]. While the number of persons with diabetes in need for care increases, inadequate supply of diagnostics and medicines, lack of staff, poor quality of care and high out-of-pocket payment hamper the delivery of continuous care for people with lifelong conditions [2–4]. Improvements in access mostly relate to decentralisation of care to the primary care level [5–8] or in special outpatient clinics [9]. Task-shifting to Community Health Workers (CHWs) or expert patients is less frequent [10,11]. Many studies show the effectiveness of a specific programme, but there is still insufficient understanding of what makes them effective in terms of promoting self-management and reaching good health outcomes. Few comparisons between programmes, their differences in content and quality of care, their context and their results have been made so far. This paper aims to narrow this knowledge gap, by an analysis of commonalities and differences between three diabetes care programmes in three LMIC.

We presume that health outcomes of persons with diabetes are determined by their bio-psycho-social characteristics and by their behaviour, which are subject to the content of care and the approach to chronic illness and self-management of the programme in which they participate, which is in turn influenced by the socio-economic and structural context. We focus our analysis on these assumptions, guided by the following questions: (1) what is the programme content and approach? (2) what are patient characteristics and outcomes? and (3) what could explain differences between programmes?

2. Methods

This study compares diabetes care programmes in 3 countries: DR Congo, Cambodia, and the Philippines. The selection process started at a workshop on chronic care in LMIC in 2009 in Belgium, where these programmes were identified for their offering care, self-management education and support to diabetic patients, and their willingness to participate in the TEXT4DSM study (ISRCTN 86247213) [12,13]. A theoretical framework was developed to understand relationships between care, self-management and health outcomes (Fig. 1).

The first programme is a 40-year-old network in Kinshasa, DR Congo (estimated diabetes prevalence 6.1% [15]). It

presently comprises 80 primary care centres, locally known as the '*réseau*' (Kin-réseau), which deliver diabetes care as part of their basic package. Its origins were laid out by a missionary doctor, who trained health centres staff in to decentralise care [18]. Kin-réseau has not been formalised into an organisation, but the two Christian organisations responsible for most facilities have employed a diabetes coordinator. External funding for specific activities contributed to the impact of the network. Currently, circa 8000 people come for regular follow-up.

The second programme consists of networks of community-based Peer Educators (PEs) in Cambodia (diabetes prevalence 3.0% [15]), supported by an organisation called MoPoTsyo Patient Information Centre (MoPoTsyo). It became operational in 2005 in Phnom Penh, with two patients with diabetes who – after having received a short training about diabetes – searched in the community for other patients to establish a peer group for exchange of information. The training of patients as PE facilitated expansion to, presently, 12 districts, more than 130 PEs and 7000 patients with diabetes. PEs spend on average 1.5 day per week on their duties, receiving small financial incentives per activity. MoPoTsyo has developed a system to support, supervise and monitor PEs and to improve access to local medical services, through support for the local hospital outpatient consultations, a revolving drug fund and laboratory examinations. In 2012, MoPoTsyo had 36 salaried staff members, 1/3 being patients with diabetes. 40% of the total cost is covered by patient fees. Starting 2013, the MOH aims to integrate the PE networks in the public health care system [22,23] (MOH2013).

The third programme is the 'First Line Diabetes Care Project" (FiLDCare) in the Philippines (diabetes prevalence 6.9% [15]). Patients receive primary care and self-management education in a health facility; self-management support is community-based, provided by CHWs. It started in 2009
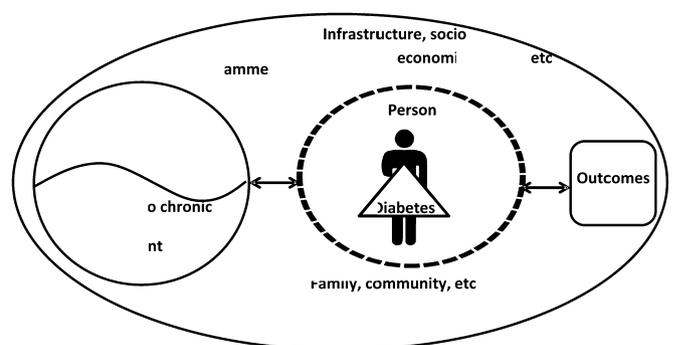
Fig. 1 – Theoretical framework to understand relations between care, self-management and health outcomes.

as a research project, aiming to improve care within the existing system with minimal additional resources [24–26]. Health workers and CHWs are trained to educate and support diabetes patients in self-management; other professionals receive a refresher training. FiLDCare runs in one urban area – where the primary contact for patients is a family physician and there are education nurses, dieticians, pharmacists, and medical specialists – and in two rural areas – where the CHW provides self-management support to the patient, besides the rural health unit physician. At present, there are approximately 1000 patients and 70 CHW educators in the programme.

