

Elaboration of a flowchart for healthcare quality improvement of patients with diabetic foot ulcer

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Abstract

Objective: The aim of this study is to map the work process of a Municipal Centre for the care of diabetic foot ulcer, in order to elaborate a multi-professional flowchart for the management of these patients. **Methods:** Qualitative study, developed by means of Bizagi software version 3.7.0.107, for the purpose to map the flow of activities encompassing the first attendance for people with diabetic foot ulcer, through observational record, elaborating a multi-professional flowchart for improving quality of care. **Results:** The investigation, mapping and comparison between two flowcharts, current and future directions, highlighted the need to offer multi-professional care for patients, besides of implementing improvements in the quality of care, emphasizing the importance of holistic approach over the chronic wound carrier, avoiding, consequently, futures complications. **Conclusion:** Finally, it was elaborated a new map of work process to consolidating the presence of multi-professional team for treatment of people with diabetic foot ulcer.

Keywords: Diabetes Mellitus; Diabetic foot; Workflow; Patient Care Team;

1. Introduction

The wound is a pathological process that occurs when the anatomical or physiological structures of the skin

are affected by internal or external agents, such as physical, mechanical, or chemical trauma, requiring evaluation and appropriate treatment (1). The wounds are classified according to the healing time in acute or chronic. The chronic wounds affect more than 2 million patients, depending on the aetiology, and involve costs that exceed 1 billion U.S. dollars (2).

Among the chronic wounds, the diabetic foot ulcer prevails, considering the high number of diabetic adults in Brazil, achieving 12.5 million, in addition to affecting a total of 425 million people in the world (3).

The main complications associated with diabetic foot ulcer are infections and amputations that require complex procedures and cause expenditures of around 96.8 billion dollars per year, what represents in Brazilian currency, 510.55 billion of reals (4).

Thus, the diabetic foot ulcer is conceptualised by the International Working Group on the Diabetic Foot (IWFGD) as infection, ulceration, and/or soft tissue destruction associated with neurological changes and varying degrees of peripheral artery disease (PAD) in the lower limbs, what consequently requires a multi-professional evaluation, and especially, from the Nurse in the nursing consultation (5).

The multi-professional team's care for patients with diabetic foot ulcers requires several actions such as the elaboration of the care plan more efficiently (6).

It is possible to identify, through a previous study, that the multi-professional evaluation with attention encompassing holistic view avoids amputations and diminishes the reulcerations, since that the teams will work for glycaemic control, treatment of wound bed, venous insufficiency management and secondary infections prevention (7).

However, it is common some difficulties for achieving goals as avoiding amputations and reulcerations in patients with diabetic foot ulcers due to the lack of multi-professionals teams acting in municipal and state reference centres for assisting this group (6).

Therefore, this study aims to map the work process at Municipal Centre for Diabetic Care, in order to elaborate a multi-professional flowchart for the treatment of these wounds.

2. Materials and Methods

It is a qualitative observational study performed through a case study at Municipal Centre for Diabetic Care (MCDC) of Uberlandia, with the purpose to proposing the improvement of quality of healthcare by means of mapping of the workflow related to the first attendance of people with diabetic foot ulcer showing the current status and future directions, including a proposal for multi-professional assistance.

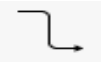
The data collection occurred from 1 February to 2 March, through 7 visits at Municipal Centre for Diabetic Care. Moreover, the data were collected by means of participant observation and requesting professionals to describing the activities of the first care for the patient with diabetic foot ulcer.

These data served as subsidium for elaboration of the maps of workflow, that described the current routine and the future proposal, outlined under a multi-professional care in accordance with previous studies which addressed such subject (8-6).

The flowcharts, current state and future directions, for attendance of people with diabetic foot ulcers were elaborated via Bizagi Modeler, a platform used for Business Process Model Notation (BPMN), version 3.7.0.107 open source.

