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DIABETIC FOOT TRACKING AND MONITORING STRATEGIES IN NURSE PRACTICE

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ABSTRACT

Objective: To identify, in the literature, the strategies for tracking and monitoring diabetic foot in nurses' practice. **Method:** Integrative review conducted in the MEDLINE, CINAHL, Web of Science, BDENF and LILACS bibliographic databases, between 2002 and 2018, totaling 23 articles. **Results:** The main strategies for diabetic foot tracking were the 10 g Semmes-Weinstein monofilament, the 128 Hz tuning fork, the assessment of the posterior and pedistibial pulses, the risk stratification, the ankle reflex and the Neuropathy Screening Instrument. from Michigan. Regarding monitoring, health education, computerized self-management tools, multidisciplinary consultation and risk-based clinical management prevailed. It was found that diabetic foot tracking and monitoring programs contributed to changes in patients' knowledge and behavior, improved cardio-metabolic control, reduced physical symptoms and incidence of diabetic foot. **Conclusion:** Diabetic foot tracking and monitoring are effective in reducing lower limb ulceration and amputation. Although allowing for comprehensiveness, satisfaction, improved self-care and continuity of care, these strategies still face difficulties to be implemented in the routine care of nurses to people with diabetes.

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INTRODUCTION

Diabetic foot is characterized by the presence of infection, ulceration and / or destruction of deep tissues, and is associated with neurological abnormalities and peripheral vascular disease (Brasil, 2013). This preventable injury is responsible for a high number of amputations and hospitalizations (Santos *et al*., 2011; Lavery *et al*., 2005). The main causes for the occurrence of diabetic foot are: poor metabolic control, lack of information and non-adherence to the recommended therapy. In addition, poor hygiene, the use of inappropriate footwear, improper nail clippings, the presence of onimicosis and onychriptosis, the removal of plantar corns, the incorrect treatment of neuro-ischemic lesions and the sudden signs of peripheral ischemia are aggravating factors of diabetic foot (Netten *et al*., 2016). The prevalence of diabetic foot in Brazil is six per 1000 people with diabetes. However, if not treated properly, in 15 years, 25% of diabetes patients end up with microvascular impairment, 35% develop diabetic neuropathy, and 12% develop foot deformities and gait impairment (Brasil, 2013; Rossaneis *et al*., 2017). Thus, screening is an effective evaluation strategy to be developed by nurses to identify early possible abnormalities and risk factors for the development of foot ulcers, through anamnesis, clinical examination, risk stratification and laboratory tests (Brasil, 2016). In contrast, monitoring consists of continuous follow-up of follow-up (Bezerra *et al*., 2015; Chin *et al*., 2014), in referral to specialist (Leese *et al*., 2011), in multidisciplinary consultation (Santos *et al*., 2011), in

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behaviors based on risk stratification (Lavery *et al*., 2005) and in health education (Sharoni *et al*., 2017), fundamental for the prevention and treatment of diabetic foot. Therefore, this study aimed to identify, in the literature, the strategies for tracking and monitoring diabetic foot in nursing practice, in order to search for gaps and raise new investigations on the subject.

MATERIALS AND METHODS

Integrative literature review, based on the theoretical framework of Whittemore and Knafl (2005), developed in six steps: 1) selection of the guiding question, 2) sampling or literature search, 3) selection of the research that comprised the sample, 4) data extraction from the included studies, 5) evaluation and interpretation of results and 6) presentation review or synthesis of the knowledge produced. The guiding question was elaborated from the acronym PICo, defining P = population: "patients with diabetic foot", I = interest "tracking and monitoring strategies" and Co = context: "nurse practice". Thus, the following research question was elaborated: what are the diabetic foot tracking and monitoring strategies in nurses' practice?. Inclusion criteria were articles from primary studies indexed in the described databases, published from 2002 to 2018, in English, Portuguese and Spanish, and related to the research theme. Notes, monographs, dissertations and theses were excluded. The time frame was based on the year of implementation of the Hiperdia Program, which, in Brazil, guides the strategies for tracking and monitoring diabetic foot in primary care.