Firstly, we assessed the programmes themselves. Information about their development, target population and content were collected from project documents and through interviews with programme managers. Relevant websites and other publications were consulted to describe the programmes' contexts (e.g. Human Development Index (HDI) [14], comparative diabetes prevalence [15]). Secondly, patient related baseline data were extracted from a database, designed for the TEXT4DSM study: utilisation of medical care (type of diabetes treatment (diet only/oral/oral + insulin/insulin only), use of hypertension medication, kidney function tests during last year (Y/N)), perceived approach to chronic illness and self-management (Patient Assessment of Chronic Illness Care (PACIC)) [16], person characteristics (sex, education (illiterate/primary-secondary education/university)), age, duration of known diabetes, body mass index (BMI), waist circumference, waist–hip ratio (WHR), knowledge of diabetes (Diabetes Knowledge Test (DKT) [17], self-management behaviour (self-monitoring of glucose (Y/N, via blood/urine)), (self-reported) medication compliance, daily walking (during at least 20 min (Y/N)) and outcomes ((glycosated Haemoglobin) HbA1c, systolic blood pressure (BP), diabetic foot lesions (Y/N), diabetes-related hospital admission ever (Y/N), diabetes-related health expenditure (last month)). Inclusion criteria for patients in all three programmes were: age above 18; confirmed diagnosis of diabetes; listed in a study centre; at least one contact for diabetes in the last year and informed consent. Data about the patients were collected in 2012/2013 within the framework of the TEXT4DSM study during a face-to-face interview with a predefined questionnaire, physical examination and blood sampling. The questionnaires were translated into local languages, retranslated back into English and pretested in all countries. This revealed problems in 1 out of the 20 DKT and 4 out of the 20 PACIC items, which were omitted from the analysis. Cronbach alpha coefficients were calculated for the PACIC-score of each country, to test the internal consistency of the questionnaire. These were sufficiently high in all programmes (0.85 in Kin-réseau; 0.93 in MoPoTsyo; and 0.91 in FiLDCare). Further details on the TEXT4DSM study are published elsewhere [13].

Univariate analyses of the quantitative data were performed at individual programme level. Some continuous variables being not normally distributed, median and Interquartile Range (IQR) were used to summarise all variables. The Kruskal–Wallis (continuous variables) and Fischer exact (categorical variables) test were used to test for differences between programmes.

3. Results

3.1. Programme content

3.1.1. Screening, diagnosis and inclusion of patients
All programmes target patients with diabetes. Kin-réseau includes new patients at the moment they present at a health centre, usually with symptoms. In addition, MoPoTsyo and FildCare organise community-based screening through glycosuria and glycaemia respectively [27]. A definite diagnosis is made based on a fasting plasma glucose (FPG) $\geq$ 126 mg/dl at two different occasions. Initial management focuses on stabilisation of glycaemia, education, followed by screening for complications and risk factors. It generally, but not necessarily, implies at least one doctor consultation.

3.1.2. Content of medical care
Kin-réseau offers a weekly health centre visit and a bi-monthly medical consultation by a trained doctor including control of glycaemia, BP, and feet examination for a standardised price (USD 3.5/month). Patients can buy their medicines in the health centre for a subsidised price. Patients on insulin generally receive their (daily or twice daily) injections at the health centre assisted by a nurse. An annual screening at the referral hospital (renal function, lipids, ECG, fundoscopy) is advised, but costs are not included in the network package.

The MoPoTsyo package includes monthly PE group sessions, urine test strips for self-monitoring, purchase of drugs against regulated tariffs in a nearby pharmacy, half-yearly urine (glycosuria, albuminuria) and blood testing (renal function, lipids, transaminases, potassium), and a consultation with a trained doctor in the district hospital. The monthly PE sessions include education, measurement of capillary glycaemia and BP, routine prescriptions and feedback on self-monitoring. Patients pay small fees for each service (1 USD for medical consultation) [28].

FiLDcare also offers regular meetings with the CHW, to support patients with information and self-monitoring. The CHW is available for self-management support on daily basis and for referral to medical services (frequency of the contact is adapted to the patient's need). In addition, patients visit their primary care provider, according to the treatment guidelines of the medical association. Contact with the CHWs and consultations at the health facilities are free, but patients pay a small fee for lab examinations (1 USD) and often need to buy medicines in private drugstores for local market prices.