The Business Process Model Notation refers to a world language to showing graphically the mapping work process associated with a particular company, such as hospitals. Its basic symbology consists to using elements to indicating specific activities, such as: events, activities, gateways, among others. The main elements utilised in this study are represented in the Box 1:

Box 1 – Elements and symbols of Business Process Model Notation

Elements	Subtypes	Symbology	Concepts
Events	Start event		It indicates the start of process;
	End event		It represents the end of process;
	Abstract task		It points out a task to being realised by person;
Activities	User task		It represents a task realised by users or clients of company;
	Manual task		It consists of tasks performed by people through the hands;
Flow	Sequence flow		It shows the sequence of activities performed by participants in workflow;
	Message flow		It represents messages from one process participant to another;
Gateways	Exclusive Gateways		It divides and/or unifies the flow, allowing only one path/decision can be taken;
	Inclusive Gateways		It divides and/or unifies the flow, allowing 2 or more alternatives flows where all paths are evaluated;
Links	Link Symbol		It connects two activities in the same process

2.1. Ethical considerations

This current study is a complementary proposal associated with a research project approved by Research Ethics Committee at Federal University of Uberlandia, underpinned by opinion number: 3.937.483 e C.A.A.E number 29441020.0.0000.5152, related to chronic wound and elaboration of assistance protocols.

3. Results

This study proposed the investigation and mapping of two flowcharts entitled, current state and future directions, in order to recommend the improvement of the work process, besides to provide multi-professional care in the treatment of diabetic foot ulcers at a municipal reference centre, emphasizing the

importance of a holistic view on those carriers of wounds.

3.1. Flowcharts of the current state and future directions

With regard to the flowchart of the first attendance for diabetic foot ulcers, the **figure 1** refers to the current state, based on the existing and real routine of care at Municipal Centre for Diabetic Care, obtained during the data collection phase of the survey.

