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Review of Quality of Diabetes Care in Low- and Middle-income European Countries

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Review of Quality of Diabetes Care in Low- and Middle-income European Countries

By

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Bachelor of Science
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2008

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An abstract of
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Abstract

Review of Quality of Diabetes Care in Low- and Middle-income European Countries

By Beth Jennifer Bahe

Objective and Data Sources: This review of published literature (systematic search of Pubmed and Embase databases) is to assess the current or most recent levels of quality of care for diabetes across European low- and middle-income countries (LMIC) to evaluate whether there are gaps in execution of known interventions and/or clinical guidelines. ***Study selection and Data Extraction:*** Inclusion criteria explicitly described the population (adult or children diagnosed with type 1 or type 2 diabetes mellitus), and outcomes (processes of care, therapeutic outcomes, or occurrence of complications) of interest. A separate single reviewer extracted quantitative data from the published articles and the relevant data was synthesized, stratifying by study design and type of diabetes. ***Results:*** Out of an article yield of 507 studies, twenty-seven studies met inclusion criteria, including 24 adult population studies, and 3 focused on children with type 1 diabetes studies. Across 8 population-based adult studies, the proportion of individuals' with A1c <8% ranged from 7.7-26.5%. Mean blood pressure (BP) across the same studies ranged from 124-141 mmHg (systolic) and 76-85 mmHg (diastolic). Across 16 clinic-based studies, individuals' mean A1c ranged from 7.7-9.7%. Mean BP across the same studies ranged from 131-173 mmHg (systolic) and 77-97 mmHg (diastolic). Within 3 studies examining outcomes for children with type 1 diabetes mellitus, individuals' mean A1c ranged from 8.5-11.9%, and retinopathy prevalence ranged from 1.7-12%. A total of 8 studies achieved a total score of 3-4 indicating that the methods were of fair quality. Five studies had a total score of 5-6 demonstrating a good assessment of the study quality; all other studies had a score indicating a poor study quality. ***Conclusion:*** Quality of care for diabetes is not optimal in European LMICs, and al countries in the region were not represented in this review. Technological advances incorporated into the European low resource settings may enhance health systems and allow providers supplementary resources for patient care. This review emphasizes the need for increased research to fill the gaps in the execution of clinical guidelines, and proper monitoring of diabetes patients living in European LMICs.

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Chapter 1

Introduction

An estimated 366 million people have diabetes and the prevalence of type 2 diabetes is increasing worldwide [1]. More than eighty percent of diabetes deaths occur in low- and middle-income countries (LMIC), while approximately 80% of healthcare expenditures is directly spent in developed countries [1, 2]. The consequences of undiagnosed or ill-managed diabetes include life-threatening complications, reduced quality of life, and significant economic impacts, and the effects are felt widely, from individuals to health systems [3-5]. For developing or LMICs, adult diabetes will likely increase 49% more, from 2010 to 2030, compared to developed countries [6]. The major consequences of diabetes are kidney failure, limb amputations, and cardiovascular disease (heart attacks, strokes, peripheral vascular diseases), while diabetic retinopathy is a main cause of blindness. Diabetes is responsible for approximately 8.2% of global mortality in people 20-79 years, accounting for 4.6 million deaths in 2011 [7].

There are evidence-based guidelines for the treatment and management of diabetes and its complications, however there is inadequate knowledge of how widely these are implemented in clinical settings and routine public health practice [5, 8]. Translating diabetes research to real world health care delivery requires consideration of the multifaceted interactions among patients, providers, causes and manifestations of the disease, and the health systems operation [8]. The Institute of Medicine (IOM) defines quality of care as “the degree to which health services for individuals and populations increase the likelihood of desired

health outcomes and are consistent with current professional knowledge [9]." Distinguishing the disparities in care delivery will allow appropriate allocation of resources to focus on reducing modifiable risk factors and addressing incidence of complications and mortality reduction in LMICs [10].

There is an absence of aggregated data regarding the quality of care for diabetes across European LMICs. In 1989, a group of European health representatives and organizations met with the World Health Organization (WHO) and the International Diabetes Federation (IDF) experts to recommend general goals and targets related to diabetes mellitus care [11]. This meeting is often referred to in the literature as the St. Vincent Declaration. Considering these goals were established over 22 years ago, audits of health care systems and diabetes management in European LMICs have been published since. However, there have been no efforts to synthesize the findings.

Considering the minimal resources available to LMICs, it is likely that quality of care measures will be diminished in LMICs of Europe, which are mainly in the Eastern European region. The primary purpose of this systematic review of the literature is to assess the current or most recent levels of quality of care for diabetes across low-income and middle-income European countries to evaluate whether there are gaps in execution of known interventions and/or clinical guidelines.

Chapter 2

Significance of the Paper

The significance of this systematic review is to find the gaps in the published literature regarding care for diabetes. Identifying the gaps in documentation of diabetes care in European LMICs will stimulate awareness of auditing quality of care as well as stimulating necessary improvements in care delivery. Performing this systematic review will provide a synopsis of the findings from individual studies, and the barriers, challenges, and successes that are identified can be addressed at the health system level through policy and program development, and potentially financing mechanisms (e.g. incentives for better self-management or recognition for providers that achieve better outcomes). Providers can use this review to improve delivery of education and management tools to patients and prompt individual motivation to enhance health.

Methods

A systematic review of published literature was performed using PubMed and Embase for studies that documented quality of care measures for diabetes care in European LMICs. The search was limited to settings that are characterized as developing or low-income or middle-income or low-resource or least developed or underdeveloped or poor or third world only. As such, low- and middle-income European countries in Central Europe, Eastern Europe, and the Commonwealth of Independent States were included. Specifically, the low- and middle-income countries were classified according to the World Bank Atlas method and gross national income (GNI – formerly referred to as GNP) per capita. The three income groups are defined as: (1) low-income, GNI per capita

of $1,005.00 or less, (2) lower middle-income, GNI per capita of $1,006.00 - $3,975.00, and (3) upper middle-income, GNI per capita of $3,976.00 - $12,275.00 [12].

A research team conducted this study. A previous research assistant initiated the review and identified the subject heading terms used for the searches. The search was limited to studies published up to July 29, 2011. Article titles and abstracts were reviewed with the intention of discarding papers with minimal or no relevance (e.g. studies that met any of the nine exclusion codes) {See Appendix A}.

The search was limited to studies published in English and only those related to humans. One article was offered primarily in a non-English language, and library service was able to request an interlibrary loan of full-text in the English language. Published studies were removed if it did not relate to diabetes, was focused on an uncommon form of diabetes, genetics or animal studies, or was implemented in high-income or developed European countries or was unrelated to quality of care and had no estimates of risk factor control.

