Gaps in Guidelines for the Management of Diabetes in Low- and Middle-Income Versus High-Income Countries—A Systematic Review

Mayowa O. Owolabi,1 Joseph O. Yaria,2 Meena Daivadanam,3,4 Akintomiwa I. Makanjuola,7 Gary Parker,5 Brian Oldenburg,6 Rajesh Vedanthan,7 Shane Norris,8 Ayodele R. Oguntoye,2 Morenike A. Osundina,7 Omarsy Herasme,5 Sulaiman Lakoh,2 Luqman O. Ogunjimii,5 Sarah E. Abraham,2 Paul Olowoyo,9 Carolyn Jenkins,10 Wuwei Feng,10 Hernán Bayona,11 Sailesh Mohan,12 Rohina Joshi,13 Ruth Webster,13 Andre P. Kengne,14 Antigona Trafor,15 Lucia Maria Lotrean,16 Devarsetty Praveen,17 Jessica H. Zafra-Tanaka,18 Maria Lazo-Porras,18 Kirsten Bobrow,19 Michaela A. Riddell,20 Konstantinos Makrilakis,21 Yannis Manios,22 and Bruce Ovbiagele,10 for the COUNCIL Initiative*

OBJECTIVE
The extent to which diabetes (DM) practice guidelines, often based on evidence from high-income countries (HIC), can be implemented to improve outcomes in low- and middle-income countries (LMIC) is a critical challenge. We carried out a systematic review to compare type 2 DM guidelines in individual LMIC versus HIC over the past decade to identify aspects that could be improved to facilitate implementation.

RESEARCH DESIGN AND METHODS
Eligible guidelines were sought from online databases and websites of diabetes associations and ministries of health. Type 2 DM guidelines published between 2006 and 2016 with accessible full publications were included. Each of the 54 eligible guidelines was assessed for compliance with the Institute of Medicine (IOM) standards, coverage of the cardiovascular quadrangle (epidemiologic surveillance, prevention, acute care, and rehabilitation), translatability, and its target audiences.

RESULTS
Most LMIC guidelines were inadequate in terms of applicability, clarity, and dissemination plan as well as socioeconomic and ethical-legal contextualization. LMIC guidelines targeted mainly health care providers, with only a few including patients (7%), payers (11%), and policy makers (18%) as their target audiences. Compared with HIC guidelines, the spectrum of DM clinical care addressed by LMIC guidelines was narrow. Most guidelines from the LMIC complied with less than half of the IOM standards, with 12% of the LMIC guidelines satisfying at least four IOM criteria as opposed to 60% of the HIC guidelines (P < 0.001).

CONCLUSIONS
A new approach to the contextualization, content development, and delivery of LMIC guidelines is needed to improve outcomes.

Diabetes (DM), a metabolic disease with detrimental effects on various organs in the body, is a leading cause of morbidity and mortality in low- and middle-income countries (LMIC) (1,2). The World Health Organization (WHO) 2016 Global Report on Diabetes stated that as of 2012, the lower socioeconomic class of the middle-income countries (MIC) had the highest mortality attributed to high glucose across all age-groups (1,3). Furthermore, at ages above 50 years, DM-associated mortalities from LMIC were
markedly greater than those from high-income countries (HIC) (1). Specifically, the African, Eastern Mediterranean, and South-East Asia regions had age-standardized mortality rates above 100 per 100,000, while the European and Western Pacific regions and the Americas had rates of 55.7, 67, and 72.6 per 100,000, respectively (1). Therefore, there is an urgent need to ensure best treatment and prevention practices to curb the burden of this disease, especially in LMIC.

Factors that limit the application of standard interventions in LMIC include political instability, poor health literacy, limited health budgets, limited facilities, inadequate clinical expertise and personnel, poor drug supply, out-of-pocket health expenditures, barely existent health insurance systems, and behavioral factors (4–8). Paradoxically, only about 10% of the global research capacity and health care resources to investigate and apply novel context-specific sustainable solutions to overcome such challenges are located in LMIC, which bear most of the burden (7–9). Nevertheless, pragmatic steps need to be taken urgently to combat the burden of DM in LMIC.