The bibliographic survey was conducted in January and February 2019 in the online Medical Literature Analysis and Retrieval System (MEDLINE via PubMed®), Cumulative Index to Nursing and Allied Health Literature (CINAHL-Ebsco), Web of ScienceTM, BDENF (Nursing Database) and bibliographic index LILACS (Latin American Literature on Health Sciences) via Virtual Health Library (VHL). Controlled and uncontrolled descriptors were selected by consulting the terms of the Medical Subject Headings (MeSH), Health Sciences Descriptors (DeCS), and List of Headings of CINAHL Information Systems. The search expressions were elaborated using the Boolean operators "OR" and "AND". Different search strategies were chosen due to the peculiarities of the databases. Search syntax is described in Table 1. The articles were accessed through the portal of journals of the Higher Education Personnel Improvement Coordination (Capes). The selection was independently developed by two reviewers in two stages: in the first, the title and abstract were read and, in the second, the full text. In cases of disagreement, there was discussion between the two evaluators to reach a consensus. The search resulted in 415 productions. In the first stage, applying the inclusion and exclusion criteria, 42 articles were selected. In the second, 19 productions were removed, totaling 23 articles, which comprised the sample and were analyzed. Figure 1 depicts the flowchart of the selected articles. The Evidence Level was classified by the model proposed by Melnyk and Fineout-Overholt (2005). Data was extracted by means of their own instrument. The results were presented descriptively and the critical analysis allowed the construction of three categories: 1) Diabetic foot tracking strategies; 2) Monitoring strategies for the prevention and treatment of diabetic foot; 3) Implications and challenges of diabetic foot tracking and monitoring in nurse practice.

The journal Diabetes Res ClinPract (13%) presented the largest number of publications related to the theme, with three (13%) articles. 2011 stood out with five (21.7%) productions. Brazil and Taiwan had five (21.7%) publications each. Cross-sectional studies and level of evidence VI predominated, respectively, in six (26.1%) and 17 (73.9%) productions, as shown in Table 2. The main screening strategies performed by nurses to detect diabetic foot were the use of Semmes-Weinstein 10 g monofilament in 10 (43.5%) studies, followed by 128 Hz tuning fork in six (26.1%).). Regarding monitoring, four (17.4%) productions addressed health education strategies, three (13%) computerized self-management tools and multidisciplinary consultation and two (8.7%) stratification-based clinical management. according to Table 1. Tracking and monitoring of diabetic foot contributed to changes in patients' knowledge and behavior in three (13%) studies, and in the reduction of physical symptoms in two (8.7%). Among the challenges, three (13%) highlighted the high prevalence of diabetic neuropathy, three (13%) routinely implemented screening and monitoring, and two (8.7%) deficits in health education and self-care with the feet according to Table 2.

DISCUSSION

Diabetic Foot Tracking Strategies: Semmes-Weinstein 10 g monofilament was the most commonly used tool to check for lack of sensitivity, the main consequence of diabetic neuropathy (Santos *et al*., 2011; Lavery *et al*., 2005; Chin *et al*., 2014; Jane *et al*., 2016; Lee *et al*., 2014; Baraz *et al*., 2014; Chang *et al*., 2013; Christensen *et al*., 2018; Lucoveis *et al*., 2018; Dutra *et al*., 2018).The magnitude of this condition was found in Divinópolis (MG), where 46% of patients with diabetes had lack of sensitivity in the lower limbs (Moraes *et al*., 2016). Moreover, a study conducted in Recife (PE) identified that the probability of amputation is 1.7% higher in patients with diabetes who presented lack of sensation in the feet and that the non-use of monofilament contributes to the silent nature of this condition (Santos *et al*., 2011). The amount of stitches to be checked with the monofilament is a frequent doubt of professionals. However, a study of the efficacy of the 10 g Semmes-Weinstein monofilament at 3, 4, 8 and 10 points showed that the differences in sensitivity of points 3 and 4 compared with points 8 and 10 were not statistically significant, emphasizing that the increase in the number of points evaluated does not influence the detection of lack of sensation in the feet. In addition, he emphasized that this device is simple, fast, painless, inexpensive and effective in tracking diabetic foot (Baraz *et al*., 2014). The vibration sensitivity test with the 128 Hz tuning fork (Chin *et al*., 2014; Jane *et al*., 2016; Lee *et al*., 2014; Chang *et al*., 2013; Lucoveis *et al*., 2018; Dutra *et al*., 2018), is effective for early detection of diabetic neuropathic because loss of sensation is the main predictor of foot ulceration (Chin *et al*., 2014). This instrument is applied to the dorsal part of the distal hallux phalanx and, if there is no sensitivity in this region, the test is repeated on more proximal segments, such as the malleolus or tibial tuberosity (Brasil, 2016). In addition, the biosthesiometer was also effective for the detection of subclinical diabetic neuropathy (Christensen *et al*., 2018). Peripheral vascular disease is one of the causes of foot ulceration in people with diabetes (Baraz *et al*., 2014). Thus, the evaluation of the posterior tibial and pedisal pulses (Santos *et al*., 2011; Lavery *et al*., 2005; Chin *et al*., 2014; Jane *et al*., 2016; Lee *et al*., 2014; Lucoveis *et al*., 2018), as well as performing the Ankle

