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## An integrative systematic review of interprofessional education on diabetes

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### ABSTRACT

Interprofessional education (IPE) aims at enhancing the ability of healthcare professionals from different disciplines to work together effectively, improving the quality of patient care. An interprofessional approach is essential in diabetes management, but there is only limited evidence of the effects of diabetes-specific IPE. The aim of this integrative review is to gather all relevant recent data on the outcomes of IPE on diabetes management. The search in the CINAHL, Medline and PsycINFO databases resulted in 1136 potential studies. An inductive content analysis was used to synthesize the key findings of the 14 studies found to fulfill the inclusion criteria of the systematic review. Two main categories and four subcategories of findings were identified. Firstly, **the achieved outcomes** included *individual gain* (e.g., learner's confidence and motivation to treat patients with diabetes) and *external benefits* (e.g., benefits for the patient). Secondly, **the experiences** of IPE included both *challenges* (e.g., competing interests of different professions) and *strengths* (e.g., practical approach to diabetes management). In conclusion, the findings indicate that both learners and patients with diabetes benefit from IPE on diabetes management. Educators are encouraged to adopt practical IP approaches in diabetes education. However, it is necessary to estimate the resources available. More research is needed on the cost-effectiveness, long-term effects, and patient perspective of IPE on diabetes management.

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### KEYWORDS

Content analysis; diabetes management; integrative systematic review; interprofessional education

## Introduction

### Background

The World Health Organization (WHO) emphasizes the importance of future health care workers' interprofessional competencies, in order to optimize the skills of diverse team members, to enhance co-operation in case management and to provide better health care for patients. As a response to this need, interprofessional education (IPE) is highly recommended. (Frenk et al., 2010; World Health Organisation, 2010) Diabetes is one of the most serious global health concerns with one in every 11 persons worldwide suffering from it (International Diabetes Federation, 2015), and an interprofessional approach is considered particularly important to offer cost-effective, optimal care for a large group of patients with diabetes (Andrews, Houdek, & Kiemele, 2015; Antoine, Pieper, Mathes, & Eikermann, 2014; Schouten, Niessen, van de Pas, Grol, & Hulscher, 2010). The care of diabetes is complex, rapidly evolving and strongly dependent on the patient's self-management, and on intensive education empowering him/her for it (American Diabetes Association, 2015; Chrvala, Sherr, & Lipman, 2016; Inzucchi et al., 2012). It is therefore essential that all the people involved in organizing and delivering diabetes care possess the best available knowledge and skills to work together for the patient (Cuddihy, Philis-Tsimikas, & Nazeri, 2011; International Diabetes Federation, 2015).

According to the WHO, "interprofessional education occurs, when two or more professions learn about, from and with each other, to enable effective collaboration and improve health outcomes" (World Health Organisation, 2010, p. 13). The idea of learning together is appealing, and IPE has been studied previously in several aspects (Reeves et al., 2016). The systematic reviews conducted on IPE for health care students reveal several positive outcomes, such as increased knowledge of the roles of other professions (Kent & Keating, 2015; Thistlethwaite & Moran, 2010), improved teamwork skills (Kent & Keating, 2015; Reeves et al., 2016; Thistlethwaite & Moran, 2010), collaborative team behavior (Reeves, Perrier, Goldman, Freeth, & Zwarenstein, 2013; Thistlethwaite & Moran, 2010), reduction of clinical errors (Reeves et al., 2013), and recognition of the patients' needs and of safety issues (Thistlethwaite & Moran, 2010). A recently updated synthesis of IPE reviews however, found rather limited evidence of IPE enhancing collaborative practice, or improving patient care (Reeves, Palaganas, & Zierler, 2017).

Interprofessional collaboration has been considered beneficial in the health services for patients with a chronic disease (Körner et al., 2016; Wagner, 2000), and the importance of IPE aimed at improving the management of chronic conditions has been acknowledged (Ross & Harris, 2005). Systematic reviews of the impact of IPE on chronic diseases

have previously addressed conditions like dementia (Jackson et al., 2016), arthritis, asthma or cardiac diseases (Reeves, Goldman, Burton, & Sawatzky-Girling, 2010).

Regardless of the positive outcomes of IPE in general, and the importance of interprofessional diabetes management in clinical practice, there is limited evidence regarding the impact of IPE on diabetes management for healthcare students and professionals (Dean et al., 2014). To our knowledge, no systematic reviews exist on this subject, so far.

## Methods

### Objective

The study question of this review was: What kind of outcomes are established when implementing IPE on diabetes management?

### Research design

This review follows the principles of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Higgins & Green, 2011; Liberati et al., 2009) and guidelines of The Joanna Briggs Institute (Joanna Briggs Institute, 2014). The principles and the methodological strategies of the systematic review were discussed before each step of the process by all the authors, and unclear issues were solved together in consensus.

### Search strategy

The literature searches were performed using the main health science databases CINAHL, Medline and PsycINFO for studies or reviews on IPE interventions on diabetes, published between January 1st, 2000 and September 7th, 2016. The time frame was chosen to cover all relevant data that is applicable to the current methods of diabetes management. The preliminary searches were performed and analyzed by the authors, and the final, modified search was conducted with the expert assistance of an information specialist. The criteria for eligible studies (Table 1) were determined according to the PICO (Participants, Interventions, Comparisons and Outcomes) method with addition of S (Study design), and formed the basis for the search terms used (Higgins & Green, 2011; Methley, Campbell, Chew-

Graham, McNally, & Cheraghi-Sohi, 2014). The searches were conducted using the Boolean logic, with Medical Subject Headings (MeSH) and free form terms. The exact search initials are available as supplemental material.

### Inclusion and exclusion criteria

Based on the study question, we focused only on studies involving an IPE program on diabetes management, targeted at two or more groups of health care or social care students or professionals, with the implementation, outcomes and experiences of the course described. We searched for qualitative, quantitative and mixed methods studies with any outcomes reported. The program was classified as IPE, when two or more groups of health care professionals or students were described learning together about, from or with each other aiming at better diabetes management, according to the WHO definition of IPE (World Health Organisation, 2010, p. 13). Therefore, we excluded interventions aimed at educating persons with diabetes by an interprofessional team, without any education targeted at the interprofessional team itself. Only peer-reviewed articles published in English between 2000 and 2016 were included. Conference abstracts were excluded.