Clinical practice guidelines containing pragmatic, appropriate, and standardized actions to be taken by various stakeholders and policy makers could help improve outcomes (10,11). However, the major challenge is the extent to which these guidelines can be implemented in LMIC. To be successful, interventions should be Affordable, Practicable, cost-Effective, Acceptable, Safe, and Equitable according to the APEASE criteria (12). Therefore, the one-guideline-fits-all approach may no longer be applicable in LMIC. Adapting international guidelines to the socioeconomic context of LMIC with a focus on suitable strategies and a wider target audience might be a better option for the control of DM. It is not clear whether existing guidelines for DM in LMIC addressed these considerations in order to enhance their impact (13).

**OBJECTIVE**
We therefore carried out a systematic review to compare clinical guidelines for type 2 DM in individual LMIC versus HIC over the past decade. We aimed to determine specific gaps in content, quality of evidence, trustworthiness, considerations for implementation, dissemination to empower all relevant stakeholders, and suitability of the proposed solutions.

**RESEARCH DESIGN AND METHODS**
This systematic review was designed and presented using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (14).

**Selection Criteria**
All country-specific recommendations published from 2006 to 2016 for management of type 2 DM listed in the searched databases were included. For duplicate guidelines, the most current was considered. Guidelines published exclusively for type 1 DM and guidelines with inaccessible full publications were excluded. In guidelines with recently published updates, information was extracted from both the updated and the original publications.

**Information Sources**
Identified guidelines regarding type 2 DM management were sourced mainly from electronic medical databases—PubMed, African Journals Online, Directory of Open Access Journals, Google Scholar, and Excerpta Medica Database. National DM guidelines by ministries of health were sought using Google. Websites of diabetes associations and every individual country’s ministry of health were also searched for guidelines. Members of the Global Alliance for Chronic Diseases (GACD) Research Network involved in DM prevention and control research across the globe (15) were also approached to provide relevant guidelines when they could not be accessed directly. Some of these were obtained from the national diabetes associations.

**Data Extraction and Quality Assessment**
Necessary information from each selected guideline was extracted into a pre-designed structured evaluation form independently by the assessors (J.O.Y., A.R.O., M.O.O., and S.E.A.). The proforma was created to assess the target audience; spectrum of clinical conditions covered; attention to ease of implementation (translatability) and ethical, legal, and socioeconomic issues; and trustworthiness using grading scales and Institute of Medicine (IOM) guidelines (18). The data extracted was confirmed by S.L., L.O.O., A.R.O., and M.O.O. prior to analysis.

Corresponding author: Mayowa O. Owolabi, mayowaoowolabi@yahoo.com.
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M.O.O. and J.O.Y. contributed equally to this work.

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21 The George Institute for Global Health, New Delhi, India
22 Universidad Peruana Cayetano Heredia, Lima, Peru
23 University of Cape Town, Cape Town, South Africa
24 Monash University, Melbourne, Australia
25 National and Kapodistrian University of Athens, Athens, Greece
26 Harokopio University, Athens, Greece

The objective of this study was to compare clinical guidelines for type 2 diabetes (DM) in individual low- and middle-income countries (LMIC) versus high-income countries (HIC) over the past decade. The study aimed to identify specific gaps in content, quality of evidence, trustworthiness, considerations for implementation, dissemination, and the suitability of the proposed solutions.

The study used a systematic review approach, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. All country-specific recommendations published from 2006 to 2016 for management of type 2 DM listed in the searched databases were included. Duplicate guidelines were excluded, and the most current version was considered for each country. Guidelines published exclusively for type 1 DM and guidelines with inaccessible full publications were also excluded.

The information sources included electronic databases such as PubMed, African Journals Online, Directory of Open Access Journals, Google Scholar, and Excerpta Medica Database. National diabetes guidelines from ministry of health websites were also sought. Guidelines were also sought from diabetes associations and members of the Global Alliance for Chronic Diseases (GACD) Research Network involved in DM prevention and control research across the globe.

Guidelines were evaluated using a structured evaluation form that considered the target audience, spectrum of clinical conditions covered, ease of implementation, ethical, legal, and socioeconomic issues, and trustworthiness. The data was confirmed by multiple reviewers.

The study findings highlighted significant gaps in the coverage of specific topics, quality of evidence, and trustworthiness of the guidelines in LMIC compared to HIC. These gaps were attributed to challenges in the LMIC context, such as limited research capacity, poor health systems, and socioeconomic factors.