Insulin is prescribed to 55.5% of all patients of Kin-réseau, while in MoPoTsyo and FiLDCare, this is less than 10% (Table 1). Antihypertensive medication is prescribed to half up to three quarters (FiLDCare) of all patients. In all programmes, roughly half of the patients had their kidney function tested in the last year.

3.1.3. Approach to chronic illness and self-management
The first line contact person for the patient as a resource for daily self-management is a nurse (Kin-réseau), PE (MoPoTsyo) or CHW (FiLDCare). The frequency of supposed contact is highest in Kin-réseau. The number of diabetes patients linked to one nurse/PE/CHW is largest in Kin-réseau, smallest in the

Table 1 – Overview of characteristics and outcomes of diabetes care programmes.			
	Kin-Réseau Democratic Republic of Congo	MoPoTsyo Cambodia	FiLDCare Philippines
Programme context			
Estimated comparative country diabetes prevalence 2013	6.1%	3.0%	6.9%
Country Human Development Index (HDI)	0.304	0.543	0.654
Approximate number of diabetic patients in the programme	7000	7000	1000
Total number of diabetic patients in sample	479	484	481
Content of care			
Treatment of diabetes			
Diet only, n (%)	25 (5.3%)	35 (7.2%)	12 (2.5%)
Oral antidiabetic drugs (ODA) only, n (%)	173 (36.2%)	407 (84.1%)	424 (88.7%)
ODA + insulin, n (%)	111 (23.3%)	34 (7.0%)	26 (5.4%)
Insulin only, n (%)	168 (35.2%)	8 (1.7%)	16 (3.4%)
Hypertension medication, n (%)	276 (50.5%)	270 (49.5%)	363 (76.9%)
Kidney function tested in last year (%)	59.1%	46.3%	51.4%
Diabetes health expenditure last month: med, IQR (USD)	24.31 (11.27–55.81)	6.41 (4.27–10.36)	34.77 (16.00–69.53)
Approach to chronic illness self-management			
First line contact person for patient	Nurse	Peer educator	(VHW-)educator
Planned frequency of contact	Weekly	Monthly	Individualised
Average number of people with diabetes per Nurse/PE/VHW (min.–max.)	89 (65–149)	68 (20–76)	8 (1–29)
Member of patient association (%)	300 (63%)	466 (96.2%)	95 (19.9%)
PACIC summary score: median, (IQR) [range 0–80]	55 (46–62)	78 (68–80)	49 (42–58)
Patient characteristics			
Sex: men/female ratio	0.47	0.40	0.59
Education			
Illiterate (%)	15.5%	27.5%	0.2%
Primary/secondary (%)	73.2%	70.6%	41.4%
University (%)	11.3%	1.9%	58.4%
Age (years): median (IQR)	63 (55–71)	55 (49–62)	60 (55–65)
% of elderly ($\geq$65)	42.6%	19.6%	28.7%
Known duration of diabetes (years): median (IQR)	7 yrs (4–12)	4 yrs (2–7)	6 yrs (3–12)
Body mass index (kg/m^2): median (IQR)	25.4 (22.4–28.2)	23.8 (21.9–26.0)	24.6 (22.0–27.6)
Waist circumference (cm): median (IQR)	90 (83–97)	83 (77–89)	89 (83–97)
Waist–hip ratio: median (IQR)	1.01 (0.98–1.05)	0.89 (0.85–0.93)	0.92 (0.88–0.97)
Diabetes knowledge (correct answers Diabetes Knowledge Test): med (IQR)	14 (12–16)	12 (10–14)	14 (12–16)
Self-management behaviour			
Patients self-monitoring glucose (% of all patients)	22.6%	60.5%	54.5%
Urine (% of all patients)	13.2%	51.5%	1.9%
Blood (% of all patients)	19.9%	18.8%	53.6%
Medication compliance: % reporting to follow the prescribed treatment category (diet only; ODA; ODA + insulin; insulin only)	81.5%	96.7%	90.1%
Reported to walk at least 20 min per day	74.4%	68.2%	72.7%
Outcomes			
HbA1c (mmol/mol): median (IQR)	69.4 (54.1–93.4)	54.1 (46.4–68.3)	57.4 (47.5–81s.4)
HbA1c (%): median (IQR)	8.9 (7.1–10.7)	7.1 (6.3–8.4)	7.4 (6.5–9.6)
People reaching target (<53 mmol/mol or 7.0%): n (%)	106 (22.2%)	210 (43.4%)	185 (39.0)
Systolic blood pressure:	140 (120–160)	127 (118–139)	142 (129–158)
median (IQR) (mmHg)	204 (42.8%)	371 (76.7%)	206 (42.8%)
n (%) < 140 mmHg			
Presence of diabetic foot lesions, n (%)	66 (13.9%)	6 (1.2%)	11 (2.3%)
Diabetes-related hospital admission ever: n (%)	125 (26%)	166 (34%)	177 (37%)

Philippines. MoPoTsyo is a patient association, so almost all patients regard themselves as a member of a patient association. Among FiLDCare participants, 20% of people report to belong to a patient association; for patients of Kin-réseau, this is 63%.