Table 1. Controlled, uncontrolled descriptors and search expressions used for article retrieval. Brazil, 2019

Me SH and List CINAHL		
P	CD	Diabetes Complications; DiabeticNeuropathies, DiabeticFoot
	NCD	Diabetes Complications; DiabeticNeuropathies; Diabetes Complication; Diabetes RelatedComplications; Diabetes-RelatedComplication; DiabeticComplications; Complicationsof Diabetes Mellitus; Diabetes Mellitus Complications; DiabeticFoot; DiabeticFeet;
I	CD	Mass Screening
	NCD	Mass Screening; Screening; Screenings
Co	CD	Nursing; NursingCare;
	NCD	Nursing; Nursing Care; Nursing Care Management; Nursings
Searchexpression Medline via Pubmed®		((((((((((((((("Diabetes Complications"[Mesh]) OR "Diabetic Neuropathies"[Mesh])) OR "diabetes complications") OR "diabetic neuropathies") OR "diabetes complication") OR "diabetes related complications") OR "diabetes related complications") OR "diabetes-related complication") OR "diabetic complications") OR "diabetic complication") OR "complications of diabetes mellitus") OR "diabetes mellitus complication") OR "diabetes mellitus complications") OR ((((((("Diabetic Foot"[Mesh]) OR "diabetic foot") OR "foot, diabetic") OR "diabetic feet") OR "Feet, Diabetic") OR "foot ulcer, diabetic"))) AND ((((((((("Mass Screening"[Mesh]) OR "mass screening") OR "Monitoring") OR "mass screenings") OR "screening, mass") OR "Screenings, Mass") OR "screening") OR "screenings")) AND (((((((("Nursing"[Mesh] OR "Nursing Care"[Mesh])) OR "nursing") OR "nursing care") OR "Care, Nursing") OR "Management, Nursing Care") OR "Nursing Care Management") OR "nursings")
Searchexpression Web ofScience™		(TS=("Diabetes Complications") OR TS=("Diabetic Neuropathies") OR TS=("diabetes complication") OR TS=("diabetes related complications") OR TS=("diabetes related complications") OR Ts=("diabetes-related complication") OR TS=("diabetes mellitus complication") OR TS=("diabetes mellitus complications") OR TS=("Diabetic Foot") OR TS=("foot, diabetic") OR TS=("diabetic feet") OR TS=("Feet, Diabetic") OR TS=("foot ulcer, diabetic")) AND (TS=("Mass Screening") OR TS=("Monitoring") OR TS=("mass screenings") OR TS=("screening, mass") OR TS=("Screenings, Mass") OR TS=("screening") OR TS=("screenings")) AND (TS=("Nursing") OR TS=("Nursing Care") OR TS=("Care, Nursing") OR TS=("Management, Nursing Care") OR TS=("Nursing Care Management") OR TS=("nursings"))
Searchexpression CINAHL		((MH "Diabetic Foot") OR "Diabetic Foot" OR "Foot, Diabetic" OR "Diabetic Feet" OR "Feet, Diabetic" OR "Foot Ulcer, Diabetic" OR "Diabetes Complications" OR "Diabetes-Related Complications" OR "Diabetes Related Complications" OR "Diabetes-Related Complication" OR "Diabetic Complications" OR "Complications of Diabetes Mellitus" OR "Diabetes Mellitus Complication" OR "Diabetes Mellitus Complications" OR (MH "Diabetic Neuropathies") OR "Diabetic Neuropathies") AND ("Mass Screening" OR "Mass Screenings" OR "Screening, Mass" OR "Screenings, Mass" OR "Screening" OR "Screenings") AND ((MH "Nursing Care") OR "Nursing Care" OR "Nursing" OR "Care, Nursing" OR "Management, Nursing Care" OR "Nursing Care Management" OR "Nursings")
DECS		
P	CD	Diabetic foot; Complications of diabetes; Diabetic Neuropathies
	NCD	Diabetic foot; Diabetic Foot Ulcer; Complications of diabetes; Complications of diabetes; Diabetic complications; Diabetic Neuropathies
I	CD	Tracking programs; Monitoring
	NCD	Tracking programs; Tracking; Mass sorting; Monitoring; Monitoring; Monitoring
Co	CD	Nursing care; Nursing
	NCD	Nursing care; Nursing care; Nursing care; Nursing Care; Nursing
Search expression BDENF e LILACS via BVS		(tw: ((mh :("Diabetic Foot")) OR (tw :("Diabetic Foot")) OR (tw :("Diabetic Foot Ulcer")) OR (mh :("Diabetes Complications")) OR (tw :("Diabetes Complications")) OR (tw :("Diabetes Complications")) OR (tw :("Diabetic Complications")) OR (mh :("Diabetic Neuropathies")) OR (tw: ("Diabetic Neuropathies")))) AND (tw: ((mh :("Tracking Programs")) OR (tw :("Tracking Programs")) OR (tw: (Tracking)) OR (tw :(Screening)) OR (tw :("Mass Screening")) OR (mh: (Monitoring)) OR (tw: (Monitoring)) OR (tw: (Monitoring)) OR (tw: (Monitoring)))) AND (tw: ((mh :("Nursing Care")) OR (tw :("Nursing Care")) OR (tw :("Nursing Care")) OR (tw :("Nursing Care")) OR (tw :("Nursing Care")) OR (mh: (Nursing)) OR (tw: (Nursing))))