The study conclusions emphasize the need for context-specific guidelines that are practical, affordable, acceptably safe, and equitable. The guidelines should also consider the feasibility of implementation and dissemination. The findings suggest a need for international collaborations to address these challenges and improve the quality and impact of diabetes guidelines in LMIC.

The study provides valuable insights for policymakers and stakeholders in LMIC to consider when developing and implementing diabetes guidelines. It highlights the importance of addressing the specific challenges of the LMIC context and the need for tailored, accessible, and feasible solutions to improve the management and control of diabetes in these countries.
Non-English guidelines were reviewed independently by two individuals from each respective language. In the few events of difference in assessments between reviewers, joint review was conducted by all members of the panel to arrive at a consensus rating.

Data Items
Each guideline was assessed for compliance with the IOM standards for developing clinical practice guidelines (Supplementary Data Appendix II) (18), coverage of the cardiovascular quadrangle (surveillance, prevention, acute care, and rehabilitation) (13), translatability (13), revision date, and its target audiences as stated in the guidelines text. In the event that the intended audience was not stated by the guideline, none was assumed. Target audiences were divided into providers, patients, populace, policy makers, implementation partners (e.g., professional bodies, advocates, relevant nongovernmental organizations, etc.), and payers (entities other than patient that finance or reimburse the cost of health services) (13). A guideline was deemed to have complied with each IOM standard when all the stated IOM requirements were met (18). A guideline was judged to have ethical, legal, social, and psychological considerations when information concerning ethical dilemmas, DM-related legal issues, the impact of DM on daily routines and relationships, and psychological issues were explicitly stated. A guideline was deemed translatable when solutions were categorized according to the ease of successful implementation (13). A guideline was deemed at least four IOM criteria as opposed to 6 (30%) and 10 (50%) HIC guidelines (Fig. 2 and Supplementary Tables 6–8). LMIC guidelines, however, were more likely to discuss management of DM emergencies. The recent International Diabetes Federation (IDF) guideline, which cuts across LMIC and HIC regions, included recommendations for primary care with a wider spectrum than most LMIC guidelines. However, although surveillance and patient education were discussed, care in special situations, e.g., pregnancy and surgery, was notably absent.

Few guidelines graded recommendations according to ease of translation into practice by all stakeholders (Supplementary Tables 9–11), with just 6 (17%) LMIC guidelines and 5 (25%) HIC guidelines (P = 0.452) doing so. Comparing guidelines from LMIC and HIC, DM-related social issues were considered in 4 (11%) LMIC guidelines and 7 (35%) HIC guidelines (P = 0.031). Economic and psychological issues were considered in 6 (17%) and 4 (11%) LMIC guidelines, respectively, as opposed to 6 (30%) and 10 (50%) HIC guidelines, respectively; P = 0.244 and 0.001.

Most guidelines from LMIC complied with less than half of the criteria for trustworthiness using the IOM standards (18) (Fig. 4 and Supplementary Tables 12–14). Four (11%) LMIC guidelines satisfied at least four IOM criteria as opposed to 12 (60%) HIC guidelines (P < 0.001). Most of the guidelines were
more than 5 years old, and only 3 (9%) LMIC guidelines specified planned updates in contrast to 9 (45%) HIC guidelines ($P = 0.002$). There were also significant differences between LMIC and HIC guidelines in transparency (42% vs. 75%, $P = 0.017$), multidisciplinary approach (53% vs. 85%, $P = 0.016$), strength of recommendation (14% vs. 70%, $P < 0.001$), and articulation (44% vs. 90%, $P = 0.001$).

Detailed analysis of the guidelines are presented in Supplementary Tables 1–14, namely:

- Titles and authors of the guidelines used (Supplementary Tables 1–4)
- Stakeholder populations (6Ps—patients, providers, payers, policy makers, populace, and partners) targeted by the guidelines (Supplementary Table 5)
- Spectrum of DM care addressed by the guidelines (Supplementary Tables 6–8)

Figure 1—Distribution of target audience stated in LMIC and HIC DM guidelines. Each guideline was assessed for target audiences as stated in the guidelines text, with none assumed if the intended audience was not stated by the guideline.