Study Inclusion Criteria

To be included in this review, studies had to meet the following guidelines:

- Children or adult populations with type 1 or type 2 diabetes mellitus (defined by the WHO and those that are self-reported)
- Participants without pre-existing cardiovascular disease (CVD), since the guidelines and risk factor control targets for people with CVD and diabetes are slightly different
- Relevant outcome measures reported for diabetes care/diabetes

management/quality of health care:

- Preventive processes of care: screenings for diabetes complications (foot, eye, urine exams; glucose, blood pressure, lipid assessments; foot care) and conveying preventative advice for control of risk factors (smoking cessation, lifestyle advice)
- Therapeutic outcomes of care: measures assessing control of risk factors like glycemic/blood pressure/lipid control, use of renin-angiotensin system modifiers, etc.
- Occurrence of diabetes complications, or patient outcomes (biochemical and metabolic parameters, health-related quality of care, other complications)
- Over-utilization of resources and/or use of unproven investigations and therapeutics

The studies published have been a broad design of observational or comparative and/or trial studies, and the baseline data of these are presented. A single reviewer extracted quantitative and qualitative data from the final articles included in this study. A quantitative meta-analysis could not be performed due to the heterogeneity among the populations and study designs published. The research team determined that a narrative synthesis would be most appropriate, providing a synopsis of recurring important themes extracted across the studies. All relevant data was organized for reporting and stratified according to type of diabetes.

Quality Score Assessment

The research team established guidelines for formal assessment of study quality using a quality score assessment. Quality scores for each category were assigned as Good (total score 5-7), Fair (total score 3-4) and Poor (total score 1-2) {see Appendix B}. The quality score examined several categories of each published study included in our review: (a) method of sampling, (b) method of data collection, (c) representativeness of sample to European LMICs, and (d) the response rate. The quality scoring criteria varied among the major components with a minimum score of zero and the highest potential score of seven. Quality scores for assessment of population survey-based and clinic-based studies were slightly different.

This systematic review did not use human subjects and did not require submission to an Institution Review Board.

Chapter 3

Results

The initial search yielded a total of 507 articles from Pubmed (386 studies) and Embase (121 studies). After eliminating 21 duplicates, the search yielded a total of 486 published articles from PubMed and Embase. A total of 372 publications were removed after meeting 1 of the 9 exclusion codes. Forty-seven of the remaining one hundred and fourteen articles could not be found and a total of 67 published studies were carefully reviewed using the set of inclusion criteria guidelines. A total of 37 articles were reviewed using the same criteria and a final total of 27 articles were deemed eligible and analyzed.

Studies reporting survey outcomes

The 9 countries represented in the studies included in this review are Albania, Bosnia, Bulgaria, Hungary, Latvia, Lithuania, Poland, Turkey, and Ukraine. A detailed description of the characteristics, data collection, outcomes (e.g. glucose, lipids, and other), and quality score for the studies reporting mainly self-reported measures of clinical parameters on questionnaires, web-based surveys or medical audits among adult patients can be found in Table 1.

The 8 population-based surveys included the following data collection methods: self-reported questionnaires, questionnaires used during interview, web-based surveys for physicians and patients, and a medical audit with case report forms filled out by investigators. Broadly, the study settings included 3 studies specifying a random sampling method and 5 studies using a non-random sampling method (e.g. participants invited by letter to participate in the survey) or not clearly indicating their method of sampling for the population. All surveys were conducted in durations of less than 5 months or study duration was not

mentioned when the methods specified a cross-sectional design.

Quality of Care Indicators

Across 8 population-based studies, the proportion of individuals with glycated hemoglobin (or hemoglobin A_{1c} {A1c}) <8% ranged from 7.7-26.5% and prescribed insulin for those that were eligible ranged from 20-85%. Mean blood pressure (BP) across the same studies ranged from 124-141 mmHg (systolic), 76-85 mmHg (diastolic), and hypertension prevalence ranged from 42.25-65.8%. Within the same studies, the mean total cholesterol ranged from 4.9-5.4mmol/l, and the mean high-density lipoprotein (HDL) ranged from 1.3-3.6mmol/l. All clinical outcomes are baseline measurements and studies reported the mean measurement or proportions of participants achieving a normal cut-off.

These 8 studies also reported on outcomes related to kidney complications and the proportion of individuals with nephropathy, or end-stage renal disease (ESRD), or kidney disease, ranging from 0.44-25.3%. Across the same studies, the proportion of smoking ranged from 7-27%, and one study indicated that 82% of the current smokers reported counseling on smoking cessation. Only one study included demographic information on the patient's education level and employment status, which more than 50% had a primary education level and 87% were retired.

Quality Score Assessment

Three surveys had a total quality score of 1 and two studies had a total score of 2 illustrating poor quality of five of the studies, mainly due to volunteer or selective sampling and self-reporting data. One study had a total quality score of 3 and two studies had a total score of 6 demonstrating a fair and good

assessment, respectively, of both design methods.

Studies reporting clinic-based outcomes

The 9 countries represented among the studies included in this review are Bulgaria, Bosnia, Hungary, Poland, Romania, Russia, Turkey, Tunisia and Ukraine. A description of the characteristics, data extraction, outcomes (e.g. glucose, lipid, and other), and quality scores for the studies that were predominantly clinic based among adult patients can be found in Table 2.

Sixteen studies were clinic-based and the study designs included were 5 intervention studies (telemonitoring and diabetes education programs and physician/nurse diabetes training); 8 cohorts (retrospective and prospective follow-up ≥2 years); and 3 case-control studies. The settings for the studies were mainly outpatient clinics with few in-patient clinics and/or University clinics.

Quality of Care Indicators

Across 16 clinic-based studies, individuals' mean A1c ranged from 7.7-9.7% values, and fasting blood glucose (FBG) ranged from 7.7-10.2mmol/l. Mean BP across the same studies ranged from 131-173 mmHg (systolic), and 77-97 mmHg (diastolic). Retinopathy was extensively addressed in the studies as a screening for diabetes complications. Across the same 16 studies, the proportion of individuals with retinopathy ranged from 1.70-28.6%, morbidity due to retinopathy ranged from 1.9-41%, blindness due to retinopathy (2.1%), and stages of retinopathy in relation to hypertension approximately ranged from 9-43%. The proportion of total cholesterol >5.2mmol/l ranged from 49-67%, and the mean triglyceride ranged from 1.21-2.18mmol/l. The proportion of smokers across the same studies ranged from 1.2-60.7%, and one 5-day intervention

reported emphasizing smoking being harmful. All clinical outcomes are baseline measurements and studies reported the mean measurement or proportions of participants achieving a specific cut-off.

Some of the 16 studies included self-reported data regarding coronary heart disease and/or stroke, ranging from 2.0-8.7% prevalence (self-reported). One study stratified the diabetes patients according to their educational level (low, middle, and high), and the same study's proportion of individuals with low daily physical activity ranged from 5.4-33.1%.

Quality Score Assessment

A total of eight studies had total scores of 1 (n=2) and 2 (n=6) illustrating a poor study quality. There were five studies that achieved a fair assessment. Two studies had a total score of 5, and one study had a total score of 6 indicating all three had a good level of study quality.

Studies reporting patient outcomes for children with type 1 diabetes

The 3 countries represented are Poland, Romania, and Russia, and the characteristics, outcomes, and quality score for each study can be found in Table 3. The study designs included 1 intervention study, and 2 cross-sectional assessments of diabetes educational programs, prevalence, management, and complications. The children's mean age ranged from 7.1-14.2 years and the duration of diabetes ranged from 2.8-4.7 years among individuals with type 1 diabetes mellitus. Across 3 studies examining outcomes for children with type 1 diabetes mellitus, individuals' mean A1c range from 8.53-11.9% values, and retinopathy prevalence ranged from 1.7-12%.