Patient education in Kin-réseau occurs when a patient is diagnosed, during individual sessions, with written and picture materials. The main focus is on food and feet care. Self-monitoring is no routine, partly because test strips have been hard to get. Instead, each health centre organises weekly sessions with a laboratory worker testing glycosuria with Benedict solution and the nurse providing education and consultation. Local patient associations organise social events and mutual support.

MoPoTsyo PEs educate new patients during group sessions and individual counselling using Khmer written materials. The group meetings, always at somebody's home and before working hours, are informal social events but include knowledge transfer and capacity-building, since patients help each other measuring BP and weight. The PE measures glycaemia and records data. Patients are advised to self-monitor with urine strips every two weeks, to increase insight in 'their own diabetes'.

Initial education in FiLDcare happens at the health facility; CHWs continue with follow-up, information, reminders and counselling, individually or in groups. They emphasise lifestyle management through diet, exercise and compliance to medications and try to strengthen support in the patient's environment. The overall assessment of Chronic Illness Care (PACIC summary score) was highest for patients of MoPoTsyo.

3.1.4. Patient register and follow-up

In all three programmes, the nurse/PE/CHW maintains a paper register of patients under his/her responsibility. They are supposed to retrace patients lost to follow-up and to report to the care provider. The Kin-réseau and MoPoTsyo maintain a central diabetes register, which is periodically updated via bottom-up reporting (MoPoTsyo) or by central collection (Kin-réseau). FiLDCare does not keep a separate register of the participants, but health centres maintain general family files. Patients have a personal identifier and patient diary to record clinical and self-management data.

3.2. Patient characteristics, behaviour and outcomes

Data from 479 patients from Kin-réseau, 484 patients from MoPoTsyo and 481patients from FiLdcare were available for analyses. In Kin-réseau, 506 patients had been recruited, but 27 patients were lost before inclusion in the study, 6 because of death and 21 due to operational barriers (waiting times, transport). In the other 2 countries, all recruited participants completed the baseline data collection.

The female dominance among patients was signifantly higher in MoPoTsyo than in the other programmes. The level of education of patients of FiLDCare is significantly higher than of patients of Kin-réseau and MoPoTsyo. The median age of patients and duration of diabetes are highest in Kin-réseau, lowest in MoPoTsyo. There is a significant difference in BMI, waist circumference and WH ratio between patients of MoPoTsyo and the other programmes.

Diabetes knowledge as measured in the DKT was similar for patients of FiLDCare and Kin-réseau (median 14/19 answers correct) and slightly lower for patients of MoPoTsyo (12/19). Patients of the Kin-réseau engage least in self-monitoring of their glucose-levels. More than 80% of patients reported to take their medication according to prescription, this number being significantly higher for MoPoTsyo patients. Significantly more patients of the Kin-réseau and MoPoTsyo reported to follow diet guidelines most of the time. More than two thirds of patients of all programmes reported walking at least 20 minutes each day.

The median HbA1C level was highest for patients of Kin-réseau; 22.2% reached the target of HbA1C < 53 mmol/mol (7.0%), versus 43.3% and 39.0% of MoPoTsyo and FiLDcare patients. Patients of MoPoTsyo had the lowest median systolic BP, 76.7% being below 140 mmHg. Feet examination revealed most foot lesions among patients of Kin-réseau (13.9%). Approximately one third of patients (of all three programmes) reported having had a diabetes-related hospital admission, most often for glycaemic deregulation, hypertension, kidney and eye problems. As the period was not specified, comparison of hospital admissions across programmes is difficult. Total diabetes-related health care expenditure per person over the past month was highest for patients of FiLDCare (34.77 USD), lowest for those of MoPoTsyo (6.41 USD).

4. Discussion

All three programmes described target at improving the care for diabetic patients in LMIC. There are contextual differences, in history, embedding in general health services and the amount of external resources available. There are parallels and differences between the programmes, patient population and health outcomes.