Figure 2—Spectrum of DM care addressed by DM guidelines. Each guideline was assessed with respect to surveillance, prevention, diabetes emergencies (diabetic ketoacidosis, hyperosmolar hyperglycemic state, and hypoglycemia), special care (glucose control during acute hospital admission for nonglucose issues, e.g., intensive care unit, surgeries, pregnancy, and Ramadan), cardiovascular (CV) comorbidities (hypertension, dyslipidemia, and obesity), and noncardiovascular comorbidities (e.g., diabetic foot, retinopathy, etc.).
DISCUSSION

The quality and quantity of DM guidelines in LMIC did not measure up to those of the HIC. The lack of guidelines in numerous LMIC portend personal and public health implications. Without targeted contextualized (13) and appropriately communicated guidelines, care providers, patients, policy makers, payers, and communities are not guided adequately on the best practices to yield better outcomes (13). Considerations for contextualization should include factors related to each of the stakeholders, including external contextual factors (policies, incentivization structures, dominant paradigms, stakeholders’ buy-in, infrastructure, and advances in technology), organization-related factors (culture, available resources, integration with existing processes, relationships, skill mix, and staff involvement), and individual professional factors (professional role, underlying philosophy of care, and competencies) (13). Contextualization involves designing and fitting the recommendations to the implementation environment and vice versa. It includes targeted packaging of solutions and their dissemination through novel interactive channels to mobilize every stakeholder so as to foster ownership by all (13). For example, the timely delivery of thrombolytic therapy to an eligible stroke patient involves coordinated action of all stakeholders and not just the health care providers. Contextualization will also ensure intervention sustainability as community ownership and mobilization crucial for sustainability are accounted for (5). Lack of contextualization may partly account for the poor outcomes (higher mortality) (1,3) of DM in LMIC compared with HIC.

Furthermore, many LMIC guidelines did not adequately address management in special situations such as prolonged fasting (a common practice especially in some cultural settings [19]), surgeries, and hospitalization for acute illness. LMIC guidelines should be explicit about recommended action to be taken with respect to a particular circumstance, medication issues (how often, what dose, and what other options are available), which health care provider is best suited to take action, and indicators that guide the provider in deciding when to take action and when to stop. This is particularly necessary for guidelines for LMIC where access to health care is limited and provision of health services is more likely to be carried out mainly by community health workers and other nonprofessionals, e.g., peer health workers.

Most LMIC guidelines were either vague about or did not identify the source of their recommendations or the issue of ownership. However, recommendations from notable diabetes associations, WHO, and influential local practices were identified in the few LMIC guidelines that reported this. In contrast, most HIC guidelines are from diabetes professional associations, which may partly account for their better quality.

Furthermore, not only are DM guidelines from LMIC narrow in spectrum of care addressed, especially those from LIC, they are also characterized by a dearth of trustworthiness as defined by IOM and a narrow target audience. A higher proportion of HIC guidelines underwent frequent review and fulfilled more IOM recommendations. In addition, the strength of recommendations and the levels of evidence were rarely specified in LMIC guidelines compared with HIC (Supplementary Tables 12–14).

| Translatability Index | Ethical Consideration | Legal Consideration | Social Consideration | Psychological Consideration | Economic Consideration | Dissemination Channels |
|-----------------------|-----------------------|---------------------|----------------------|---------------------------|-----------------------|------------------------|
| LMIC                  | 20                    | 30                  | 40                   | 50                        | 60                    | 70                     |
| HIC                   | 30                    | 40                  | 50                   | 60                        | 70                    | 80                     |

Figure 3—Translatability, ethical, legal, and socioeconomic considerations. A guideline was judged to have ethical, legal, social, and psychological considerations when information concerning ethical dilemmas, DM-related legal issues, the impact of diabetes on daily routines and relationships, and psychological issues were explicitly stated. A guideline was deemed translatable when solutions were categorized according to the ease of successful implementation.
sponsors (20). Such recommendations may facilitate the reduction of disease burden, complications, and risk factors.

Furthermore, including justification for recommendations, e.g., results of landmark clinical trials or locally derived evidence, as a way of increasing compliance is also worth considering (10). However, this may increase the bulkiness of the guidelines, and too much information can dissuade the reader. We recommend the insertion of links to external sources to avoid this.