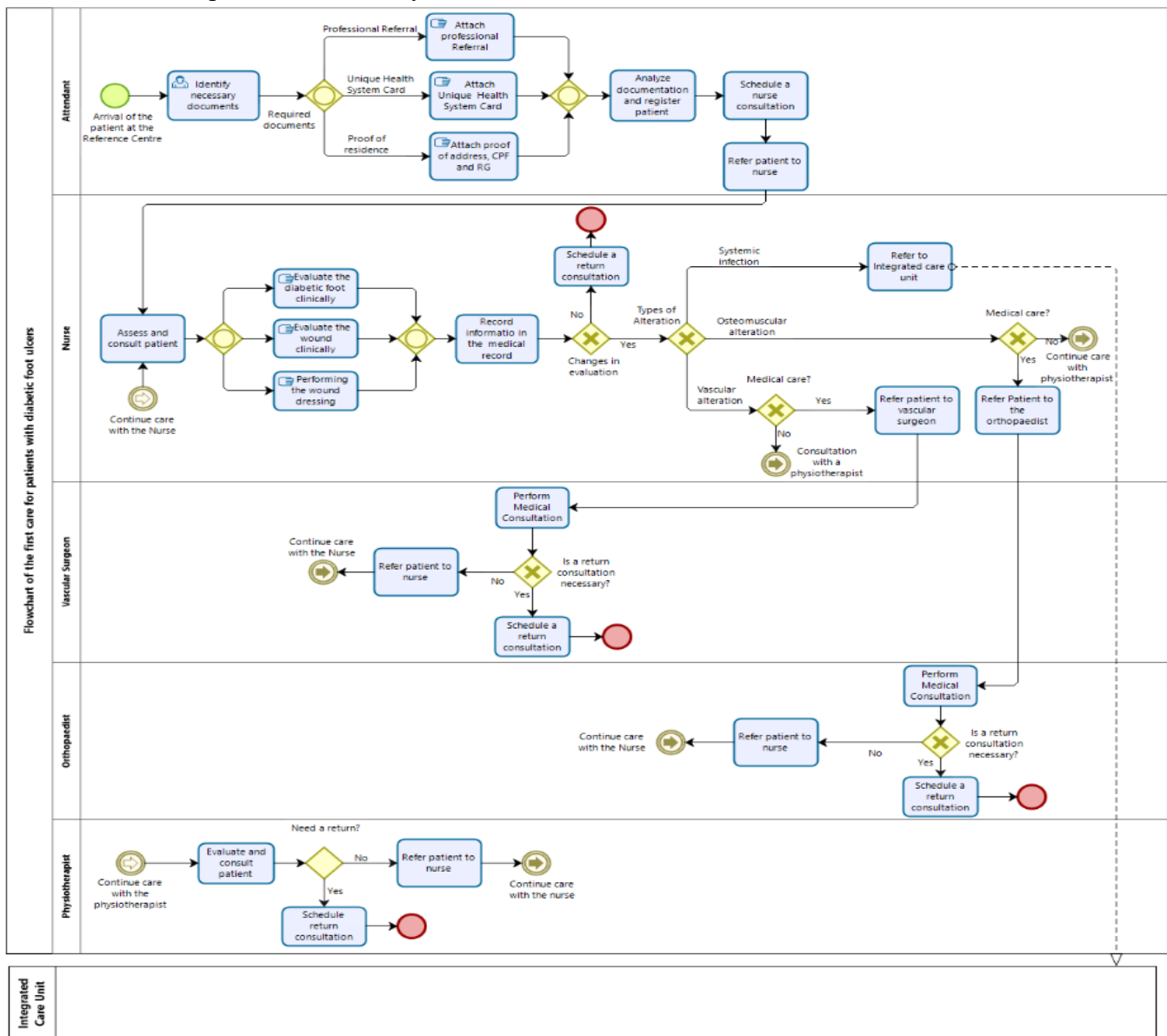


Figure 1 - Flowchart of the first care for patient with diabetic foot ulcer - Current Status.

In the **figure 2**, aiming at quality multi-professional service for attendance the diabetic foot ulcer carrier, the flowchart of the work process (Future directions), was elaborated with the purpose of approaching the emphasis in the holistic vision to these users of the health system and to avoid gaps during the execution of the activities.

When the future directions flowchart was compared with the current state, it was not noted differences concerning the activities performed by the attendant in the reception of the patient, considering that these administrative activities do not directly interfere in the treatment of the diabetic foot ulcer carrier.

After that, following the sequence flow, the attendant will analyse the documentation, registering the patient information and scheduling him with the Nurse (**Figure 2**). The patient in future directions will be attended by the nursing technician who will check vital signs and will collect blood samples for hemogram and biochemical tests according to protocols. In the next step, in accordance with the flow, the patient will be referred to the Nurse with a systematised nursing consultation directed to the clinical assessment of the feet; wound bed evaluation, and the first wound dressing, besides the control of complications (**Figure 2**).

The flow will continue with the patient being referred to the nutritionist. At this stage, a nutritional consultation is performed with the goal to implement pertinent conduits for improving the nutritional condition of the individual, what will contribute to wound healing (**Figure 2**).

Thereafter, the patient will be referred to psychological care, where he is evaluated and if necessary, the patient will receive psychological intervention and mental health care plan to controlling the factors that affect the healing process. After psychological evaluation, the patient will be referred to the social assistant, and this moment constitutes an important stage, in which it involves control of social and economic factors, which directly and/or indirectly interfere in the wound healing (**Figure 2**).

Hereafter, the flowchart continues with the patient being attended by the physiotherapist, receiving care focused on exercises, prescription of insoles and shoes adapted through baropodometer and referral by this professional to the orthopaedic technician, the professional who produces insoles and orthopaedic shoes.

In terms of medical consultation, the last stage of the future directions flowchart, blood tests will be interpreted and alterations pointed out by multi-professional team will be analysed and treated (**Figure 2**).

Finally, there is a possibility of the patient to be scheduled for returning to the Reference Centre with any professional, and whether he needs a medical specialty, he will proceed to a multi-professional ambulatory, in which its alterations will be discussed and new conduits will be taken with the purpose to treat the patient, according to the evaluation of all professionals (**Figure 2**).