Key: CD (Controlled descriptor); NCD (Non-Controlled descriptor).

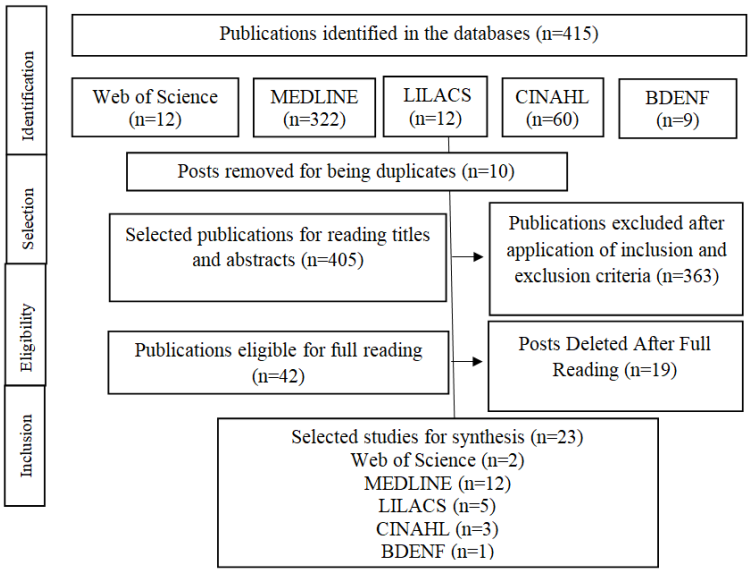

Figure 1. Flowchart of selected articles. Brazil, 2019

Chart 2. Summary of articles addressing identification, journal, year, place of study, design, sample and level of evidence. Brazil, 2019