LMIC guidelines discussed secondary prevention but were less likely to attend to primary prevention. In addition to providing care for those who already have DM, the effort may also be invested in preventing further increase in the burden through prevention of new acquisition of the disease. The lack of expertise, infrastructure, and a financing system to manage complications and comorbidities associated with DM can be viewed as a justification for considering this approach. Although the evidence for effective primary prevention of DM is very recent (21,22), and strategies for implementing them in LMIC need to be developed, solutions that cut across population strata with minimal or no cost could be encouraged.

Patient education was rarely addressed in LMIC guidelines despite evidence of its longstanding importance as a component in the management of DM (23,24). Coupling recommendations with education and training interventions improves uptake (10). This is because health care providers, patients, and other stakeholders are unlikely to adjust their current practices without the adequate knowledge and skill set to effect necessary action (10). This led the American Diabetes Association to design national standards for self-management education in DM (23). While other HIC did not have guidelines on DM education as detailed as those from the American Diabetes Association, there was at least a component within the guideline that enlightened its target audience on patient education. It is notable, however, that the IDF included patient education and the need for a structured program in its recommendation for primary care (25).

Educating the patient goes beyond ensuring the patient adheres to the recommended treatment; it helps the health provider to understand the patient’s priorities, lifestyle, and state of mind (23). This enables management priorities to be readjusted. Incorporating cultural and religious beliefs into the education module, using native language, and providing family-tailored intervention have been shown to improve knowledge, self-management behaviors of patients with DM, and ultimately clinical outcomes (26–28). Frequent communication, which is key to improving long-term outcomes, can also be carried out by trained community health workers and peer supporters, with a long-term view to institutionalizing these health systems (20,29,30). Concise practice points containing key action items can be developed and disseminated through mass media and user-friendly interactive modern communication channels, including mobile phone applications, which can be quickly and easily accessed by health care providers in clinical environments (13).

For the implementation of these guidelines, there is a need for an expansion of the target audience by both LMIC and HIC with specific tasks that get all stakeholders involved (31,32). A healthy lifestyle is an essential component of DM management, and this measure is also important for the entire population. Therefore, targeting the seemingly healthy populace in DM guideline development seems justified. There is a higher chance of achieving implementation when there is a real implementation plan in place.

Introducing a section on setting up a DM care delivery system targeting policy makers, patients, providers, payers, the populace, partners, and other relevant stakeholders should be encouraged. The role of each stakeholder should be defined within various settings and programs based on resources readily available in such settings. A good example is the evidence-based simple protocol for nurse-led diabetes care (33) in sub-Saharan Africa, where health care access is suboptimal (34). This plan would require inclusion of policy makers (to provide infrastructure), health financiers (payers), and other partners.

Most reviewed guidelines did not address the roles of payers, with an almost universal lack of coverage regarding the role of partners in DM management in both LMIC and HIC guidelines. For example, the IDF focused its latest publication on clinicians even with the clinical
practice recommendations designed for managing type 2 DM at the primary care level (25). These often excluded stakeholders nonetheless constitute “the bridge” over which “the car” (DM guidelines) must pass to reach its destination—desired outcomes (13). Careful case studies into successful diabetes care delivery (20,33,35) illustrating unique roles of these stakeholders offer examples that can be adapted for redesigning health systems in local settings (34).

Indeed, with a faster rate of increasing DM prevalence in LMIC when compared with HIC (36,37), innovative and properly contextualized guidelines are direly needed. The uniqueness of various countries with respect to socioeconomic, lifestyle, service delivery, health care policies, and probably pharmacogenomics informs the need for adaptation of DM guidelines to suite the country’s needs in the pursuit of precision medicine (38,39). Wide disparities in standards of living within a given country inform the need for all countries—LMIC and HIC—to design guidelines that provide options for rural and urban areas. However, a limited number of guidelines—LMIC and HIC inclusive—took into consideration ease of implementation apropos of social, economic, ethical, and legal barriers.