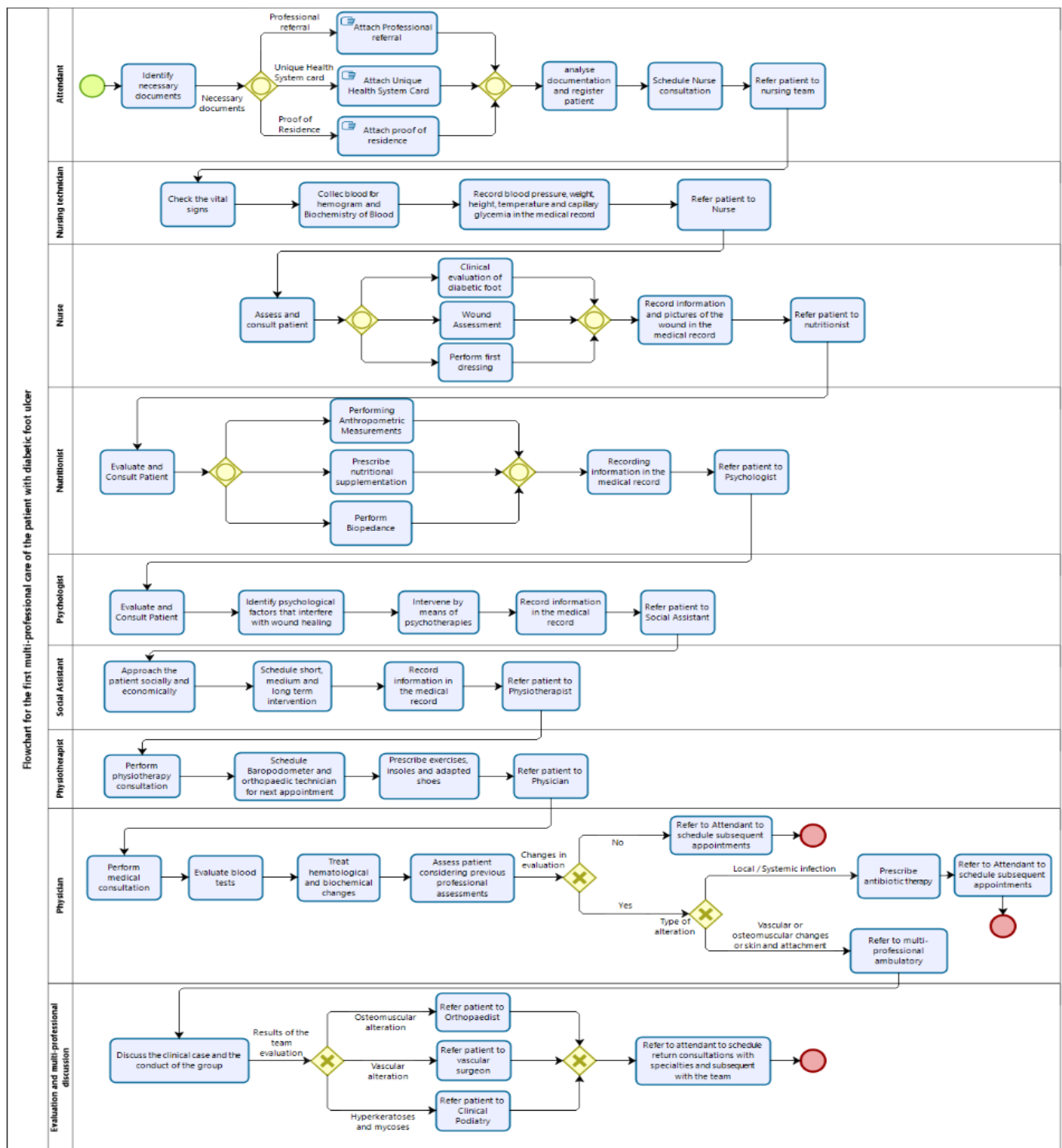


Figure 2 - Flowchart of the first multi-professional care of the patient with diabetic foot ulcer - Future Directions

4. Discussion

4.1. Multi-professional flowchart for the care of diabetic ulcer carriers

For the mapping of workflow, it was elaborated the flowchart, future directions, aiming to provide multi-professional healthcare to diabetic foot ulcers carriers.

The attendance performed by different professional categories, allows to patient fast diagnostic and

accurate range of the therapeutic goals controlling all factors that may interfere in wound healing, such as psychological, social, nutritional and physiological. Therefore, the patients should be referenced and assessed by psychologists; social assistants; nutritionists; physiotherapists; physician and nurses (8).

A Previous finding suggests a relation between depression and diabetes, that is, depression is associated with a higher risk to developing type 2 diabetes, what consequently, may result in depression (9). The consultation carried out by psychologists have the purpose of handling depression, the mental stress and anguish, commons in this group of diabetic foot ulcer carriers. The changes imposed by chronic stress promotes high levels of cortisol hormone, that consequently, delays the healing process due to the interference in inflammatory phase associated with anti-inflammatory effect of this hormone (10). We highlighted that the importance of this professional in attendance of patients with diabetic foot ulcers, since that, depression was associated with high risk of mortality in those individuals that developed diabetes foot ulcer in the earliest 5 years (11).