Quality Score Assessment

Two studies achieved a total score of 3 indicating that the methods were

of fair quality. One study had a total score of 2, signifying a poor measure of the study quality.

Main Findings

In general, 9 of the twenty-four adult population studies were conducted in Poland, 6 were in Bulgaria, 3 in Hungary, and 2 were set in Russia. The self-reported questionnaires indicated that initial patient knowledge of diabetes was satisfactory but often participants could not recall discussing specific topics like drug side effects, glucose control, or diabetes management with their specialist or practitioner. Eastern Europe had the lowest proportion of screenings for type 1 complications in the last 24 hours among their 914 patients [13]. The same study reported 99.3% of Eastern Europe subjects had health coverage [13]. In both type 1 and type 2 patients, ≥60% recalled frequent medical check ups and regular appointments with physician specialists (i.e. ophthalmologists and neurologic exams). Two follow-up studies specifically asked patients if they keep diabetes logbooks and 16% reported affirmatively that they kept a logbook, while the other patients did not have one or never heard of it. Almost half of the studies included mentioned the St. Vincent Declaration as the basis for initiating their intervention or assessment.

Themes emerging from studies

1. European LMICs had varying diabetes quality of care offered by their primary care and specialist centers, and differed in terms of diabetes education delivered, therapy compliance, and consistency of scheduling appointments [13, 14].
2. An increase in diabetes quality of care assessments for European LMICs

can assist to identify (1) additional specialty units, (2) establishing therapeutic programs, and (3) clinical guidelines aimed at better control of diabetes and CVD risk factors that can be implemented throughout stages of health care from local through national levels [15, 16].

3. Individuals with diabetes vary according to their knowledge of the disease, and the frequency of counseling by their providers [17, 18]

Chapter 4

Discussion

Broadly, the twenty-four adult population studies in this review were conducted in a variety of countries: 9 studies were from Poland, 6 were in Bulgaria, 3 from Hungary, and 2 were set in Russia. The countries represented in the review of children population studies with type 1 diabetes mellitus were conducted in Romania, Russia, and Poland. Overall, fourteen countries are represented in the 27 total published studies. There are over ten European LMICs not represented in this review. Tajikistan and Kyrgyz Republic are both classified as low-income economies, and the remaining absence of European LMICs are classified within the lower-middle- or upper-middle-income countries [12]. Some of these countries neglected in regards to publications of their quality of care measures for diabetes are Azerbaijan, Kazakhstan, Kosovo, Turkmenistan, and Uzbekistan. The majority of European LMICs have insufficient knowledge of how well a known intervention or proven clinical guidelines can be implemented in their individual nations.

Outcomes

All twenty-seven studies included reports of at least some combination of processes of care, therapeutic outcomes, and patient complications among people with diabetes. The lack of studies reporting executions of known interventions and/or clinical guidelines for a majority of European LMICs expectedly exposes the gap in data for these low resource settings.

There were no incentive programs found in this literature review but it has been suggested to use them for diabetes management in developing countries [19]. Although providing tokens of encouragement to patients and or providers in

low resource settings may improve quality of care, the perception of an incentive must be acceptable to patients, providers, and the community. It may be difficult to consider applying this program concept to European LMICs when basic medical materials are not fully accessible. For example, a Poland study indicated chronic complications from diabetes are expensive to treat and provide care [20]. It appears reducing the occurrence of diabetes complications will allow allocation of financial resources to other needs in these economies. Before many of these European LMICs can begin to ponder incentive programs, they will need adequate data to demonstrate and highlight the best management tools that should be implemented.

Also, the lack of cost-benefit analyses may explain the shortage of diabetes teaching programs with proven direct and indirect net benefits of intervention for European LMICs. One study conducted on type 1 diabetic patients participating in a 5-day inpatient treatment and teaching program showed direct and indirect net benefits of the intervention per patient (-14,400 rubles net costs within 2 years) as well as reductions in hospitalizations (direct costs) and lost of productivity (indirect costs) [21]. The idea that low resource settings can impact the treatment and management of diabetes should become an achievable goal by LMICs. It is necessary to thoroughly examine diabetes management interventions across European LMICs settings, and cost-effectiveness assessments should be included.

The diabetes quality of care was found to be inadequate when compared to other European countries [14]. Among 8 population-based and 16 clinic-based

studies, the findings reveal few patients are able to maintain their HbA1c levels at or below 7% [22]. The poorly controlled risk factors and assessments suggest the current and most recent levels of quality of care for diabetes must be improved. Across all 24 adult population studies, the proportion of individuals with regularly measured BP ranged from 28-67%, indicating a lack of consistent BP monitoring [14, 18]. The meager monitoring of therapeutic outcomes of care shown in this review of European LMICs reflects lost opportunities to reduce the increasing burden of diabetes and its complications in LMICs.

Implications

The two major implications presented in this review are (1) diabetes quality of care was not as optimal as desired, and (2) a majority of the European low- and middle-income countries were not represented in this study. Addressing the poor diabetes quality of care and lack of data representative of European LMICs requires a complex approach involving the individuals, providers, and health systems.

Individual Implications

This review showed quality of care for individuals diagnosed with diabetes is less than ideal and not what had been hoped for. This is evidenced by the lack of disease knowledge and its risk factors reported by patients. Patient education was a major component of all the intervention studies; nonetheless, at baseline, 78.2% of patients received counseling by their physicians to use acetylsalicylic acid (ASA [aspirin]) regularly and 90% of the users reported being uninformed about the treatment side effects by their physicians [23]. It has been previously advised that a key to effective management of diabetes patients is the treatment

of associated cardiovascular risks [19]. Though individuals with diabetes are receiving counseling on drug treatments to prevent heart attacks, the comprehensiveness of the preventive advice for control of risk factors is not clarified throughout the European LMICs. Much greater variation may be seen in preventative processes of care since widespread use of drugs to control blood pressure and cholesterol in European LMICs is also unknown. Over time, the literature has shown that an individual diagnosed with diabetes can be sufficiently educated on monitoring their blood glucose, and controlling risk factors to positively impact quality of life and decrease complications.

The variation across European LMICs in regards to data on processes of care for diabetes is limited. The topic of individualized diabetes management and their risk factor related knowledge was addressed in studies conducted in Bosnia Herzegovina, Hungary, Poland, and Russia. The data regarding patient knowledge of diabetes is not extensive with a gap of 20 countries not represented. In Russia, a subject's diabetes related knowledge test scores increased after participating in a health education intervention;[21] however, another study surveyed subjects and they considered their knowledge of the disease sufficient but not very good, and this population derived from a city in Poland [18]. Diabetes risk factor knowledge was reported for Bosnia Herzegovina, and 81.6% of known smokers were advised to stop smoking but it is uncertain whether the advice was followed [14]. These are examples of preventative processes of care data gaps in European LMICs. There is potential for reducing the burden of disease across European LMICs by focusing on the

patients' preventative care, and increasing data pertaining to monitoring among this region.