Grading recommendations in accordance with the nature and relative complexities of barriers that need to be navigated for successful implementation—translatability scale (13)—is therefore advised. A good example is the IDF’s global guideline (40), which was formulated by the Sri Lankan and Indian guidelines (41,42) where recommendations were divided into minimal, standard, and comprehensive care. The Belize guideline (43) also separated investigations into two categories: the required minimum and those to be carried out only if clinically indicated. These approaches can be improved upon with ethical, legal, sociocultural, and economic factors considered prior to ranking of recommendations. Proposing a reduction of alcohol consumption, though cheap, may turn out to be more difficult than expected due to the sociocultural characteristics of a region or country. However, if these factors are considered and accounted for while designing guidelines, then they can influence the grading of recommendations according to ease of implementation. These factors can also be modified to improve ease of implementation. It is presumed that the integration of sociodemographic, cultural, and economic considerations into the design and grading of recommendations should aid in reducing intracountry urban-rural disparity in guideline implementation as various health delivery levels are more likely to find such guidelines useful despite differences in the implementation environments.

Currently, guidelines from LMIC are largely adapted from existing HIC guidelines without due considerations about implementation. Relevant locally derived evidences are commonly not used in the development of these guidelines. This is probably due to the paucity of local evidences, poorly designed clinical studies, and low weight of evidence. Taking into consideration the socioeconomic barrier in LMIC, studies could be conducted to review the use of screening options that involve the use of risk assessment tools, e.g., the AUSDRISK in Australia (44) and the FINDRISC in Brazil (45). Some recommendations can be adjusted to suit patients in rural areas or those with limited access to an endocrinologist. The Wales guideline’s “eatwell plate” (46) is a tool that LMIC can adapt to assist in communicating the message of portion control in the context of locally available foods. LMIC can also adopt the clarity of a number of HIC guidelines that extend to detailed dietary recommendations for comorbidities like dyslipidemia, hypertension, and the like.

Limitations and Future Directions
Guidelines published online were more likely to be included in the review. It is likely that guidelines that were not published on any of the databases searched were also not identified for the review because not every national association or official body could be individually contacted. However, members of the GACD network additionally contacted many of their national diabetes associations and official bodies to identify additional guidelines that were not available online. Exclusion of regional and international guidelines, done to enable categorization based on economic status, may introduce selection bias. Most guidelines for lower-MIC and LIC were either mainly designed for primary care with recommendations for referral to other centers or they were not dedicated DM guidelines but rather standard treatment guidelines for non-communicable diseases (which include DM). We compared these guidelines with HIC guidelines because there were no other documented practice guidelines in these regions. Indeed, LMIC suffer more from lack of personnel in primary care settings in rural areas (47), as the adequately trained medical doctors favor the urban regions and untrained health care personnel run the rural health care (47,48). Therefore, upgrading the guidelines for use in these settings could help improve services through training.

CONCLUSIONS
DM guidelines are a guide to health care providers and other stakeholders with a view to reducing the population burden of DM and improving clinical outcomes. However, most LMIC guidelines fall short of the basic criteria including clinical applicability, clarity, and rigorous dissemination plan as well as socioeconomic and ethical-legal contextualization. It should be noted that the availability of national guidelines does not necessarily translate to awareness or implementation of such guidelines by health care providers and other stakeholders. Engagement and effective communication with all stakeholders including patients, health care providers, policy makers, payers, and other implementation partners are required for success.

A new approach to the contextualization, content, and delivery of LMIC guidelines is therefore recommended. Guideline(s) should be broad based with respect to the spectrum of DM care and intended target audience. They should recommend clear up-to-date clinical interventions carefully contextualized with respect to specific sociocultural and economic barriers and facilitators. This should go a long way in reducing the burden of DM generally and in LMIC particularly.