### Screening of publications

In total, 1136 articles were found in the databases used: 65 in PsycINFO, 458 in Medline, and 613 in CINAHL. The articles were collected in Refworks, and duplicates were excluded. A PRISMA flow diagram representing the selection of studies for the integrative review is shown in Figure 1. Firstly, the titles and the keywords, and secondly the abstracts of the publications were screened against the inclusion criteria independently by two of the authors (SK and T-MR). Discrepant views on the selection of articles were discussed and solved together, after reading the full-text article. Full-texts of the chosen articles were searched for and if not found, the article was excluded from the final selection. The remaining 54 articles were read and assessed by the two researchers individually against the inclusion criteria.

### Data extraction and critical appraisal

As recommended by The Joanna Briggs Institute (JBI), the international research and development centre within the Faculty of Health and Medical Sciences at the University of Adelaide, South Australia, the quality assessment was planned together by all the authors in advance, conducted individually by the two primary reviewers, and then screened together (The Joanna Briggs Institute, 2014, p. 23). Methodological validity was first assessed by using the JBI critical appraisal instruments for specific studies: for quantitative studies, the Review Instrument checklists (Meta Analysis of Statistics Assessment MAsTARI) was used, and for qualitative studies, the Qualitative Assessment and Review Instrument checklist (QARI), respectively (Joanna Briggs Institute, 2014, p. 69). However, these checklists turned out to rate the methodologically diverse studies unjustly. Therefore, the articles were also assessed using a generic critical appraisal tool developed by Woolliams,

**Table 1.** The criteria for eligible studies in the systematic review.

Population	Two or more groups of health care or social care students or professionals.
Interventions	Any kind of education, learning, training or teaching initiative targeted at learning diabetes management, with the focus on interprofessional education (IPE), i.e., involving two or more health care professional or student groups learning together about, from or with each other, aiming at better diabetes management.
Outcomes	Any kind of outcome of the programme described.
Study design	Any type of qualitative, quantitative or mixed methods study describing the implementation and the experiences/outcomes of the IPE intervention

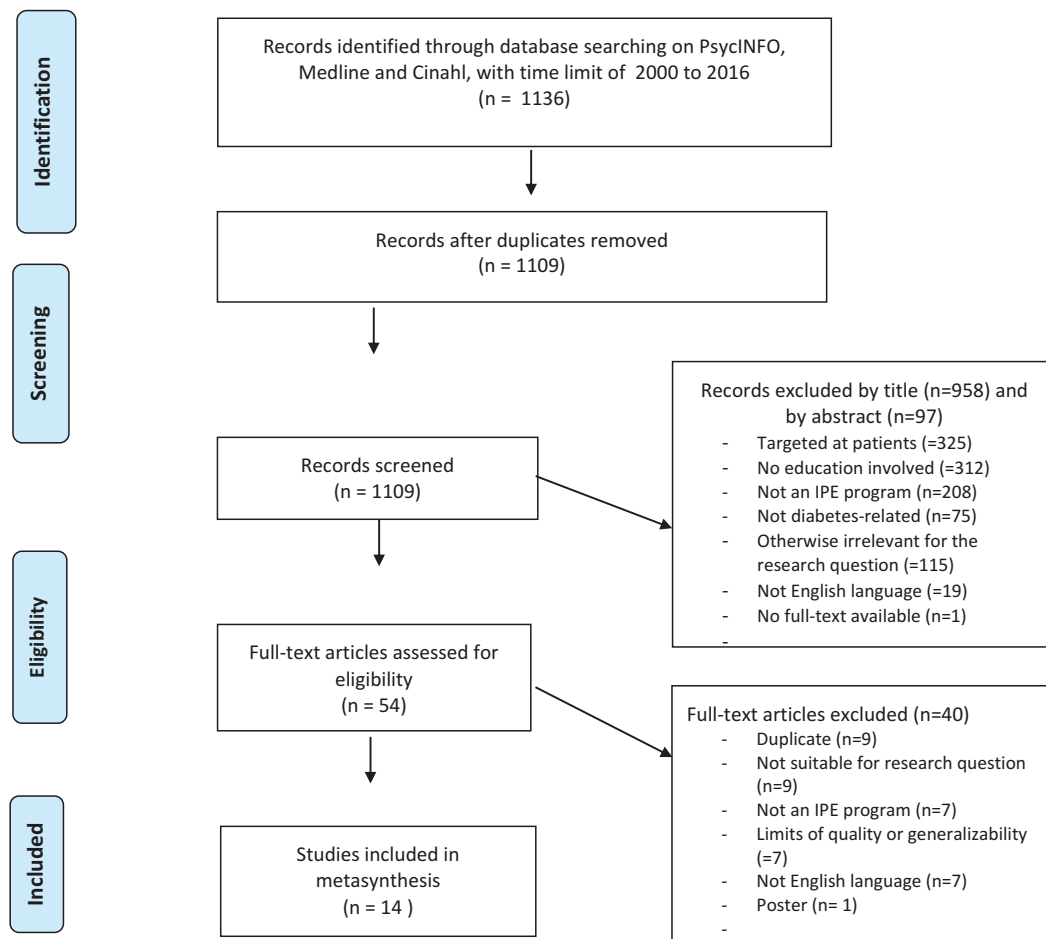


Figure 1. A PRISMA flow diagram describing the identification, screening, eligibility assessment and inclusion of studies for the integrative systematic review.

Williams, Butcher, and Pye (2009), which focuses the evaluation on the elementary value of the research. This generic tool is recommended for the evaluation, when specific appraisal tools are unsuited for the existing diverse studies (Aveyard, 2014, p. 108). The studies were rated according to the general judgement as good, tolerable or poor. The studies were rated good, if the JBI rate was 7 or more, and for mixed methods studies 4 + 7. If the JBI rate was 4 – 6, and for mixed methods studies 4 + 6, or the studies fulfilled 6/6 issues according to the generic tool, the studies were rated tolerable. The two critical appraisal tools supplemented each other and were considered to add to the validity of the quality assessment of these diverse studies. Only studies with a good or a tolerable rating were included in the final analysis. Altogether 14 articles met the inclusion criteria and were selected to the integrative review. One IPE study was represented in two different articles, of which the one considered to present better quality was selected for the review (Ching, Forte, Aitchison, & Earle, 2015). The design and the quality assessment of the studies are represented in Table 2.

**Data analysis**

We performed a qualitative, inductive content analysis of the studies included in the systematic review, to answer the

Table 2. Design and quality of the studies included in the systematic review.