Providers Implications

The inadequate diabetes management inferred by this review narrates the provider's lethargy toward intensifying treatments for people with diabetes. For type 2 diabetes, the mean duration of hypertension was over 10 years [24] and a majority of studies reported >60% of subjects had poorly controlled BP [16, 23]. It is necessary for health care providers (physicians and nurses) to receive proper training that emphasizes accurate performance of known diabetes guidelines. The delivery of diabetes quality of care can become more effective when proven guidelines are repeatedly used in studies and tailored to each LMIC setting.

An increase in comprehensive data across European LMICs that address the intensity of a provider's responsibility to convey diabetes quality of care is necessary. The Staged Diabetes Management program implemented in the Lodz region of Poland stressed if clinical targets are not reached in an approved time frame then therapy had to be changed [20]. With the longer duration of a condition or complication, then practitioners must realize the need for a multifaceted approach to patient care. A provider's delivery of care is an important aspect to achieving improved patient health, but there is no data pertaining to this topic for at least fourteen European LMICs. Without the knowledge of diabetes complication occurrences in countries like Uzbekistan, Kosovo, or Macedonia, which are not represented in this review then it is not possible to improve diabetes care across European LMICs. The growing burden

of diabetes among LMICs in the European region points out a crucial void in data concerning delivery of care by providers.

Health System Implications

The clinical guidelines implemented by European LMICs health systems included in this review imply a potential need for technological upgrades in the methods for care of diabetes. The Polish Diabetes Society was mentioned to have published guidelines on diabetes patient management addressing glycaemia, lipid levels, arterial blood pressure and other indicators [25]. However this was the only study utilizing specific guidelines to improve measures assessing control of risk factors. It may be helpful for health systems to incorporate information technology innovations that will assist with filling the gaps in execution of clinical guidelines. A telemonitoring intervention demonstrated technology provided better accessibility between the physician and patient. The study reported approximately 64% of patients with telemonitoring had a desire to continue telemedicine support [26]. It has been previously suggested to incorporate technology improvements for therapeutic outcomes of care to increase the proportion of patients consistently monitored [19]. Establishing progressive technology within the health systems may allow for optimal maintenance of diabetes risk factors in European low resource settings.

As previously mentioned, the entire European LMICs was not represented in this review. This highlights the need for data on the existing strengths and weakness of their health systems in order to adapt appropriate diabetes management tools and materials. It is possible that an increase in representative data will serve as important findings to recognize which areas of a system will

benefit from technological innovation. Several European LMICs reported poor diabetes management often led to hospitalization for patients that could not maintain adequate control of risk factors. European LMICs should aim to minimize the amount of hospitalizations and amount of sick leave days associated with diabetes to save resources. A medical audit reported 67.5% of type 1 and type 2 patients had received some form of patient education related to their disease within the past year [14]. The health systems are functioning however the delivery of care is not ideal. An expansion of data to include the fourteen other European LMICs not represented in this study will encourage investigation of the health system operations in each country and provider indicators for capacity growth.

The two main implications are diabetes quality of care was not ideal and a number of European LMICs were not represented in this study. Individual self-monitoring of diabetes risk factors, and proper training of providers to accurately execute known diabetes guidelines can both provide relief to a growing burden of diabetes in European LMICs. Reinforcing the need for extensive research to fill the gaps in data coupled with technological advances in European LMIC health systems will provide feasible improvements to a less an adequate quality of care for diabetes.

Consideration of Study Designs

The study design of an investigation will influence the conclusions and recommendations provided in a publication. Among these twenty-seven studies, a variation of data collection and extraction occurred ranging from self-reporting, case histories, medical audits, questionnaires based on national registry data or

completed by interview, study specific measurements or recall, and medical chart review. Few studies incorporated an intervention based on health education related to diabetes management therefore it is conceivable that awareness of disease is minimal. Few studies could provide a sample of diabetes patients without coexisting complications or diagnoses of other illnesses. The range of study designs from cross-sectional to clinical trials often had few proven diabetes management guidelines to base their own approach making it apparent that European LMICs thus far have not modified standards of care processes for diabetes patients. This systematic review highlights its usefulness to establishing multifaceted health systems that empower patients to better self-manage their diabetes. It is likely that an increase in interventions with diabetes education components will assist to improve quality of care delivered to patients.

The quality scores for 14 of the studies, across the spectrum of survey-based, clinic-based, and studies in children were poor quality, mainly because these studies were non-random, self-reported, not representative of European LMICs and unable to report the response rate. The major themes in these poor quality studies have consistent themes found in the fair and good quality studies, which emphasize diabetes management through provider's continued education, and appropriate patient education as well as health systems implementing clinic guidelines to improve the capacity of diabetes quality of care.

Qualitative Implications

The most interesting findings of this systematic review broadly touch on the need for a strong patient-physician relationship such that patients are empowered to better self-manage their diabetes. European LMICs health care

systems can be adjusted to meet the needs of its population considering the differences in the countries represented in this literature review. An individual's quality of care may not entirely depend on health costs and researching other existing circumstances that may be preventing them from obtaining appropriate care is applicable for the European LMICs. Considering that some LMICs may have less than optimal resources for delivery of care then it would be beneficial to learn and understand how other countries with limited resource settings achieve best care. A patient's individual contribution to their health should be well invested during the early stages of their diagnosis and maintained throughout the progression of diabetes. Ideally, patients diagnosed with diabetes should have a positive shift in their commitment to disease management, and possibly overcoming an individual barrier for better diabetes care.

Limitations

The limitations of this systematic review of the literature include heterogeneity, publication bias, language bias, and limited generalizability to all LMICs of the world, or to the entire European region (high-income countries and LMICs combined). The published study results reported in this literature review did not follow the same experimental protocol and their designs were broadly categorized as survey-based or clinic-based studies. The methods applied for each published study will vary by country, especially pertaining to language materials printed or verbally used during studies. The topic of language bias also pertains to this systematic review because only published papers available in English were included. Bias may also stem from excluding unpublished studies and other forms of literature like editorials, commentary, or conference

presentations, which might affect the amount of optimistic results. Proven guidelines for diabetes quality of care may not be universally applicable to all European communities, especially for rural settings with financial restrictions.

Conclusion

Diabetes quality of care requires a multifaceted approach that involves important investments by the individual, provider, and the health system. A patient's commitment and empowerment is one component in quality of care as well as averting providers from acting with indifference when delivering care thus creating incentive programs that encourage intensive treatments may improve European LMICs quality of care for diabetes. Furthermore this complex approach requires health systems to establish support tools and information technology systems that will best facilitate delivery of care. When European LMICs compose tools and resources for diabetes management it is important to consider the individual perspective, accommodate questions and concerns while providers purposefully show an investment in a patient's health and in return enable the patient to improve their health.

Continued education is a provider's professional contribution that enhances the effectiveness of diabetes delivery of care. Teaching techniques used to educate a patient about health management should consider a patient's unique diagnosis. When a health system review is completed one of the deliverables should be sharing an audit summary with the health care providers to offer recommendations for their professional growth in their daily work.