Patients of MoPoTsyo had the best health outcomes (HbA1C, BP, diabetic foot lesions). Patient engagement in self-monitoring was most evident for patients in MoPoTsyo, although their knowledge about diabetes was slightly less than that of patients in the other programmes. Knowledge was better or comparable to those measured in studies in similar settings [29,30]. More than 80% of patients said to take follow the advised type of treatment for their diabetes. More than two thirds of patients of all programmes reported walking at least 20 minutes each day. The female dominance among patients was highest in MoPoTsyo, education level highest among FiLDCare patients. Patients of MoPoTsyo have a more favourable body composition in the other programmes. The median age and duration of diabetes were highest in the Kin-réseau, lowest in MoPoTsyo. Diabetes-related health care expenditure was highest for FiLDCare patients.

Limitations of our study relate to patient recruitment, data collection and data analysis. Patients not being regular attendants (for instance because they felt not ill) or those feeling too ill to participate had more chance of not being recruited, which might have led to an inclusion bias, depicting more favourable results for all programmes. The validation of the instruments PACIC and DKT was done in another context, cultural bias in answering among our study populations can therefore not be

excluded. The scope of this paper did not allow a multivariate analysis of dependant variables for each country.

Nevertheless, this is the first study, to our knowledge, which compares diabetes programmes, their patients and outcomes in three different LMIC. The study shows that it is possible to maintain diabetes programmes in different low resource settings, with minimal reserves, offering patients care and self-management support.

In an attempt to understand parallels and differences between the programmes, we returned to the theoretical framework (Fig. 1). This framework shows that factors influencing health outcomes are related to (a) the person and his behaviour; (b) the course of his diabetes; (c) his surroundings (family, community and the larger context); and (d) the diabetes programme. Looking through the lenses of this framework, we can make the following observations. In the programme with the best health outcomes (MoPoTsyo), the measured characteristics of people with diabetes (age, duration of diabetes) and their reported behaviour (walking, compliance) were more favourable than in the other programmes. While the components of medical care described seem reasonable in all programmes, the analysis shows a stronger focus of MoPoTsyo on self-management and chronic illness. The socio-economic context of Kin-réseau, DR Congo, is most constraint [19–21]. The personal characteristics (for instance age) and the diabetes characteristics (duration of diabetes, possibly also the genetic type of diabetes) are unadvantageous for diabetes control. The framework also indicates the interrelatedness of factors. The differences in patient characteristics, for instance, are partly influenced by differences in programme duration and the way of patient recruitment. Active case detection through community screening seems to lead to patients entering the programme at a younger age and in an earlier stage of disease, contributing better HbA1C levels and less complications. MoPoTsyo is an organisation which targets mainly people with diabetes, with access to more external resources than the other programmes. This may contribute to its focus and leverage. Each programmes is exemplary for a different approaches that developed in reaction to time and context.

This study illustrates that health outcomes of persons with diabetes are determined by their bio-psycho-social characteristics and by their behaviour, which are each subject to the content of care and the approach to chronic illness and self-management of the programme in which they participate, which is in turn influenced by the socio-economic and structural context. Similar programmes in other contexts may benefit from our observations. It is worthwhile to prospectively study if more focus on the seemingly effective practices indeed improves outcomes, also for people with other chronic conditions.

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Contribution statement

JVO is coordinating investigator of the study and drafted the first version of this text. GMK is in charge of the study in the Philippines and has contributed to the text about FiLD-Care. She has also contributed substantially to the discussion and methods section. MVP has written parts of the text about MoPoTsyo. He has also contributed substantially to the introduction and discussion section. JCK is in charge of the study in the DR Congo and has contributed to the text of Kin-réseau. EB is involved in the study in the DR Congo and has contributed to the text of Kin-réseau. HH is in charge of the study in Cambodia and had contributed to the text about MoPoTsyo. CD has contributed to the introduction, methods and discussion substantial parts and comments of the parts on their respective programmes. KVA have provided specialist advice about diabetes epidemiology. NE has contributed to the statistical analysis of the data and to the interpretation of those. FS has been extensively involved from the set-up of the paper until the last version. Structure and contents have been drafted with his help. GK has given in-depth advice about the structure, methods and the discussion part of this paper and about the study in general.

Conflict of interest

KVA has a function in the Diabetes Foot Programme of IDF. MVP is executive director of MoPoTsyo. HH is employee of MoPoTsyo. CD is volunteer at Memisa Brussel. EB is employees of Memisa DR Congo. JCK is employees of Memisa DR Congo. GMK has been the initiator of the FiLDCare project. FS has no conflict of interest. GK is the principal investigator of the TEXT4DSM study. He has no financial conflict of interest. JVO is the coordinating investigator of the TEXT4DSM study.

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