Authors	Study design	Rating*
Ching et al., 2015	cohort study, mixed methods	tolerable
Coates et al., 2008	quasi-experimental, quantitative	tolerable
Hearnshaw et al., 2001	longitudinal cohort, quantitative	tolerable
Herring et al., 2013	pilot study, quantitative	tolerable
Janson et al., 2009	non-randomized, parallel-group clinical trial, quantitative	good
Kapur et al., 2015	descriptive pilot study, mixed methods	good
Kipp et al., 2007	pilot study, mixed methods	tolerable
Lennon-Dearing et al., 2008	descriptive pilot study, quantitative	tolerable
MacNeill et al., 2014	comparative pilot study, qualitative	good
Nikendei et al., 2016	pilot study, qualitative	good
Parekh et al., 2015	pilot study, quantitative	good
Pittenger et al., 2013	pilot study, mixed methods	tolerable
Shiyabola et al., 2012	quasi-experimental, quantitative	tolerable
Swanson et al., 2011	pilot study, mixed methods	good

\* good = JBI rates 7 or more, mixed methods 4 + 7 or more  
 tolerable = JBI rates 4 to 6, mixed methods 4 + 6, or 6/6 positive answers to the questions of generic critical appraisal tool  
 poor = JBI rates under 4, mixed methods under 4 + 6, or 5/6 or fewer positive answers to the critical appraisal tool's questions  
 JBI critical appraisal instruments (Joanna Briggs Institute, 2014, 69) and a generic critical appraisal tool (Woolliams et al. 2009).

research question: What kind of outcomes are established when implementing IPE on diabetes management? (Graneheim & Lundman, 2004). In an integrative analysis of research with mixed methods, the analysis is focused on all the study findings relevant to the study questions, regardless

of whether the studies are quantitative or qualitative (Sandelowski, Voils, & Barroso, 2006). Before it was possible to assimilate the diverse data into single synthesis, the quantitative data, i.e., the findings of the reviews, needed to be converted into a qualitative format, as meaningful units and codes. In this way, quantitative data were presented alongside with qualitative data, as recommended in the JBI guidelines for mixed methods research and integrated methodologies (The Joanna Briggs Institute, 2014). Firstly, the studies were read through several times and the relevant results regarding the study question were extracted by underlining. Of the quantitative data, only statistically significant ( $p \leq 0,05$ ) evidence was taken into account. Secondly, the adequate meaningful units and initial codes were determined and finally classified into subcategories according to similarities and differences. The subcategories formulated the main categories to present the abstracted data. (Graneheim & Lundman, 2004.)

## Findings

### Study characteristics

The characteristics of the selected studies are shown in Table 3. Most of the articles were from the United Kingdom ( $n = 5$ ) and the United States ( $n = 4$ ), followed by Canada ( $n = 2$ ), Germany, Denmark and Australia ( $n = 1$  of each). The studies were mainly pre-post pilot or quasi-experimental studies describing or evaluating an IPE program conducted ( $n = 11$ ). Two of the selected studies were cohort studies and one was a nonrandomized, parallel-group clinical trial. Seven studies were quantitative, five were mixed-methods and two were qualitative studies.

### Participants of the IPE programs

The IPE programs were targeted either for healthcare professionals (8/14), or for undergraduate students (6/14). Of the IPE programs implemented for undergraduate students, nursing students participated in all (6/6) and medical students in 5/6 programs. Other participants were students of pharmacy (4/6), dietetics (3/6), and physiotherapy, dental hygiene, social work or public health 1/6 each. The IPE programs implemented for professionals represented nearly an equal variety of health care specialist: nurses participated every program (8/8), physicians all except one (7/8) and the other participants were dietitians (4/8), pharmacists (3/8), and social workers or physiotherapists (1/8). In contrast to the IPE programs targeted for students, the programs for healthcare professionals also included podiatrists, laboratory technicians, occupational therapists, health care assistants and nursing technicians.

### Objectives of the IPE programs

The IPE programs were mainly targeted at improving the participants' competency, knowledge and expertise in collaborative diabetes care, and at increasing their understanding of the needs of people who live with diabetes (Coates et al., 2008; Herring et al., 2013; Nikendei et al., 2016; Pittenger, Westberg, Rowan, & Schweiss, 2013; Shiyانبola, Lammers,

Randall, & Richards, 2012). Several programmes aimed at improving the quality of care and the outcomes of patients with diabetes by enhancing an interprofessional team-based approach, interprofessional communication, and teamwork skills. In addition, one study aimed at facilitating behavioral changes of the patients by teaching communication skills and understanding of patient behavior to the healthcare professionals (Swanson, Gold, & Keen, 2011).

### IPE settings and methods

Usually the IPE programme/course was voluntary and the participants received either study credits and/or a certificate upon completion. One professional course was mandatory (Hearnshaw et al., 2001), and one course offered a financial grant for participation (Lennon-Dearing, Florence, Garrett, Click, & Abercrombie, 2008). The programmes were identical for all the participants from various professions, except for three IPE programmes organized partly in parallel sessions, with discipline-specific contents (Coates et al., 2008; Kipp, Pimlott, & Satzinger, 2007; Shiyانبola et al., 2012). In addition, one comparative study evaluated a 12-week online course consisting of similar background e-modules for all learners, and a longitudinal build-a-case exercise performed either individually or in an interprofessional group (MacNeill, Telner, Sparaggis-Agaliotis, & Hanna, 2014).

A wide variety of learning methods were used, including, e.g., interactive seminars, classes or workshops, simulated ward rounds (Nikendei et al., 2016), role plays (Swanson et al., 2011), and interactive games (Kapur, McAleer, Persson, & Bjerre-Christensen, 2015; MacNeill et al., 2014; Shiyانبola et al., 2012). In one program, the students participated in a week-long experience of living with diabetes, involving "insulin" injections (saline) four times a day, and appropriate blood glucose monitoring (Pittenger et al., 2013). In addition, patient cases were studied through clinical visits or team placements (Coates et al., 2008; Kipp et al., 2007; Lennon-Dearing et al., 2008), through internet-based clinical scenarios (Ching et al., 2015; MacNeill et al., 2014; Parekh, Bush, Cook, & Grant, 2015; Pittenger et al., 2013), and through text-based case studies (Hearnshaw et al., 2001; Herring et al., 2013; MacNeill et al., 2014).

The learners were either supported to transfer their knowledge into practice by specific IP team work assignments, like preparing action plans for team-based projects (Hearnshaw et al., 2001; Kapur et al., 2015; Lennon-Dearing et al., 2008), or by clinical visits (Coates et al., 2008; Janson et al., 2009; Lennon-Dearing et al., 2008), or the learners tested their knowledge gain in their own working environment (Ching et al., 2015; Herring et al., 2013).