Health centers can improve on compliance with criteria and standards implemented at the early stages of diabetes. A majority of European LMICs

should develop and implement continuing education for their providers in order to practice high standards of quality of care. If clinical performance guidelines for diabetes management have been established in a country then they should be firmly followed. European LMICs health systems function in low resource settings therefore optimal use of primary care centers is key to incorporating diabetes counseling since it is most suitable for patient's continuity of care and less division of diabetes care.

Recommendations

This review emphasizes the lack of widespread data on diabetes quality of care among European LMICs despite the diverse settings there is a universal disease disparity occurring in these populations. The scarcity of data coincides with the scarcity of financial resources for the European LMICs and there is a need for a strong community approach to improve quality of care for people with diabetes. First, the individual perspective of diabetes quality of care potentially can utilize local assessments of clinical guidelines to carefully consider the treatment strategies on individual disease status. Secondly, the providers approach to enhancing quality of care of diabetes will entail more active management and preventive education being delivered to their patients diagnosed with diabetes mellitus. Last, a nation's health system can improve diabetes quality of care by implementing novel health initiatives and technology that may lead to a cost reduction of diabetes care. Additionally, national health systems can apply guidelines for adequate provider preparation to deliver optimal quality of care and thus preventing diabetes complications.

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Tables

Table 1

Characteristics of Survey Studies Included in Review (Listed alphabetically and arranged by type 1, type 2, and type 1 & type 2 diabetes mellitus)

First Author (year); Country	Setting	Data Collection	Population	Clinical Characteristics	Glucose, Lipid, and Other Outcomes	Quality Score
Type 1 Diabetes Mellitus (2)						
M. Andel [27] (2008); **Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia**	258 outpatient diabetic clinics	"Questionnaires for each randomly enrolled patient" Completed by endocrinologist or diabetologist	N=2497 51.6% male 36.9 years mean age	24.0 BMI mean; 13.7 years mean duration of diabetes • **Other** Retinopathy 40.9%; Nephropathy 27.8%; ESRD 0.44%; Neuropathy 31.2%;	• **Glucose Outcomes** 8.2% mean HbA1c; 91% SMBG; 69% human insulin • **Lipid Outcomes** 1.5mmol/l HDL; 2.8 mmol/l LDL; 4.9mmol/l TC; 1.34 mmol/l TG • **Other Outcomes** 124 mmHg mean systolic BP; 76 mmHg mean diastolic BP; 2.4% metformin; 35% ACE inhibitors; 82% feet exam; 93% eyes exam; 57% combined (ECG, feet and eyes); 18.3% smoking	3
F. Toti [16] (2007); **Albania**	-	"We examined the medical records of all diabetic adults living in Tirana district, updated during the period 2004-2005." Participants interviewed during medical visit; Updated questionnaire used computerized	N=740 51.35% male 20.2 years mean age at diagnosis	26.48 mean BMI; 9.7 years mean dd • **Other** 32% central obesity; 6.5% history of CVD	• **Lipid Outcomes** 56.49% TC ≥200 mg/dl; 79.17% low HDL-C for men; 80.56% low HDL-C for women; 17.36% TG >250 mg/dl; 40.3% dx hypercholesterolemia; 26.3% medication to control hypercholesterolemia	6

		program and database			• **Other Outcomes** 133.1 mmHg mean systolic BP; 81.7 mmHg mean diastolic BP; 42.25% HTN; 85.4% current insulin treatment; 21.4% HTA dx or treated; 46.1% medication for HTA control; 26.6% daily aspirin use; 16% current smokers	
Type 2 Diabetes Mellitus (5)						
M. Andel [27] (2008); **Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia**	258 outpatient diabetic clinics	"Questionnaires for each randomly enrolled patient" Questionnaire completed by endocrinologist or diabetologist	N=8231 47.3% male 62.2 years mean age	30.6 BMI mean 10.2 years duration of diabetes • **Other** Retinopathy 31.8%; Nephropathy 25.3%; ESRD 0.47%; Neuropathy 31.0%;	• **Glucose Outcomes** 7.7% mean HbA1c; 67%; SMBG; 46% human insulin • **Lipid Outcomes** 1.27mmol/l HDL; 3.11mmol/l LDL; 5.39 mmol/l TC; 2.12 mmol/l TG • **Other Outcomes** 141 mmHg mean systolic BP; 83 mmHg mean diastolic BP; ACE inhibitors 60%; 82% feet exam; 88% eyes exam; 67% combined (ECG, feet and eyes); 50% metformin; 18.8% smoking	3
L. Leiter [28] (2006); **Ukraine, Hungary, Bulgaria, Turkey, Czech Republic,**	Physicians caring for ≥ 40 T2D patients per month, practicing ≥ 2 y since formal med training	"Physicians were invited to take part in the survey by a letter…" Web-based survey	N=208	• **Other** No known CVD	• **Lipid Outcomes** 3.6 mmol/L mean HDL-C; 3.4 mmol/L mean LDL-C; 88% TG routinely evaluated; 90% TC routinely evaluated; 89% HDL-C routinely evaluated; 74% LDL-C routinely	1

Slovakia, Poland, Romania					evaluated	
K. Malec [25] (2008); **Poland**	1 primary health care clinic	"The register of the outpatient clinic included 279 diabetic patients; All diabetic patients invited to take part in the questionnaire."	N=168 35% male 67.2 years mean age	32.6 kg/m^2 mean BMI 8.2 years mean duration of diabetes • **Education** 6% partial primary; 58.5% primary; 19% elementary; 14% secondary; 2.5% university degree • **Other** 87% retired; 8% working; 5% unemployed	• **Glucose Outcomes** 40% did self-control of blood glucose; 90% unknown last HbA_{1c} test; 3% during last 6-12 months; 33% patients performing BGSM • **Other Outcomes** 7% patients on diet; 65% treated with drugs; 5% oral drugs & insulin; 23% insulin; 55% BP control done; 34% performed foot exams	2
M. Molnár [24] (2000); **Hungary**	1 outpatient department of Nephrological and Diabetes Center, Medical University of Pecs	"Patients followed-up at our outpatient department" Case history processing	N=200 50% male 57.8 years mean age of NA group 58.6 years mean age of MA group 60.6 years mean age of MAA group	NA group: 9.8 years mean duration of diabetes; 65% HTN; 11.5 years mean duration of HTN MA group: 10.6 years mean duration of diabetes; 77% HTN; 10.6 years mean duration of HTN; MAA group: 12.1 y mean duration of diabetes; 81% HTN; 12.9 years mean duration of HTN	• **Glucose Outcomes** NA group: 8.7 mmol/l mean FBG; 8.6% mean HbA_{1c} MA group: 10.0 mmol/l mean FBG: 7.73% mean HbA_{1c} MAA group: 9.8 mmol/l FBG; 8.36% mean HbA_{1c} • **Lipid Outcomes** NA group: 5.96 mmol/l mean cholesterol; 2.52 mmol/l mean TG MA group: 6.04 mmol/l mean cholesterol; 3.1 mmol/l mean TG MAA group: 6.4 mmol/l mean cholesterol; 3.55 mmol/l mean TG • **Other Outcomes**	1