Identification	Journal, year and place of study	Design and sample	Level of evidence
A1	Nursing, 2016, Brazil	Cross-sectional study – 150	VI
A2	Latinam nurs journ, 2011, Brazil.	Moethodological Study – 50	VI
A3	ReneJourn, 2011, Brazil.	Cross-sectional epidemiological study – 61	VI
A4	BMJ Open, 2017, Malasia.	Quasi-experimental study - 31	III
A5	BMJ Open, 2016, Taiwan.	Cross-sectional study – 628	VI
A6	Diabet Med, 2017, China.	Randomized clinicl trial -3.586	II
A7	Diabetes Res ClinPract, 2015, Taiwan.	Retrospective study - 23.183	VI
A8	BMC EndocrDisord, 2014, Taiwan.	Cross-sectional study – 404	VI
A9	Int J Nurs Stud, 2014, Taiwan.	Longitudinal study – 290	VI
A10	J Diabetes Metab Disord, 2014, Irã.	Quasi-experimental study -150	III
A11	BMC Public Health, 2013, Taiwan.	Longitudinal cohort study – 387	IV
A12	Diabetes Educ, 2011, United States of America.	Randomized controlled trial – 46	II
A13	J Wound Ostomy Continence Nurs, 2011, United States of America.	Prospective descriptive study – 18	VI
A14	Diabetes Res ClinPract, 2006, United States of America.	Randomized controlled trial – 332	II
A15	Inform Prim Care, 2011, Scotland.	Exploratory study with a qualitative approach – 13	VI
A16	Can J Public Health, 2006, Canada.	Analytical study - 1.151	VI
A17	Int J Low Extremity Wounds, 2007, Switzerland.	Analytical study – 172	VI
A18	Br J Diabetes Vasc Dis, 2016, Scotland.	Descriptive study - 140.000	VI
A19	J Clin Nurs, 2008, Germany.	Cross-sectional study – 269	VI
A20	Diabetes Res ClinPract, 2005, United States of America.	Analytical study – 1.708	VI
A21	Diabetes Tecnol Ther, 2018, Denmark.	Analytical study – 156	VI
A22	Braz Journ Nurs, 2018, Brazil.	Exploratory and descriptive study – 50	VI
A23	Braz Journ Nurs, 2018, Brazil.	Analytical cross-sectional study – 117	VI

Table 1. Diabetic foot tracking and monitoring strategies in nursing practice identified in the studies. Brazil, 2019

Type of strategies	n	%
Tracking		
Semmes-Weinstein Monofilament 10 g	10	43.5
Tuningfork 128 Hz	6	26.1
Evaluation of the posterior and pedistibial pulses	6	26.1
Risk Stratification	6	26.1
Ankle reflex	6	26.1
Michigan Neuropathy Screening Instrument	5	21.7
AAI	4	17.4
Ulceration Investigation	3	13.0
Musculoskeletal examination	3	13.0
Footwear Inspection	3	13.0
Clinical examination of the feet	3	13.0
Diabetes history and knowledge test	2	8.7
Glycemiccontrol	2	8.7
Risk behavior and / or discomfort	2	8.7
Painful sensitivitiesand thermal	2	8.7
King's College Classification	1	4.3
NeuroQuol	1	4.3
Texas Risk Rating	1	4.3
Wagner classification	1	4.3
Amputation Risk Rating	1	4.3
International Consensus on the Diabetic Foot Rating	1	4.3
Scottish Care Information-Diabetes Collaboration	1	4.3
Biosthesiometer	1	4.3
Analogic visual scale	1	4.3
Monitorization		
Health education	4	17.4
Computerized self-management tools	3	13.0
Multidisciplinary consultation	3	13.0
Risk stratification based conduct	2	8.7
Community Based Care	1	4.3
Follow up	1	4.3
Referral to Expert	1	4.3
Problem Areas in Diabetes Scale (PAID)	1	4.3
Debridementandacronym TIME	1	4.3
PUSHscale	1	4.3

Arm Index (AAI) (Hsu *et al*., 2015; Lee *et al*., 2014; Chang *et al*., 2013; Dutra *et al*., 2018) track vasculopathies and enable early interventions. Patients with reports of tingling, burning, burning, and pain in the base or dorsal areas of the feet should receive more professional attention (Jane *et al*., 2016).

Risk stratification of diabetic foot guides care and follow-up after initial assessment (Lavery *et al*., 2005; Leese *et al*., 2011; Jane *et al*., 2016; Chang *et al*., 2013; Lucoveis *et al*., 2018; Dutra *et al*., 2018). In the King's College (Chang *et al*., 2013), Texas classifications (Chang *et al*., 2013), risk of amputations

Table 2. Implications and challenges of diabetic foot tracking and monitoring in nurse practice. Brazil, 2019

Types	n	%
Implications		
Changes in patient knowledge and behavior	3	13.0
Reduction of physical symptoms	2	8.7
Improved Cardiometabolic Control	2	8.7
Reduction of amputation incidence	1	4.3
Reduced incidence of diabetic foot	1	4.3
Monofilament Effectiveness for Diabetic Foot Tracking	1	4.3
Complication reduction	1	4.3
Improved patient satisfaction	1	4.3
Reduction of wound healing time	1	4.3
Improvement of nurses' knowledge and practice	1	4.3
Challenges		
High prevalence of diabetic neuropathy	3	13.0
Routine tracking and monitoring implementation	3	13.0
Health education deficits and foot self-care	2	8.7
High prevalence of ulceration	2	8.7
Failure to perform clinical examination of the feet	2	8.7
High risk and high prevalence of amputation	1	4.3
Control of risk factors	1	4.3