### Description of outcomes measured

A summary of the measured learning objectives is shown in Table 4. Most of the studies aimed at measuring the learners' knowledge of diabetes management (8/14) and changes in the learners' behavior, when transferring the acquired knowledge and skills into their practice (7/14). Several studies focused on measuring changes in the learners' understanding of the roles of

**Table 3.** Characteristics and main results of the studies included in the systematic review.

	Authors, year, country	Population	Objectives	Setting and methods	Study design, time frame	Main results
1.	Ching et al. (2015), UK	<b>Professionals</b> GP and N from 26 practices; <b>Patients</b> (n = 4167)	To evaluate the impact on clinical behaviors and care outcomes of a novel IPE program aiming to transfer specialist diabetes care to primary care.	Curriculum based on identification of the areas of diabetes considered challenging by HCPs. Ten weekly, interactive classes, workshops and use of clinical scenarios.	Clinical data (pre-post), in-depth interviews (post), 24 months	A positive impact on the attitudes towards diabetes management at both the organisational and personal level for at least 2 years. Improvements in patient outcomes.
2.	Coates et al. (2008), UK	<b>Professionals</b> N (n = 41), Pod (n = 31), GP (n = 10), Diet (n = 15), Phar (n = 2)	To describe the operation and analysis of a community-oriented multi-professional diabetes care course over four years	Once a month classroom sessions with case studies from the patient's point of view, to learn how the members of the IP team can provide integrated patient care. Learning in the clinics, and a learning-portfolio to facilitate IP learning and debate in the classroom.	Survey (pre-post), 4 years	Improvements in students' self-assessed knowledge, clinical confidence, standard of DM care and motivation to improve the care of DM patients. Good perception of quality and usefulness.
3.	Hearnshaw et al. (2001), UK	<b>Professionals</b> GP (n = 16), N (n = 12)	To evaluate a mandatory IPE course in diabetes care for primary health care professionals.	30 hours of contact education for participants from primary care, to enable sharing of the existing knowledge and skills of the participants, supported by published evidence.	Survey (pre-post), 1 year	Improvements in self-assessed diabetes knowledge and practice organization.
4.	Herring et al. (2013), UK	<b>Professionals</b> N (n = 17), HA (n = 8), Phar (n = 3), junior doctors (n = 3); <b>Patients</b> (n = 104)	To evaluate an IPE tool used in an IPE pilot program of inpatient diabetes care.	An education tool with a jigsaw of 10 pieces module, group activities, structured discussions and practical skills related to patient scenarios and problems in diabetes management.	Self-evaluation (post), survey (pre-post), clinical data (pre-post)	The education tool improved healthcare professionals' confidence, knowledge and quality of inpatient diabetes care.
5.	Janson et al. (2009), USA	<b>Students</b> medicine residents, NS, Phar. S; <b>Patients</b> (n = 221) + control (n = 163)	To improve the care and outcomes of adult patients with type 2 diabetes; to learn the principles and practices of the Improving Chronic Illness Care Model.	The intervention group received care from the IPE learners, and the control group had the usual care. The course included weekly seminars (didactic presentations, clinical discussions on patient management and quality improvement, clinic visits), to plan quality improvement projects	Survey (pre-post), clinical data 24 months (pre) and 18 months during intervention	IP learners were able to implement quality improvement initiatives. Patients had improved processes of care, more scheduled visits and a trend toward less use of urgent care than control patients. IP learners rated higher on accomplishment, preparation, and success of care than the usual care learners.
6.	Kapur et al. (2015) DEN	<b>Professionals</b> PH, N, Diet, DEd, Lab, Pod	To evaluate the impact of an international Practical Diabetology IP course for health care professionals.	The course was directed at building a team-based approach to diabetes care, and preparing an action plan for team-based projects in the professionals' working environment.	Survey (pre-post), 6 months	The courses were appreciated. Significantly improved knowledge and positive change in attitudes were seen in the short term. 42% of the action plans were implemented.
7.	Kipp et al. (2007), CAN	<b>Students</b> MED, NS, Diet.S, Phar.S	To determine a meaningful and sustainable approach to IP team placements in diabetes management in the local health care.	A project-based team experience designed to increase students' profession-specific knowledge of diabetes, while enhancing their team process skills. Students identified top 3 diabetes-related projects for their team placement. IP teams were established from various professions, based on these choices.	Focus groups (post), Survey (post)	Increased knowledge of the roles of other health care professionals and of diabetes management from the perspective of other professions. Minor impact on students' IP team skills, knowledge of IP team functions and ability to modify team function in practice.
8.	Lennon-Dearing et al. (2008), USA	<b>Students</b> SW.S (n = 4), NS (n = 6), PubH.S (n = 3), Diet.S (n = 5), MED (n = 3)	To describe the effects of an IP, community-based course, preparing the students for work as part of an IP team.	The course included didactic learning and a community-based experience: 30 classroom hours, 30 community hours, and 30 hours of independent learning. The IP teams developed recommendations on improvements in health care delivery.	Survey (pre-post)	Student evaluations of the experience were largely positive. Working in IP diabetes team was valued most. Respect for other professions increased among all the students.
9.	MacNeill et al. (2014), CAN	<b>Professionals</b> N (n = 7), SW (n = 4), OT (n = 2), Phys. (n = 1), Diet (n = 1)	To understand the experiences, advantages, and challenges of group versus individual online learning.	12-week online course (2 weeks face-to-face + 10 weeks online): Background e-modules and a longitudinal, online build-a-patient case exercise, performed either individually or in an IP group.	Focus group (post) 4 months, reflection homework (post)	Individual learners (IL) enjoyed the control, but were less motivated. Group learners (GL) appreciated the feedback from co-learners, but felt social pressure. Both groups learned about IP roles, but GL had a deeper learning experience than IL.

(Continued)

Table 3. (Continued).