					27% smokers; 11% former smokers; 62% non-smokers	
F. Toti [16] (2007); **Albania**	-	"We examined the medical records of all diabetic adults living in Tirana district, updated during the period 2004-2005." Participants interviewed during medical visit; Updated questionnaire used computerized program and database	N=6480; 48.58% male 57.5 years mean age at diagnosis	28.71 kg/m^2 mean BMI 4.56 years mean duration of diabetes • **Other** 55.5% central obesity; 9.1% history of CVD	• **Lipid Outcomes** 67.49% TC ≥200 mg/dl; 76.64% low HDL-C for mean; 87.64% low HDL-C for women; 15.94% TG >250 mg/dl • **Other Outcomes** 141.0 mean systolic BP; 85.06 mean diastolic BP; 65.88% HTN; 0.69% diet only; 40.2% HTA diagnosed or treated; 60.2% medication for HTA control; 49.3% dx hypercholesterolemia; 8.7% daily aspirin use; 17.1% current smokers	6
Type 1 and Type 2 Diabetes Mellitus (3)						
J. Drzewoski [23] (2005); **Poland**	1 internal diseases dept.; 3 out-patient centers	"Randomly selected asked to complete a questionnaire"	N=464 (9 T1D, 455 T2D) 38.8% male 61.3 years mean age	33.4 kg/m^2 mean BMI 68.5% classified as overweight or obese 69 years average duration of diabetes • **Other** 63.6% self-reported CHD; 30.2% declared CHD family history	• **Lipid Outcomes** 58% reported elevated cholesterol • **Other Outcomes** 72.1% regularly take ASA; 78.2% reported counseling by physician why to use ASA regularly; 90% of ASA users reported uninformed about ASA side effects; 9% patients were informed by physician that diabetes increases risk of CVD & considered equivalent to CHD; 62.9%	1

					HTN; 7.1% current smokers	
A. Novo [14] (2008); **Bosnia and Herzegovina**	5 Primary health care centers: Doboj, Brčko, Tuzla, Klandaj, Orašje	"Each of the 18 family medicine teams was asked to retrieve the medical record of every fourth patient with type 1 or type 2 diabetes mellitus and gather a total of 30 records per team; The teams were asked to fill out the questionnaire by answering the questions for each patient." 10-day medical audit	N=536; 36.8% male; 55.6% patients in 61-75 age group 11.4% T1D 88.6% T2D	25% had BMI measured at each visit to family medicine team Duration of diabetes was unknown • **Other** 138 patients with family history of disease	• **Glucose outcomes** 26.5% normal HbA_{1c} in previous 3 months; 43% normal FBG • **Lipid Outcomes** 72.9% lipid profile or TC checked • **Other Outcomes** 67.2% BP was measured at each family medicine visit; 76.9% known increased BP; 91% taking other prescription medicine; 67.5% received oral diabetic medications; 67.5% received some sort of patient education related to disease during last year; 60 smokers; 81.6% smokers advised to stop	6
E. Opalińska [18](2003); **Poland**	Single center, provincial diabetic outpatient department	"…Participants filled in a questionnaire"	N=53 43.4% male 57.5 years mean age 15% T1D; 85% T2D	28 kg/m^2 mean BMI 39.6% normal body mass 60.4% overweight or obese 9.7 years mean duration of diabetes • **Other** 71.7% retired subjects; 30.2% coronary artery disease; 7.5% kidney disease; 3.8% liver disease; 52.8% sight	• **Other Outcomes** 52% measure glucose level at home; 28.3% checked BP systematically; 98% systematically underwent medical check up once per 3 mo.; 20.7% insulin; 5.7 years mean duration insulin therapy; 67.8% regular ophthalmologist visit; 67.9% took care of feet; 56.6% HTN; 56.6% PA; 71.7% considered knowledge of DM sufficient;	2

	deterioration complaints	20.7% smokers

Table 2

Characteristics of Clinic Based Studies included in Literature Review (Listed alphabetically and arranged by type of diabetes mellitus)

First Author (year); Country	Setting	Data Extraction	Population	Clinical Characteristics	Glucose, Lipid, and Other Outcomes	Quality Score
Type 1 Diabetes Mellitus						
M. Bujnowska-Fedak [26] (2006); **Poland**	Family doctor practices located in Lower Silesia region	Telemedicine system: patient unit and medical unit connected by network	N=30	-	~ 64% patients with telemonitoring desire to continue telemedicine support ~8.5% HbA1c of insulin dependent patients with telemonitoring ~ 8% $HbA1_c$ of insulin dependent patients with traditional monitoring	2
J. Chan [13] (2009); **Romania, Bulgaria, Turkey, Tunisia, Bosnia**	-	"Physicians enrolled the first five type 1 diabetic…aged 18 years who attended their clinics over a 2-week period."	N=914 35.2 years mean age	24.0 kg/m^2 mean men BMI 23.4 kg/m^2 mean women BMI 11.0 years mean time since diagnosis	• **Lipid Outcomes** 41.5% LDL cholesterol <100 mg/dl; 78.4% HDL >40 mg/dl; 70.5% TG <150 mg/dl • **Other Outcomes** 43.8% BP <130/80 mmHg; 99.2% health coverage; 92.6% trained by diabetes educator; 81.4% regularly SMBG	3
P. Luźniak [15](1993); **Poland**	Warsaw City diabetic out-patient service	"In 1992 the representative cohort of diabetic patients…"	N=580 50.3% male 42.4 years average age	22.0 years average duration of diabetes	• **Other Outcomes** 41% morbidity due to diabetic retinopathy; 12.1% morbidity due to proliferative retinopathy 9.7% morbidity due to diabetic nephropathy; 12.7% morbidity due to ischemic heart disease	2

J. Nadas [29] (2009); **Hungary**	11 diabetes outpatient departments	"Adult Caucasian patients with type 1 diabetes were consecutively investigated"	N=437 47.8% male 40.3 years mean age of low education level 37.9 years mean age of middle education level 37.2 years mean age of high education level	Low, Middle and High Education Level (all education): 24.6-26.5 kg/m^2 mean range BMI 18.9-21.1 years mean duration of diabetes • **Other** 2.3-12.5% range of CVD	• **Glucose Outcomes** All education levels: 7.9-8.8%, average range HbA_{1c} • **Lipid Outcomes** All education levels: 1.43 -1.52 mmol/l mean range of HDL-C; 1.21-1.42 mmol/l mean range serum TG • **Other Outcomes** All education levels: 126-129 mmHg mean range systolic BP; 77-79 mmHg mean range diastolic BP; 5.4-33.1% range of low daily PA; 11.6-28.6% range of smokers	2
E. Starostina [21] (1994); **Russia**	Single center, National Research Centre for Endocrinology	"121 consecutive Type 1 diabetic patients…who were admitted for in-patient treatment"	N=121 49.6% male 28.7 years mean age of female UGSM group 29.1 years mean age of female BGSM group	23.6 kg/m^2 mean BMI of UGSM group; 22.4 kg/m^2 mean BMI of BGSM group 11 years mean dd of female UGSM group; 10.9 years mean dd of female BGSM group	UGSM group: 12.5% mean HbA_1; 9.8 mean diabetes related hospitalization days; 7.8 mean diabetes-related, sick leave days BGSM group: 12.6% mean HbA_1, 9.0 mean diabetes related, hospitalization days; 11.1 mean diabetes-related sick leave days • **Other Outcomes** 8 hypoglycaemia cases; 19 diabetic ketoacidosis cases	3
J. Wilczynski [20] (1999); **Poland**	Lodz participating centers	"…Randomly selected patients"	N=88 39.8% male 34.9 years mean age	25.03 kg/m^2 mean BMI 12.2 years mean duration of diabetes	• **Glucose Outcomes** 8.13% mean HbA_{1c}; 8.4mmol/l mean FBG; No hypoglycaemia observed • **Other Outcomes**	3