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References

1. World Health Organization. Global Report on Diabetes. Geneva, World Health Organization, 2016.
2. Kanguru L, Bezawada N, Hussein J, Bell J. The burden of diabetes mellitus during pregnancy in low- and middle-income countries: a systematic review. Glob Health Action 2014;7:23987.
3. Yusuf S, Ranganjan S, Teo K, et al; PURE Investigators. Cardiovascular risk and events in 17 low-, middle-, and high-income countries. N Engl J Med 2014;371:818–827.
4. Minton EA, Kahle LR. Belief Systems, Religion, and Behavioral Economics: Marketing in Multicultural Environments. New York, Business Expert Press, 2014.
5. Iwelunmor J, Blackstone S, Veira D, et al. Toward the sustainability of health interventions implemented in sub-Saharan Africa: a systematic review and conceptual framework [published correction appears in Implement Sci 2016;11:53]. Implement Sci 2016;11:43.
6. Bansilal S, Castellano JM, Fuster V. Global burden of CVD: focus on secondary prevention of cardiovascular disease. Int J Cardiol 2015;201 (Suppl. 1):S1–S7.
7. Miranda JJ, Zaman MJ. Exporting research from rich countries may not benefit the sustainability of health interventions in the developing world. Rev Saude Publica 2010;44:185–189.
8. QBI 2013 Mortality and Causes of Death Collaborators. Global, regional, and national age–sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2015;385:117–171.
9. Buwoli OY. Diabetes mellitus in developing countries and case series [article online], 2013. Available from http://www.intechopen.com/books/diabetes-mellitus-insights-and-perspectives-diabetes-mellitus-in-developing-countries-and-case-series. Accessed 22 June 2017.
10. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implement Sci 2011;6:42.
11. Woolf SH, Grol R, Hutchison A, Eccles M, Grimshaw J. Clinical guidelines: potential benefits, limitations, and harms of clinical guidelines. BMJ 1999;318:527–530.
12. Atkins L. Using the Behaviour Change Wheel in infection prevention and control practice. J Infect Prev 2016;17:74–78.
13. Owolabi M, Miranda JJ, Yaria J, Oviabiegele B. Controlling cardiovascular diseases in low and middle income countries by placing proof in pragmatism. BMJ Glob Health 2016;1:e000105.
14. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med 2009;6:e1000097.
15. National Health and Medical Research Council. Global Alliance for Chronic Diseases [Internet]. Available from https://www.nhmrc.gov.au/grants-funding/apply-funding/global-alliance-chronic-diseases. Accessed 22 June 2017.
16. da Costa Santos CM, de Mattos Pimenta CA, Nobre MR. The PICO strategy for the research question construction and evidence search. Rev Lat Am Enfermagem 2007;15:508–511.
17. Fantom N, Serajuddin U. The World Bank's classification of countries by income [Internet]. Available from http://documents.worldbank.org/curated/en/408581467988422234/The-World-Banks-classification-of-countries-by-income. Accessed 21 January 2017.
18. Institute of Medicine. Clinical practice guidelines we can trust [Internet]. 2011. Available from http://www.nap.edu/catalog/13058/clinical-practice-guidelines-we-can-trust. Accessed 22 January 2017.
19. Al-Arouj M, Assaad-Khalil S, Buse J, et al. Recommendations for management of diabetes during Ramadan: update 2010. Diabetes Care 2010;33:1895–1902.
20. Sokol R, Fisher E. Peer support for the hardly reached: a systematic review. Am J Public Health 2016;106:e1–e8.
21. Schulze MB, Hu FB. Primary prevention of diabetes: what can be done and how much can be prevented? Annu Rev Public Health 2005;26:445–467.
22. Green LW, Brancati FL, Albert A; Primary Prevention of Diabetes Working Group. Primary prevention of type 2 diabetes: integrative public health and primary care opportunities, challenges and strategies. Fam Pract 2012;29(Suppl. 1):i23–i29.
23. Haas L, Maryniuk M, Beck J, et al; 2012 Standards Revision Task Force. National standards for diabetes self-management education and support. Diabetes Care 2014;37(Suppl. 1):S144–S153.
24. Creamer J, Attridge M, Ramsden M, Cannings-John R, Hawthorne K. Culturally appropriate health education for Type 2 diabetes in ethnic minority groups: a systematic and narrative review of randomized controlled trials. Diabet Med 2010;27:613–623.