Authors, year, country	Population	Objectives	Setting and methods	Study design, time frame	Main results
10. Nikendei et al. (2016), GER	<b>Students</b> MED (n = 13), NS (n = 9), Phys.S (n = 7)	To explore students' experiences during IP ward round training.	Simulation-based IP ward round training with a focus on discharge planning. Learning exchange of occupation-specific treatment goals and IP treatment planning.	Focus group (post)	Positive: learning from each other, course preparation, setting of the training, involvement of the participants and positive learning atmosphere. Negative: flawed atmosphere, unrealistic situation, lack of equal benefit.
11. Parekh et al. (2015), AUS	<b>Professionals</b> GP, Phar, N, Ded, Den etc.	To enhance communication in primary care net-works, to support best practices and to develop IP teamwork.	9 online clinical education trainings prior to 26 IP learning workshops of 8 h each. Case studies facilitating IP discussions and awareness of the roles of other members of the IP team.	Survey (pre-post) 1 week after	Increase in participants' knowledge, perceived ability to adopt this knowledge at work, and willingness to change professional behaviour.
12. Pittenger et al. (2013), USA	<b>Students</b> Phar.S (n = 34), NS (n = 17)	To improve pharmacy and nursing students' competency in IP diabetes management.	Web-based collaborative tools were used to allow students to apply diabetes management content as an IP team. Social networking in IP teams and in face-to-face sessions.	Survey (pre-post)	Increased knowledge of roles and responsibilities with respect to the other profession. Obtained understanding of IP communication strategies and their central role in effective teamwork.
13. Shiyanbola et al. (2012), USA	<b>Students</b> MED (n = 14), NS (n = 4), Phar.S (n = 14), Dent.S (n = 9), Diet.S (n = 1)	To evaluate the impact of IPE program on students' IP proficiency and understanding of diabetes management.	6 monthly interactive student-led sessions to learn critical components of diabetes management. All students attended each session, to learn from each other and to understand the role of each profession in diabetes care.	Survey (pre-post) 6 months, clinical data	Improvements in students' diabetes knowledge, understanding of the roles of healthcare professionals and ability to work with other healthcare professionals.
14. Swanson et al. (2011), UK	<b>Professionals</b> Diab, GP, Diet, Pod, N (diabetes specialist), N (primary care)	To evaluate training of psychological skills, focusing on communication and supporting patients in behavioral changes.	IP workshops in urban and rural health service areas. Group discussions, supported by case studies, video material, worksheet tasks and role plays.	Survey (pre-post)	Increase in 'positive' communication and behaviour change techniques, and a decrease in 'negative' techniques. Positive impact on understanding patient motivation. Evaluation of the course was positive.

**Abbreviations:** IP = Interprofessional, IPE = Interprofessional education

Students: MED = medical student, NS = nursing student, PharS = pharmacy student, PhysS = physiotherapy student, DietS = dietetics student, DentS = dental hygiene student, SWS = social work student, PubHS = public health student

Health Care

Professionals (HCP): N = nurse, GP = general practitioner, PH = physician, Diet = dietician, OT = occupational therapist, Phar = pharmacist, SW = social worker, Phys = physiotherapist, Pod = podiatrist, HA = health care assistant, DEd = diabetes educator, Den = dentist, Lab = laboratory technician, NT = nursing technician, Diab = diabetologist

other healthcare professionals (5/14), ability to work with other healthcare professionals (4/14) and attitudes related to interprofessional care (3/14). All except two studies also described the learners' or the facilitators' perceived experiences of the course.

Patient outcomes were measured in four IPE programs. The outcome variables most commonly measured were laboratory assessments and clinical health indicators, such as blood pressure, body mass index and smoking status. In addition, the frequency of foot examinations or clinical visits, referrals to secondary care, and management errors were documented. Furthermore, the patients' knowledge of diabetes, and discussions on self-management goals were assessed.

### Findings of the content analysis of IPE outcomes

Two main categories and four subcategories of the outcomes of IPE on diabetes were found: 1. Achieved outcomes, including individual gain and external benefits and 2. Experiences, including strengths and challenges. The findings are presented in Figure 2.

### Achieved outcomes

**Individual gain.** Individual gain for the healthcare students or professionals was reflected as *improved knowledge and skills, confidence and motivation in treating patients with diabetes, and teamwork competency*. Eleven implemented IPE programmes increased the perceived or measured knowledge of diabetes management (Ching et al., 2015; Coates et al., 2008; Hearnshaw et al., 2001; Herring et al., 2013; Janson et al., 2009; Kapur et al., 2015; Kipp et al., 2007; MacNeill et al., 2014; Parekh et al., 2015; Shiyanbola et al., 2012; Swanson et al., 2011). Knowledge was estimated to be deeper due to collaborative learning compared to discipline-specific content (Kipp et al., 2007; MacNeill et al., 2014). In addition, 79% of the students were highly satisfied with the course topics, knowledge acquired, and/or the skills learned (Lennon-Dearing et al., 2008).

"...students emphasized they learned more through creating a patient education resource within an interdisciplinary student team than about discipline specific content related to diabetes." (Kipp et al., 2007)

**Table 4.** Summary of the learning outcomes measured and patient involvement in the IPE studies reviewed.

Study	Learning experience	Knowledge of diabetes management	Clinical management behaviour	Knowledge of other professions	Patient outcome	Teamwork skills and IP communication	Confidence in diabetes management	Attitudes towards IP care	Communication and motivation skills	Patient involvement
1. Ching et al. (2015)	X		X		X					26 clinics with patients treated by the learners
2. Coates et al. (2008)	X	X	X					X		2 clinical visits by the learners
3. Hearnshaw et al. (2001)	X	X	X							Patients treated by the learners (38 practices)
4. Herring et al. (2013)	X	X			X			X		patients treated by the learners
5. Janson et al. (2009)		X	X		X	X	X			patients treated by IPE student teams at the clinics
6. Kapur et al. (2015)	X	X	X						X	Action plans implemented in the learners' work
7. Kipp et al. (2007)	X	X		X						Team placements in diabetes management
8. Lennon-Dearing et al. (2008)	X								X	5 clinics where students interviewed patients
9. MacNeill et al. (2014)	X			X		X				None
10. Nikendei et al. (2016)	X						X			None
11. Parekh et al. (2015)		X	X					X		309 primary care professionals working with DM patients
12. Pittenger et al. (2013)	X			X			X			None
13. Shiyabola et al. (2012)	X	X		X	X	X				19 patients participating the IPE program
14. Swanson et al. (2011)	X		X						X	Patients treated by the learners

The students were reported to possess various skills required in patient care after finishing the IPE program/course. Achieved skills concerned improved learners' self-knowledge and problem solving skills (Kapur et al., 2015), as well as deeper understanding of the skills and knowledge possessed by other professions (Kipp et al., 2007). In addition, the ability to educate patients to reach their goals, techniques for efficient communication and supporting behavioral changes of the patient were learned (Shiyabola et al., 2012; Swanson et al., 2011). The learners felt that the knowledge and skills acquired had increased their confidence in treating patients with diabetes (Ching et al., 2015; Coates et al., 2008; Herring et al., 2013; Janson et al., 2009; Pittenger et al., 2013; Swanson et al., 2011). The reports

described enhanced confidence in using the available health care systems and community resources (Janson et al., 2009), and deeper understanding of patient motivation (Swanson et al., 2011) and of commonly used diabetes medications (Coates et al., 2008). Two IPE programs resulted in increased confidence in making appropriate referrals (Ching et al., 2015; Coates et al., 2008), whereas the IPE program reported by Herring et al. (2013) did not influence the number of appropriate diabetes referrals, or prescribing errors.