					44 cases no evidence of chronic diabetes complications; 10 retinopathy and 2 nephropathy cases; 14 cases with retinopathy, neuropathy & nephropathy	
Type 2 Diabetes Mellitus						
H. Greenberg [30] (2005); **Russia**	1 clinic; Kazan Polyclinic #18	"Enrolled 192 patients with hypertension"	N=68 23.5% male 57 years mean age • **Other** 10.3% history of MI; 10.3% history of stroke	94.1% BMI > 25 kg/m^2	• **Glucose Outcomes** 56.6% mean HbA_{1c} >8%; 67.7% fasting blood sugar >6.9 mmol/L • **Lipid Outcomes** 67.7% cholesterol > 5.2 mmol/L • **Other Outcomes** 172.9 mmHg mean Systolic BP; 97.9 mmHg mean Diastolic BP; 5.9% smoking	1
J. Gumprecht [31] (2008); **Poland**	-	"In order to minimize selection bias, patients were enrolled on a consecutive basis…"	N=4117 48% male 60.7 years mean age	30.5 kg/m^2 mean BMI 7.1 years mean duration of diabetes • **Other** 28.6% Retinopathy; 9.3% nephropathy; 20.6% neuropathy	• **Glucose Outcomes** 8.95% mean HbA_{1c}; 10.2 mmol/l mean FBG • **Other Outcomes** 89.2% oral anti-diabetics; 10.8% no drug treatment	5
M. Khalangot [32] (2008); **Ukraine**	Multicenter (25 regions and city of Kiev)	Population-based register "System of Diabetes Mellitus Care in Ukraine (SINADIAB); information supplied by primary care doctors; "population-based observational cohort"	N=89,443 34.1% male 63.3 years mean age of men 65.5 years mean age of women	Men: 27.1 kg/m^2 mean BMI 30.6% dd <5 years; 59% dd 5-19 years; 10.4% dd ≥ 20 years Women: 28.4 kg/m^2 mean BMI	• **Glucose Outcomes** Men: 47.4% OGLD for men; 27.8% insulin; 24.8% OGLD & insulin Women: 51.8% OGLD for women; 21.9% insulin; 26.3% OGLD & insulin • **Lipid Outcomes**	3

				26.2% dd <5 years; 62.2% dd 5 – 19 years; 11.6% dd ≥ 20 years • **Other** 8.77% diagnosed with CHD and stroke at baseline	5.6 mmol/l mean serum cholesterol men; 5.7 mmol/l mean serum cholesterol women • **Other Outcomes** Men: 86 mmHg mean diastolic BP; 144 mmHg mean systolic BP; 20.3% current smoking Women: 87 mmHg mean diastolic BP; 148 mmHg mean systolic BP 1.2% current smoking	
D. Kurktschiev [33] (2009); **Bulgaria**	-	Subjects examined between 2005 to 2007; questionnaire on medical history; anthropometric measurements	N = 1131 (556 T2D, 575 control) 49.2 % male 54 years mean age	27.1 kg/m^2 mean BMI; 101 cm mean WC Clinical onset diabetes > 60 years; unknown duration of diabetes • **Other** 78% history of angina pectoris or myocardial infarction;	• **Glucose Outcomes** 8.4 mmol/l mean FBG T2D • **Lipid Outcomes** 5.8mmol/l mean TC; 2.18 mmol/l mean TG; 0.96 mmol/l mean HDL • **Other Outcomes** 131 mmHG mean systolic BP; 85 mmHG mean diastolic BP; 56% medical history of HTN; 20% smokers	3
P. Luźniak [15] (1993): **Poland**	Warsaw City diabetic out-patient service	"In 1992 the representative cohort of diabetic patients"	N=2346 45.7% male 59.3 years average age	16.7 years average duration of diabetes	• **Other Outcomes** 25.3% morbidity due to diabetic retinopathy; 1.9% morbidity due to proliferative retinopathy; 3.4% morbidity due to diabetic nephropathy; 47.9% morbidity due to ischemic heart disease	2
V. Petkova [34] (2006);	1 community pharmacy	"The course presented to 24 ambulatory patients."	N=24; 29% male; 64.96 y mean age	8.7 years average duration of diabetes	• **Glucose Outcomes** 8mmol/l mean blood glucose; 58% frequency of hypo/hyper-	2

Bulgaria					glycemic incidents; 72% sulphonylurea agents consumed • **Other Outcomes** 12.5% QL positive changes in mood; 18.4% QL increase in days "being easy"; 10.8% QL increase in social activity; 15% QL increase in days being "rested"; 13.4% QL increase in PA	
M. Pibernik-Okanovic [35] (2004): **Croatia**	Intervention; Vuk Vrhovac University Clinic	"Patients were partially recruited within regular medical check-ups and partially by sending invitational letters from clinic"; patient files and questionnaires	N=108 52.5% male 53.3 years mean age of intervention (I); 52.8 years mean age of control (C)	28.7 kg/m^2 mean BMI I; 28.8 kg/m^2 mean BMI C 8.0 years mean dd I; 6.1 years mean dd C	9.65% mean HbA_{1c}; 38% readiness to participate in empowering course; 43 votes aware of seriousness of diabetes; 31 votes encouraged for self-management; 70 votes difficulty associated with daily problems	5
Ž. Resman [36] (1993): **Croatia**	Vuk Vrhovac Institute	"Patients consulted at this Institute have been entered into database"; findings entered into dbaseIII+ and standardized record form	N=3244	Non-proliferative retinopathy: ~18% 0-5 years dd; ~39% 6-10 years dd; ~63% 11-20 years dd; ~69% >20 years dd • **Other** 2.1% blind due to diabetic retinopathy	Non-proliferative retinopathy: ~43% HTN; 50% insulin therapy; 10% diet therapy Proliferative Retinopathy: ~9% HTN; ~10% insulin therapy; ~1% diet therapy Maculopathy: ~20% HTN; ~20% insulin therapy; ~3% diet therapy Overall: 72% patients examined by Ophthalmologist within past 2 years	2
J. Wilczynski [20] (1999);	-	"Randomly selected patients"	N=132; 45.5% male; 61.1 y mean age;	30.4 kg/m^2 mean BMI 10 years mean	• **Glucose Outcomes** 9.08% mean HbA_{1c}; 7.7 mmol/l	3