The diabetic foot ulcers, besides the numberless complications, have their clinical improvement influenced by the social and economic environmental around the patient. We emphasize, thereby, the relevance of healthcare that the social assistance provides to diabetic foot ulcer carrier because this professional is directly involved with social support systems and financial resources that assure care to these patients (12). Most of patients with diabetic foot ulcer have a micronutrients imbalance, what may cause malnutrition and damage to the wound healing. The minerals and vitamins such as zinc, vitamin A and C are associated with collagen synthesis and immunomodulation accelerating the wound healing process (13-14).

The nutrients prescribed by nutritionists as arginine, glutamine and beta-hydroxy-beta-methylbutyrate (HMB), a leucine metabolite that presents an anti-catabolic effect, have been reported in a study while nutrients that favours the healing of diabetic foot ulcers (15).

The nutritional assessment and dietary supplements offer are strategies that also interfere in wound healing, showing the notorious work of nutritionists who contribute to the health of the diabetic foot ulcer carrier (15).

The physiotherapist is a professional who assist the population emphasizing the maintaining of body movement, preventing, treating and recovering dysfunctions and skeletal muscle diseases, being, therefore, its main working medium (16). It was demonstrated implications of physical exercises using lower limbs on wound healing, with the goal to promote muscle strengthening, balanced posture, and weight control among other factors (17).

The physical assessment of the physician is necessary for evaluating the patient and keep the continuous workflow. The addressing of the wound by physician team should include essential action as clinical diagnosis, detection of comorbidities associated with peripheral vascular disease; neuropathies; necessity of surgical debridement and treatment of wound infection, requesting tissue culture of wound for prescribing the correct antibiotic promoting the rational use of the medicine (18).

Although the endocrinologist was not predicted in the flowchart entitled future directions, this specialist is in charge to deal with the control of endocrinopathies whose its main functions are to educate and empower the patient, besides to handle risk factors that affect the wound healing (19). The orthopaedist, while member of multi-professional team, should act preventing and treating diseases that affect tendons, ligaments, muscles, joints and bones in theses DFU patients. The relation between diabetic foot ulcer and

this specialist is due to the need for orthopaedic surgeries, which there is a paramount role in the management of this pathology. Furthermore, the orthopaedist is responsible some activities, such as the treatment of the foot deformities utilising surgery; to determine the patients eligibles for the surgical debridement, to indicate the correct antibiotics and treatment for Charcot neuropathy (20).

Regarding the vascular surgeon, this professional is relevant for the treatment of diabetic foot ulcers since that is need to correct vascular insufficiencies. It is important to mention that this professional should never indicate amputation without an accurate evaluation of veins and arteries of the lower limbs, employing Doppler and transcutaneous oximetry (TcPO₂), in order to indicate revascularization, which in turn, is essential in wound healing (21).

It is understandable a range of activities performed by nurses in relation to diabetic foot ulcer management, because this professional acts promoting health, preventing wounds, detecting peripheral neuropathies and vascular insufficiency, besides of realising the wound curatives and prescribing primary dressings (22).

According to the Federal Board of Nursing of Brazil, it is the responsibility of nurses the assessment, prescription, and execution of dressings, including mechanical, biological, enzymatic and autolytic debridement's. Even though there are doubts about the wide range of actions performed by nurses in wound treatment, this professional is authorised to treat wounds using Low-level laser therapy (LLLT), since this professional has obtained the title of specialist such as stomatotherapy and dermatological nursing (22). Moreover, the nurse is authorised to use the Light-Emitting Diode (LED), an adjuvant therapeutic modality that promotes the tissue repair of acute and chronic wounds, once fulfilled the previous requirements associated with a professional specialisation (23).

We highlight still, the autonomy regarding negative pressure to treat diabetic foot ulcers. This therapy provides a non-invasive, local and controlled sub-spherical pressure what allows the healing of wound. It is important to remember that, the nurses have autonomy to prescribe this new technology either stomatotherapist or dermatological nursing (24).

5. Conclusion

Therefore, the flowchart future directions, elaborated in the present study, represents quality improvement in healthcare provided to patients with diabetic foot ulcers, since this flowchart contemplates a multi-professional assessment, aiming continuously the prevention, recovery and rehabilitation of these patients under holistic view.

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