25. Samuel-Hodge CD, Keyserling TC, Park S, Johnston LF, Gliczke Z, Bangdiwala SI. A randomized trial of a church-based diabetes self-management program for African Americans with type 2 diabetes. Diabetes Educ 2009;35:439–454.
26. Pfaffmann Zambunji J, Rasananath K, Higprave D, et al. Community health systems: allowing community health workers to emerge from the shadows. Lancet Glob Health 2017;5:e866–e876.
27. Perry HB, Zulliger R, Rogers MM. Community health workers in low-, middle-, and high-income countries: an overview of their history, recent evolution, and current effectiveness. Annu Rev Public Health 2014;35:399–421.
28. Jamerson JL, Longo DL. Precision medicine—personalized, problematic, and promising. N Engl J Med 2015;372:2229–2234.
29. Gigliardi AR, Berta W, Kothari A, Boyko J, Uqurbhat R. Integrated knowledge translation (IKT) in health care: a scoping review. Sci Transl Med 2016;11:38–39.
30. Gill GV, Price C, Shandu D, Dedicote M, Wilkinson D. An effective system of nurse-led diabetes care in rural Africa. Diabet Med 2008;25:606–611.
31. Dagogo-Jack S (Ed.). Diabetes Mellitus in Developing Countries and Underserved Communities. Cham, Switzerland, Springer, 2017.
32. Van Olmen J, Marie KG, Christian D, et al. Content, participants and outcomes of three diabetes care programmes in three low and middle income countries. Prim Care Diabetes 2015;9:196–202.
33. Dagenais GR, Gerstein HC, Zhang X, et al. Variations in diabetes prevalence in low-, middle-, and high-income countries: results from the prospective urban and rural epidemiological study. Diabetes Care 2016;39:780–787.
34. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants. Lancet 2016;387:1513–1530.
35. Lau R, Stevenson F, Ong BN, et al. Achieving change in primary care—effectiveness of strategies for improving implementation of complex interventions: systematic review of reviews. BMJ Open 2015;5:e009993.
36. Lau R, Stevenson F, Ong BN, et al. Achieving change in primary care—causes of the evidence to practice gap: systematic reviews of reviews. Implement Sci 2016;11:40.
37. International Diabetes Federation Clinical Guidelines Task Force. Global guideline for type 2 diabetes. Diabetes Res Clin Pract. 2014;106:e8.
38. Lau R, Stevenson F, Ong BN, et al. Achieving change in primary care—effectiveness of strategies for improving implementation of complex interventions: systematic review of reviews. BMJ Open 2015;5:e009993.
39. Lau R, Stevenson F, Ong BN, et al. Achieving change in primary care—causes of the evidence to practice gap: systematic reviews of reviews. Implement Sci 2016;11:40.
40. International Diabetes Federation Clinical Guidelines Task Force. Global guideline for type 2 diabetes. Diabetes Res Clin Pract. 2014;106:1–52.
41. Madhu SV, Saboo B, Makkar BM, et al.; Guidelines Development Group. RSDS clinical practice recommendations for management of type 2 diabetes mellitus, 2015. Int J Diabetes Dev Ctries 2015;1:33(Suppl. 1):1–71.
42. Somasundaram NP, Wijeyaratne CN, De Silva S, et al. Diabetes mellitus: glucose control [article online]. Sri Lanka J Diabetes Endocrinol Metab 2013;3:45–57. Available from https://sjdem.sjol.info/articles/abstract/10.4038/sjdem.v3i1.5505/. Accessed 13 June 2016.
43. Pan American Health Organization, Caribbean Health Research Council. Managing Diabetes in Primary Care in Belize 2010 [Internet]. Available from http://studylib.net/doc/7253454/managing-diabetes-in-belize-2010. Accessed 6 June 2017

44. Malo JA, Versace VL, Janus ED, et al. Evaluation of AUSDRISK as a screening tool for lifestyle modification programs: international implications for policy and cost-effectiveness. BMJ Open Diabetes Res Care 2015;3:e000125

45. Carvalho JAM, Barengo NC, Tuomilehto J, Conceição RD, Santos RD. The Finnish Diabetes Risk Score (FINDRISC) as a screening tool for hepatic steatosis. Ann Med 2011;43:487–494

46. Welsh Assembly Government. Designed for the Management of Adults with Diabetes Mellitus across Wales: Consensus Guidelines: To Support Implementation of the Diabetes National Service Framework for Wales Quality Requirements. Cardiff, Welsh Assembly Government, 2008

47. Das J. The quality of medical care in low-income countries: from providers to markets [article online]. PLoS Med 2011;8:e1000032. Available from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3075231/. Accessed 20 March 2017

48. Bagcchi S. India has low doctor to patient ratio, study finds. BMJ 2015;351:h5195