Poland				duration of diabetes	mean FBG • **Other Outcomes** 23 retinopathy cases; 4 nephropathy cases; 64 HTN cases; No hypoglycaemia observed	
Type 1 & Type 2 Diabetes Mellitus						
K. Dębe [37] (2008); **Poland**	Single center, Medical University of Warsaw	Retrospective analysis of hospital records between 1994 – 1998	N=1772 (243 T1D, 1529 T2D) Overall: 65.5 years mean age 42.67% male	9.57 years duration of diabetes	T1D: 24.07% patients with hypoglycaemia; 12.56% patients without hypoglycaemia; T2D: 77.22% patients with hypoglycaemia; 84.01% patients without hypoglycaemia T1D & T2D: 42.59% incidence of complications of diabetes among patients with hypoglycemia; 50.0% insulin therapy among hypoglycemia group; 28.02% insulin therapy among group without hypoglycemia	1
D. Koev [38] (2001); **Bulgaria**	4 University centers; 48 regional centers; 4 centers for education of children with diabetes	For patients' convenience some centers, compressed 10 education sessions in 3 consecutive days; "2055 patients were allocated to education or not to be educated."	N=2055 (1,028 T1D and 1,003470 T2D) Education group: 41.76% male; 46.29 years mean age Non education group: 45.72% male; 51.31 years mean age	25.60 kg/m^2 mean BMI education group 25.87 kg/m^2 mean BMI non education group 10.47 years mean dd education group 12.98 years mean dd non education group	Education group: 49.8% routine visit reason for consultation; 5.89% newly diagnosed reason for consultation; 4.22% emergency reason for consultation; Non Education group: 54.92 % routine visit reason for consultation; 3.79% newly diagnosed reason for consultation; 1.74% emergency reason for consultation	2

T. Tankova [17] (2001); **Bulgaria**	1 center; Medical University of Sofia	"Diabetic patients educated in Department of Diabetology"; all patients underwent standardized evaluation protocol using patient data, lab results, and knowledge assessment	N=201 (147 T1D, 54 T2D) 43.0% male 34.4 years mean age	10.3 years mean duration of diabetes • **Other** 28% diabetic retinopathy; 17% nephropathy; 6% ESRD; 9% MI; 7% stroke	• **Glucose Outcomes** 9.1% mean HbA_{1c}; • **Other Outcomes** 41 overall quality of life score; 52% diabetes-related knowledge; 4% carried 15g of sugar; 16% keep log book; 122 smokers;	6

Table 3
Characteristics of Children Population, Type 1 Diabetes Studies included in Review (Listed alphabetically)

First Author (year); Country	Setting	Data Collection and/or Extraction	Population	Clinical Characteristics	Glucose, Lipid, and Other Outcomes	Quality Score
P. Betts [39] (1999); **Russia**	3 diabetic centers in Moscow, Tambov and Tula	"Children were selected according to distance they lived from the center"	N=266 7.11 years mean age at diagnosis	(According to 1990 British chart) mean BMI 56th centile; mean height 21st centile; mean weight 50th centile 2.81 years mean duration of diabetes	• **Glucose Outcomes** 9.6% mean HbA_{1c} with sufficient insulin; 8.7% mean HbA_{1c} with insufficient insulin • **Other Outcomes** 12% background retinopathy; 12% reported episodes of severe hypoglycaemia resulting in change in consciousness level 7% 1st degree relatives with DM; 69% ketoacidosis at presentation; 30 days average initial hospital stay	3
Jarosz-Chobot [40] (2000); **Poland**	"Children from Upper Silesia, Poland"; "diabetes centers in Katowice, Poland."	"263 Simple and anonymous questionnaires"; "The children were filling in the questionnaires by themselves."	N=80 45% male 14.19 years mean age	4.77 years mean duration of diabetes	• **Glucose Outcomes** 8.53% mean HbA1c Polish group: 61% intensive insulin therapy • **Other Outcomes** 57.5% carrying sugars; 87.5% forgetting insulin shots-never; 3.75% forgetting insulin shots-once a month; 1.25% forgetting insulin shots-once a week	2
Romanian Young	12 health centers	"Longitudinal, sequential study"; patient study visits every 4 weeks	N=159 49.1% male	46.6 lbs. mean weight 4.07 years mean	• **Glucose Outcomes** 11.91% mean HbA_1; 10.6 mean	3

Diabetics Study Team [41] (1997); **Romania**	over 12 week period; all patients invited for follow-up ~ 1 year after transfer to Mixtard® 30 HM Penfill®; Questionnaire in Romanian	13.45 years mean age	duration of diabetes • **Other** 1.7% non-proliferative retinopathy; 6.7% signs of neuropathy; 11% micro vascular disease	FBG; 10.81 BG mean before lunch; 11.77 BG mean before dinner; • **Other Outcomes** 0.025 number of events/patient/year severe hypoglycemia; 0.47 number of events/patient/year severe ketoacidosis;

Appendix A

Exclusion Code Guidelines

Exclusion Code	Reason
1	Does not include diabetes mellitus
2	Uncommon forms of diabetes mellitus
3	Focuses on genetics of metabolic disorders
4	Non-human subjects
5	Focuses only on gestational diabetes
6	Focuses only on developed and/or high-income countries (as defined by World Bank Atlas) [12]
7	No quality of care indicators and no population-based estimates of risk factor control
8	Not in English language
9	Duplicate of previous article
Relative Considerations	Pre-existing cardiovascular disease

Appendix B

Quality Score Assessment Guidelines

Survey and clinic based studies quality assessment

Quality Score	Method of Sampling	Method of Data Collection	Representative Sample	Response Rate
7 Total Score Possible	0 = voluntary or selective sample 1 = random selection or chart review	0 = self reported 1 = chart review or registry database review 2 = measured for study	0 = no 1 = yes	0 = not reported 1 = <50% 2 = 50% – 74.9% 3 ≥75%

Total Score assessment	Score
Good	5-7
Fair	3-4
Poor	1-2

Quality Scoring Criterion

I. Method of sampling
   a. 0= voluntary sampling / selective sampling
      i. *Example: people who volunteer as patients in diabetes specialty center/University departments*
      ii. *Example: private physician offices who selectively invite particular patients to participate*
   b. 1= random sampling or chart review
      i. *Example: first 15 patients in line on a particular day or chart review throughout a clinic or patient registry review*
      ii. *Example: sampling patients randomly or with a systematic process (every 10th patient)*

II. Method of data collection
   a. 0= self reported
   b. 1= chart review/national registry database review
   c. 2= measured for study in standardized manner among all patients

III. Representative sample
   a. 0= non representative sample
      i. *Example: private physician*
      ii. *Example: patients of diabetes specialty center / only type 1 DM / specialized patients*
      iii. *Example: only rural or only elderly or only kids or only males*
   b. 1= representative sample

i. Example: gives you a sense that the sample was balanced and possibly represents a range of ages / genders / education level / etc.

Representative Sample (continued)

ii. Example: representative of country's healthcare system

IV. Response rate
   a. 0= not reported
   b. 1=<50%
   c. 2=50-74.9%
   d. 3= ≥75%
      i. *Example: chart review is most likely 100% (if data were missing for a chart review, count it the same as response rate; i.e. for 30% missing data, receives a 2 for response rate)*