(Santos *et al*., 2011) and International Consensus on the Diabetic Foot (Lucoveis *et al*., 2018), The degree of risk is established based on parameters such as the presence of neuropathy, peripheral vascular disease, foot deformities, ulcerations, and previous amputations. Wagner's classification (Santos *et al*., 2011)is no longer recommended as it is very superficial. The Michigan Neuropathy Screening Instrument (MNSI) was one of the key strategies for screening diabetic neuropathy. This instrument is divided into two parts: the first investigates sensitivity problems and the second addresses physical assessment, foot appearance, ulceration, ankle reflexes, hallux vibration perception and monofilament sensitivity (Chin *et al*., 2014; Jane *et al*., 2016; Lee *et al*., 2014; Chang *et al*., 2013; Christensen *et al*., 2018). It was noted that the evaluation of the total or partial absence of the Achilles reflex is an important predictive sign of ulcerative processes in the feet, due to diabetic neuropathy reaching the sensory fibers, which reduces deep reflexes and causes Achilles tendon shortening (Jane *et al*., 2016). Thus, the ankle reflex test also supports the prevention of diabetic foot (Brasil, 2016; Hsu *et al*., 2015; Lee *et al*., 2014; Chang *et al*., 2013; Lucoveis *et al*., 2018; Dutra *et al*., 2018). Clinical examination of the feet (Chin *et al*., 2014; Chang *et al*., 2013; Lucoveis *et al*., 2018).

It consists of anamnesis, anatomical evaluation of the foot, investigation of deformities, hydration, coloration, temperature, distribution of hair, integrity of nails and skin, presence of callosities, neurological and vascular evaluation. In addition, the nurse needs to be able to recognize deformities (Lavery *et al*., 2005; Chin *et al*., 2014; Chang *et al*., 2013) of diabetic neuropathy, such as increased metatarsal bony prominence, claw toe, hammer toe, bunion and Charcot arthropathy. Wearing properly sized shoes and seamless cotton socks are key practices for preventing foot injuries (Chin *et al*., 2014; Moraes *et al*., 2016; Schmidt *et al*., 2008). However, studies have highlighted that most patients with diabetes do not perform this preventive self-care (Moraes *et al*., 2016; Schmidt *et al*., 2008). Thus, the self-care knowledge test (Virani *et al*., 2006) proved useful for guiding guidelines and encouraging foot care. Another assistive strategy in diabetic foot tracking is investigating risk behavior (Jane *et al*., 2016; Christensen *et al*., 2018), such as non-adherence to drug treatment, non-physical activity, use of tobacco, non-compliance with hypoglycemic and hypolipidic diet, and lack of glycemic control. Thermal Sensitivity Assessments, with cold metal, and painful, using a Japanese toothpick, were also employed to check the plantar protective sensitivity. Already the Visual Analog Scalewas used to measure the intensity of neuropathic symptoms, important for preventing complications (Lucoveis *et al*., 2018; Dutra *et al*., 2018).

Monitoring strategies for diabetic foot prevention and treatment: Regarding monitoring, continuous follow-up, health education focused on self-care and prevention of complications, adherence to therapy and patient satisfaction increased. The educational resources used were: seminars, flyers, weekly visits for physical and emotional support, portable laboratory, training programs, leafletand illustrative traffic light focusing on the risks. (Leese *et al*., 2011; Sharoni *et al*., 2017; Virani *et al*., 2006; Schmidt *et al*., 2008). Among the computerized self-management tools, Internet portals to strengthen treatment adherence and remember follow-up appointments, the use of telemedicine in patients with poorly controlled diabetes and the computerized data logging, allowing self-management and vigilance by the nurse, ensured better cardio-metabolic control (Tutino *et al*., 2017; Welch *et al*., 2011; Gabby *et al*., 2006). The multidisciplinary consultation (Santos *et al*., 2011; Hsu *et al*., 2015; Pataky *et al*., 2007)and community based care (Virani *et al*., 2006) contributed to holistic assistance and cost minimization. The behaviors based on risk stratification (Lavery *et al*., 2005; Leese *et al*., 2011)proved to be punctual to prevent complications (Gabby *et al*., 2006)and amputations (Hsu *et al*., 2015). In Scotland, risk stratification classified patients with low, moderate, high risk or active ulceration, and the guidelines, referrals and frequency of foot assessment were guided by the risk score (Leese *et al*., 2011). Emotional problems related to diabetes have been observed to include guilt, anger, depression, worry and fear. Thus, the Problem Areas in Diabetes Scale (PAID) (Gabby *et al*., 2006)proved to be important to note and intervene in these impasses that make adherence to therapy difficult, as early referral to the necessary specialists, as well as the availability of functioning referral and counter-referral services (Leese *et al*., 2011), facilitate the follow-up (Chin *et al*., 2014). A study pointed out that early debridement and the use of the acronym TIME contributed to the reduction of diabetic ulcer healing time. The acronym TIME involves clinical observations, interventions for the pathophysiology involved, and expected outcomes for each of the four components: T (non-viable tissue), I (infection /