"These students felt that learning with other health professions students had enhanced their knowledge of and confidence in treating patients with diabetes." (Pittenger et al., 2013)



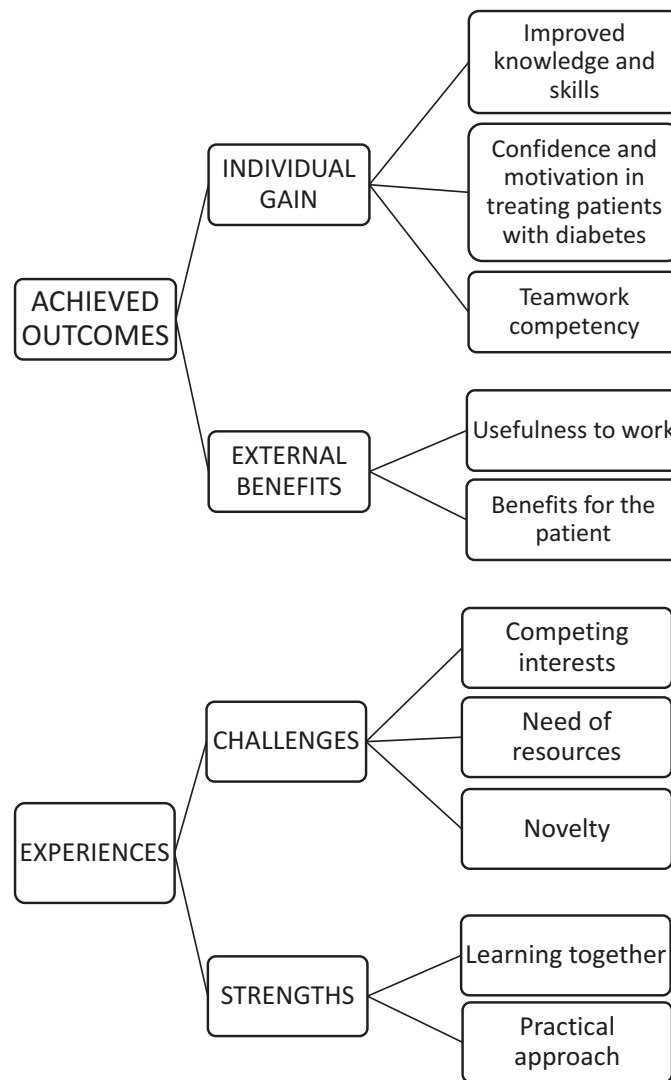


Figure 2. Outcomes of interprofessional education on diabetes.

The courses also contributed to the participants' motivation for diabetes management. After the IPE course, the learners felt they were more willing to change their own professional behavior, to improve patient management (Coates et al., 2008; Parekh et al., 2015; Swanson et al., 2011) and to take more responsibility for diabetes care, with improved standards of care (Coates et al., 2008). The courses increased positive attitudes towards diabetes management at a personal and an organizational level (Ching et al., 2015), helped the students in career development (Coates et al., 2008) and activated thinking of the changes required at work to improve the care of diabetes (Herring et al., 2013; Kapur et al., 2015).

“... health professionals subsequently felt integrated care was a greater priority than before the course and that the need for “aggressive” care was a priority.” (Coates et al., 2008)

Factors to improve teamwork competency were commonly described. The participants' understanding about the roles of other professions in providing care for patients with diabetes increased in seven IPE programs (Ching et al., 2015; Kapur et al., 2015; Kipp et al., 2007; MacNeill et al., 2014; Nikendei

et al., 2016; Pittenger et al., 2013; Shiyanbola et al., 2012). Interprofessional learning increased the students' understanding of the need and value of teamwork as they were allowed to work together (Kapur et al., 2015). The IPE participants felt that they learned to work as teams with other health care professionals (Ching et al., 2015; Janson et al., 2009; Kapur et al., 2015; MacNeill et al., 2014; Shiyanbola et al., 2012) and felt more competent to deliver interprofessional care (Pittenger et al., 2013). The learners expressed mutual appreciation and respect towards each other's contribution and roles (Ching et al., 2015), and a more positive attitude towards training teamwork and skills needed in a diabetes team (Kapur et al., 2015). There were results indicating improved understanding of interprofessional communication strategies and their central role in teamwork (Pittenger et al., 2013), enhanced task distribution (MacNeill et al., 2014; Nikendei et al., 2016) and problem solving skills (Kapur et al., 2015), and minor increases in the students' teamwork skills, knowledge of interprofessional team functions, and knowledge of how to modify team function in a clinical setting (Kipp et al., 2007). Although the collaboration skills of the learners were

not improved in all the IPE programs, the importance of these skills was invariably acknowledged (MacNeill et al., 2014).

“Students demonstrated increased knowledge of roles and responsibilities with respect to the other profession, and they developed an understanding of interprofessional communication strategies and its central role in effective teamwork.” (Pittenger et al., 2013)

**External benefits.** The category of external benefits included headings of *usefulness to work* and *benefits for the patient*. The learners felt satisfaction with their clinical practice after completing the course, and it was considered relevant for and useful to the daily work (Herring et al., 2013; Janson et al., 2009; Kapur et al., 2015; Lennon-Dearing et al., 2008; Swanson et al., 2011). At the organizational level, several changes in diabetes care practices were implemented. More time was dedicated to diabetes clinics and more annual reviews were undertaken (Hearnshaw et al., 2001). In addition, more service development (Coates et al., 2008) and action plans were implemented (Kapur et al., 2015), and a positive contribution to the community as a result of the completed course program was suggested (Lennon-Dearing et al., 2008). Beneficial results were also reported regarding primary health care, as referrals to secondary or tertiary care decreased, which was considered to reflect increased confidence in diabetes care in the primary care units (Ching et al., 2015).