inflammation), M (moisture imbalance), and E (epidermis) (Baraz *et al*., 2014). The total score of the Pressure Ulcer Scale for Healing (PUSH) instrument proved to be able to predict the healing time of diabetic ulcer, being advantageous for monitoring nursing care. This instrument considers three parameters: wound area, amount of exudate, and appearance of the wound bed (Gardner *et al*., 2011).

Implications and challenges of diabetic foot tracking and monitoring in nurse practice: Diabetic foot tracking and monitoring programs have contributed to holistic care as they have enabled changes in knowledge and behavior (Sharoni *et al*., 2017; Welch *et al*., 2011; Gabby *et al*., 2006), improved cardio-metabolic control (Tutino *et al*., 2017), reduction of physical symptoms (Sharoni *et al*., 2017; Welch *et al*., 2011) and incidence of diabetic foot (Hsu *et al*., 2015). In addition, the survey of risk factors (Lavery *et al*., 2005; Jane *et al*., 2016) and follow up (Chin *et al*., 2014)contributed to defragmentation of care and decreased amputations in the lower limbs.

The use of monitoring instruments reduced the healing time of diabetic ulcer, decreased the length of stay, improved satisfaction and patients' quality of life (Lavery *et al*., 2005; Hsu *et al*., 2015; Gardner *et al*., 2011; Virani *et al*., 2006; Jane *et al*., 2016). In addition, continuous training, referral to the specialist, provision of adequate infrastructure and a multi-professional team facilitated early intervention and reduced diabetic foot (Santos *et al*., 2011; Leese *et al*., 2011; Hsu *et al*., 2015; Pataky *et al*., 2007). Among the challenges in caring for people with diabetes were the high prevalence of diabetic neuropathy (Leese *et al*., 2011; Jane *et al*., 2016; Lee *et al*., 2014), ulceration (Chin *et al*., 2014; Leese *et al*., 2011), amputation (Santos *et al*., 2011), self-care deficits (Moraes *et al*., 2016; Hsu *et al*., 2015) and not performing the clinical examination of the feet (Santos *et al*., 2011; Lucoveis *et al*., 2018).Nevertheless, ongoing assistance (Leese *et al*., 2011), implementing routine tracking and monitoring (Jane *et al*., 2016; Lee *et al*., 2014; Crawford *et al*., 2011), the effective functioning of health care networks and referral and counter-referral services (Leese *et al*., 2011)are barriers that hinder the systematization of nursing care.

Conclusion

It was evidenced that the tracking strategies addressed the sensitivity of the feet, the risk stratification, the risk factors and the clinical examination of the feet. The monitoring tools, on the other hand, instituted health education, computerized self-management, early referral to the specialist, follow-up monitoring and use of instruments to evaluate the diabetic ulcer healing process. The results showed that diabetic foot tracking and monitoring were effective to reduce the incidence of ulceration and lower limb amputations. Although allowing for comprehensiveness, satisfaction, improved self-care and continuity of care, these strategies still face difficulties to be implemented in the routine care of nurses to people with diabetes. It was found that most of the identified studies on the subject have low level of evidence, thus requiring greater commitment of researchers and health professionals to make more robust designs, in order to produce significant results and that will contribute to boost the insertion of these strategies for tracking and monitoring diabetic foot in health policies to improve nursing care for people with diabetes.

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