In some of the studies reviewed here, the IPE programs can be considered beneficial for the patients, as they influenced several patient outcomes positively. The learners considered themselves offering a better standard of diabetes care (Coates et al., 2008; Swanson et al., 2011). The patients treated by the IPE teams had a more appropriate frequency of blood glucose monitoring (Herring et al., 2013) and more frequently received assessments of HbA1c, cholesterol, blood pressure, and smoking status (Janson et al., 2009). They were also tested for microalbuminuria more often (Ching et al., 2015; Janson et al., 2009), and more foot exams were performed (Ching et al., 2015; Herring et al., 2013; Janson et al., 2009). The number of patients with favorable blood pressure and cholesterol levels increased (Ching et al., 2015), and the number of diabetes management errors decreased, mainly due to more appropriate hypoglycaemia management (Herring et al., 2013). All in all, the interprofessional intervention resulted in more appropriate health care utilization (Janson et al., 2009). However, there was no change in the HbA1c levels measured (Ching et al., 2015), or in other clinical outcome variables at the final assessment, 18 months after the IPE intervention (Janson et al., 2009).

“... the teams learned to work together to improve the quality of diabetes care (...) and demonstrated significant improvements in the processes of care.” (Janson et al., 2009)

## Experiences

**Challenges.** The challenges concerning the execution of IPE on diabetes management can be presented as *competing interests*, *need of resources* and *novelty*. The diversity of IPE

involved competing interests of different professions. The learners felt that there was too much information included (MacNeill et al., 2014; Swanson et al., 2011), or the learners from different professions preferred to concentrate on different topics (Coates et al., 2008; Nikendei et al., 2016). This led to difficulties in setting common learning goals and in prioritizing the learning focuses (MacNeill et al., 2014), and feelings of unequal learning benefits from the IPE program for different professions (Nikendei et al., 2016).

“In practice the extent to which different professional groups wanted to learn about particular issues varied and the teaching team had to work closely with the students to negotiate a balance in the way topics were addressed.” (Coates et al., 2008)

Interprofessional education was challenged by its novelty. The results showed problems due to lack of faculty experience in IPE, and difficulties in promoting and implementing institutional changes required for the new curricula (Lennon-Dearing et al., 2008). As the IPE courses were mainly novel and outside the mandatory curricula, they were perceived as an extra workload and problems were faced in recruiting students (Kipp et al., 2007; Lennon-Dearing et al., 2008). In addition, planning and implementing an IPE course required many resources. Scheduling a course within the existing curricula of various disciplines was found time-consuming (Lennon-Dearing et al., 2008; MacNeill et al., 2014), and ongoing flexibility was found important in the course development (Coates et al., 2008; MacNeill et al., 2014). The authors also described an increased faculty workload, and a need of time, human, technology and financial resources (Hearnshaw et al., 2001; Lennon-Dearing et al., 2008; MacNeill et al., 2014). The students expressed a need for feedback on their teamwork performance, which also called for resources from the teachers (Kipp et al., 2007).

“The obstacles encountered centered on difficulties with course scheduling, faculty workload and other responsibilities, recruiting students into a non-required course, and the difficulties of promoting and implementing institutional change around established curricula.” (Lennon-Dearing et al., 2008)

**Strengths.** The strengths of IPE on diabetes management include features valued by the learners, such as *learning together* and a *practical approach* to the subject to be learned. The learners appreciated the interprofessional nature of the course (Ching et al., 2015; Coates et al., 2008; Kapur et al., 2015; Lennon-Dearing et al., 2008; MacNeill et al., 2014; Pittenger et al., 2013; Swanson et al., 2011) and regarded the experience of learning together as an unexpected benefit of the course (Hearnshaw et al., 2001). At least one IPE programme faced lack of interest, when recruiting students to the programme. At the end of the programme, however, these students estimated that they learned more about diabetes in the interprofessional teams than in discipline-specific education (Kipp et al., 2007). In addition, collaborative learning was perceived to offer a deeper knowledge and a richer learning experience than individual learning (MacNeill et al., 2014). Collaborative discussion and sharing of information was

highly appreciated, as it offered the learners a valuable opportunity to reflection and gaining of self-confidence, and to empowerment of the teams (Kapur et al., 2015; MacNeill et al., 2014; Swanson et al., 2011). The chance to discussion with other professions was appreciated both in learning implemented in real life and online, but the students preferred factual collaboration and learning face-to-face (Pittenger et al., 2013). Learning together was also related to enhanced motivation, due to the social pressure and revealing of unperceived knowledge gaps compared to other learners (MacNeill et al., 2014).

“Comments added to the evaluation also indicated that the opportunity to learn from and learn about other health professionals was very valuable.” (Coates et al., 2008)

The practical approach commonly applied in IPE was found to be beneficial and highly valued. The learners appreciated the connection to real life, whether it was actualized as treating patients with diabetes, as clinical visits or as real patient scenarios (Ching et al., 2015; Coates et al., 2008; Kapur et al., 2015; Lennon-Dearing et al., 2008; Nikendei et al., 2016; Pittenger et al., 2013; Swanson et al., 2011). In addition, the learners valued the possibility to practice in an interprofessional setting and in real life shortly after the theoretical learning sessions, because it enabled testing the didactic theory in reality, and enabled learning about other professions (Lennon-Dearing et al., 2008; Swanson et al., 2011). It was also stated that the focus on a chronic disease was relevant for interprofessional teamwork (Kipp et al., 2007). Nonetheless, training in a simulated ward round scenario or role-plays in interprofessional teams were found artificial and unrealistic compared to a real clinical setting (Nikendei et al., 2016; Swanson et al., 2011).

“The course was highly regarded for its practical nature since most sessions were taught with the concept of “learning by doing” and based on real scenarios.” (Ching et al., 2015)

## Discussion

This integrative review on diabetes-specific IPE was deemed timely, because an interprofessional, team-based approach is essential in diabetes management, but IPE on this issue has not been systematically analyzed, thus far. The main findings of this review were that IPE on diabetes is highly appreciated by both undergraduate students and professionals, and results in positive outcomes for the learners (*individual gain*) and, to some extent, for the patients with diabetes (*external benefits*). Learning together and a practical approach were regarded as the major *strengths* of IPE on diabetes management. IPE, however, was also faced with *challenges*, such as the competing interests of different professions, the need of various resources, and the novelty of IPE in diabetes education. The findings are largely compatible with previous literature on the outcomes of IPE in health care professionals and students (e.g. Reeves et al., 2016), but the overall results of diabetes-associated IPE appeared even more positive than IPE in general. The benefits of the IPE on diabetes management were achieved via fairly short courses, with various methods of implementation.

The ability of health care professionals to support effective self-management of such a challenging chronic disease as diabetes requires a wide variety of knowledge and skills, in order to foster the patients’ motivation for self-management and understanding of diabetes and its medications, among other things (Wilkinson, Whitehead, & Ritchie, 2014). Furthermore, it is acknowledged that interprofessional teamwork in chronic diseases results in positive patient-, staff- and organization-related outcomes (Körner et al., 2016). It is important that the education of future health care professionals is not only knowledge- and skills-oriented, but also aims at educating students to collaborate effectively in interprofessional teams. Based on this literature search of numerous interventions of education on diabetes management, it is clear that educators have seen the importance of providing future health care workers with effective learning opportunities on diabetes management.

The IPE programs on diabetes were challenged by the diversity of study subjects involved or desired. It is obvious that different disciplines prefer their own perspectives and goals for learning, which may result in competing interests in IPE programs. Nevertheless, the findings presented here show, how the learners from different professions changed their profession-specific perspective on diabetes management and the role of other professions in it during the IPE courses (e.g. Ching et al., 2015; Kapur et al., 2015). Even though it has been argued whether IPE can permanently change the students’ attitudes towards other professions (e.g. Kent & Keating, 2015; Thistlethwaite, 2012), our findings add to the evidence that IPE on diabetes management appears to enhance the students’ perceptions of one another and their positive attitudes towards interprofessional collaboration (Lapkin, Levett-Jones, & Gilligan, 2013; Reeves et al., 2016). The findings are promising, as the traditional patterns of professional roles are still highly prevalent in health care and there is lack of knowledge of each other’s competences and capabilities among students from different disciplines – factors estimated to influence teamwork effectiveness negatively (Aase, Hansen, & Aase, 2014).

In the IPE field, it has been discussed that better design of studies is needed to confirm the link between IPE and patient outcomes (Cox, Cuff, Brandt, Reeves, & Zierler, 2016). Even though this was perceptible also in the present review, it seemed that the patients with diabetes do benefit from diabetes-specific IPE, reflected in, e.g., more appropriate use of health care services (Janson et al., 2009). Even though the measured positive patient outcomes were not consistent, and also neutral effects were reported, like no changes in HbA1C levels (Ching et al., 2015), the implemented IPE programs did have a positive effect, e.g., on the participating patients’ blood pressure and cholesterol levels (Ching et al., 2015). Moreover, the positive effects on the learners’ knowledge, skills, and motivation to treat patients with diabetes in an interprofessional setting are likely to benefit many patients with diabetes, treated by these professionals during their later career. Increased teamwork competency, and changes made at the organizational level contribute to the benefits, as well. Also Reeves and his colleagues (Reeves et al., 2016) concluded that there is growing evidence relating IPE to changes in the learners’ behavior, changes in organizational practice, and benefits to the patients.

The findings also emphasize the challenges faced when IPE programs on diabetes management are implemented. Previously, Sunguya and colleagues in their systematic review (2014) found ten barriers in implementing IPE, including the competing interests of various students, the requirement of multiple resources, and also the participants' lack of enthusiasm (Sunguya et al., 2014.) Conversely, in the studies evaluated here, IPE programs were highly appreciated by the learners. This may be due to the larger number of programs targeted at professionals, who already valued the relevance of interprofessional teamwork in diabetes management. Overall, diabetes care professionals have highlighted the need for more collaboration of health care professionals to provide successful care of diabetes (Stuckey et al., 2015). Likewise, it has been noted that IPE implemented in the context of the student's current or future practice is important for effective learning (Reeves et al., 2016), and therefore voluntary IPE courses for a targeted population of students are likely to yield the best learning outcomes.

There are limitations to this review. The systematic literature review was conducted using three key health science databases, entailing the possibility of missing some studies relevant to the study question. However, the databases were carefully selected, in co-operation with an information specialist, and adding more databases to the search was not expected to strengthen the search process. In addition, including only articles in English, this review may have excluded some noteworthy publications.

The methodological diversity of the included studies was notable. This was expectable due to our inclusion criteria, as we did not want to reject any relevant information available. Indeed, the mixed methods approach, including both quantitative and qualitative studies, is recommended when evaluating the impact of IPE (Institute of Medicine, 2015, p. 7). Nevertheless, several studies evaluated in this review had methodological limitations, such as not describing the basic methodological or IPE design details. This phenomenon is recognized in the research field of IPE as a whole, and may diminish the generalizability of the results (e.g. Abu-Rish et al., 2012; Reeves et al., 2011). The need for a common reporting framework for IPE studies, as well as a standard for implementing and measuring IPE outcomes (Abu-Rish et al., 2012; Institute of Medicine, 2015, pp. 45, 47–48) is also supported by this review. As a result, we found it challenging to assess the quality of various IPE studies according to the evaluation format of JBI (Joanna Briggs Institute, 2014, p. 69) and we therefore decided to evaluate the articles also using an additional generic critical appraisal tool, developed by Woolliams et al. (2009). This is not to be understood as a weakness of the studies included in the systematic review, but it may rather indicate that we found a comprehensive and representative sample of all the studies in the area.

The study results included in the review were mainly based on self-assessment by the students. Even though self-reporting instruments are commonly used in studies evaluating the impact of IPE (Reeves et al., 2016), they may be a source of bias, providing inaccurate information (Polit & Beck, 2012, pp. 312–313). It is also noteworthy that all except one of the IPE programs were not mandatory, and the volunteered

participants were most likely highly motivated for the studies. This includes a risk of selection bias. However, the results of the only mandatory course did not differ from the voluntary ones, but supported the benefits of the interprofessional setting (Hearnshaw et al., 2001). Finally, the findings in this review should be read recognizing the difficulty for any study to prove causation between education and outcomes, especially health outcomes (Cox et al., 2016).

## Conclusions

The findings of this review indicate that diabetes-specific IPE results in individual benefits for the learners, both undergraduate and professional ones, and seems to contribute to better health care for patients with diabetes. The findings indicate that fairly short courses with various methods of IPE are applicable to learning diabetes management. It is essential, however, to estimate the resources available, as it requires time and commitment of the faculty to overcome the challenges of equality in learning and novelty of the approach. Educators are encouraged to adopt interprofessional and practical approaches when planning education related to diabetes management, as well as other chronic diseases, for future health care professionals. More information is needed on the cost-effectiveness and long-term effects of IPE on diabetes management. In addition, the patient's view of the interprofessional approach in practice would be worth studying, as previous studies have mainly focused on the student's perspective.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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