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# Patient Safety in Hemodialysis

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## Abstract

Patient safety addresses the risks involved in health care, simplifying or eliminating adverse events, these are defined as incidents that occur during the provision of health care and that result in harm to the patient. Health care is increasingly complex and can increase the potential for incidents, errors or failures to occur. Hemodialysis is a technically complex procedure, with many potential sources of error and which can cause harm to patients. Dialysis is a therapy that in recent years has benefited many patients, but it is a care process that involves important dangers and risks. Hemodialysis is a hospital sector with a great risk potential for the occurrence of adverse events, this occurs for several reasons such as complex procedures, the use of high technology, the characteristic of chronic kidney disease, the high use of medications. Strategies need to be taken to reduce the occurrence of adverse events, thus ensuring the quality of dialysis, consequently the quality of life of patients with chronic kidney disease undergoing dialysis treatment.

**Keywords:** renal dialysis, patient safety, nursing care, chronic renal failure, nursing in nephrology

## 1. Introduction

Patient safety is defined by the World Health Organization (WHO) as reducing the risk of unnecessary harm associated with healthcare to an acceptable minimum [1].

The topic of patient safety has been increasingly disseminated within institutions and among healthcare professionals, about the search for the quality of care provided and the reduction of preventable incidents [2].

Patient safety addresses the risks involved in health care to reduce or eliminate Adverse Events (AEs), defined as incidents that occur during health care and result in harm to the patient, characterized as physical, social, and psychological, including illness, injury, suffering, disability or death [1].

The interest in this topic is a result of the realization that the occurrence of Adverse Events (AEs) involves considerable social and economic costs, and may involve irreversible damage to patients and their families [3].

The patient safety issue began with the publication of the Institute of Medicine (IOM) report *To Err is Human*. This publication provoked the mobilization of the medical class and the public in general, of North American organizations and several countries for issues related to patient safety. This mobilization is the result of the realization that the occurrence of adverse events (AE) involves considerable social and economic costs, and can cause irreversible damage to patients and their families. The IOM report estimated the occurrence of 44 to 98 thousand deaths each year, in the United States (USA), resulting from AEs [4].

According to the Institute of Medicine (1999) quality in healthcare, considering current scientific knowledge, is defined as the degree to which the services provided to the patient, on the one hand, decrease the probability of unfavorable outcomes, and, on the other, increase the probability of favorable outcomes. Unfavorable outcomes are adverse events (AEs).

Developments in patient safety and reliability of health services imply a change in the conduct practiced by most services. The safety culture of an organization is the set of values, attitudes, perceptions, competencies, and behavioral patterns that determine the commitment, style, and proficiency of the administration of a healthcare organization with safety management [5].

Health care is increasingly complex, and predisposes the occurrence of incidents, errors or failures. Injuries or damage resulting from the care provided constitute a serious problem related to the performance of health services; unsafe health care can cause increased morbidity and mortality worldwide [6].

Researches that investigate the patient safety culture in the hospital environment are increasingly present in the scientific environment. The positive safety culture favors the improvement of safe practices, through improvements in communication, teamwork and knowledge sharing [3].

The development of a safety culture, the practice of records, the discussion about the circumstances in which incidents occur, as well as the professional and organizational behaviors in front of this situation, constitute a path to be followed for the transformation of the reality in health institutions [7].

In this perspective, the development of safety culture has received increasing attention in the field of healthcare organizations. The complexity present in health care, which involves its dynamic and multifaceted nature, the use of leading-edge technology and the action of professionals from different fields, predisposes to error and, to minimize it, potential sources must be identified and prioritized [8].

It is a fact that unsafe health care can result in increased morbidity and mortality, which makes this a global concern, because many errors could be avoidable from the implementation of safety indicators in quality monitoring programs in the care offered to hospitalized patients [9].

It is currently recommended that, in assessing the impact of events related to patient safety, not only mortality but also morbidity be considered given the repercussions on the quality of life of patients who have suffered damage [5].

Chronic kidney disease (CKD) is a condition with several attributes that have the potential to increase the risk of errors and patient safety failures. People with CKD have higher rates of hospitalizations, which leaves them susceptible to interventions with the potential for errors to occur [10].

There is a high proportion of people with chronic kidney disease (CKD) who experience safety-related events. This factor highlights the vulnerability of this population to potential adverse effects of care [11].

Patients with CKD have hemodialysis as one of the treatment modalities. Regarding the Hemodialysis Service, it is emphasized that the treatment is complex, with specific activities, for example, the control of the extracorporeal blood circulation system, requiring adequate structure and trained professionals for a safe care practice, which, if not respected, may cause irreversible damage to the user [12].

Hemodialysis (HD) is a technically complex procedure, with many potential sources of error that can cause harm to patients. Carrying out hemodialysis safely requires many steps, ranging from creating the dialyzer and other equipment, accessing the bloodstream and monitoring the patient to prevent complications and ensure hemodynamic stability [13].

Dialysis is a therapy that in recent years has been benefiting many patients, but it is a care process that involves important dangers and risks. The risks of

hemodialysis in situations of chronic disease comorbidities are related to the fact that the patient has a terminal disease that depends on permanent life support, in addition to the use of many medications [5].

The complexity of hemodialysis procedures specifically involves the use of advanced technologies, water quality, dialyser reuse, infection control, machine disinfection and the use of medications [8]. The complexity of chronic kidney disease (CKD): the chronicity of the disease, the involvement of multiple health care professionals, and the different activities of care [14].

Thus, in this type of procedure, considering the frequency with which patients undergo the procedure that involves the use of high technology, it is important to evaluate issues related to patient safety.

There are several risk factors for adverse events in hemodialysis, among which he highlights: invasive procedures, use of complex equipment, critical patients, high patient turnover, and administration of potentially dangerous drugs such as heparin [15].

The authors conducted a study in which they identified some avoidable variables that may have contributed to the deaths of patients on hemodialysis. They point out that these variables were related to communication, organization, and human factors, associated with five main causes, for example: the treatment of hyperkalemia, the prescription, the time of treatment, the presence of infection, and vascular access [16].

The use of Checklists is a patient safety strategy that can be effective. Checklists are tools used to improve patient safety, adherence to protocols and policies, contribute to communication, teamwork, and the standardization of procedures [17].

Authors emphasize that the use of Checklists is an important strategy to ensure that procedures are performed safely, as it allows the occurrence/recurrence of preventable harm to be identified and prevented [13].

When used properly, guidelines, protocols, and checklists can result in quality care, considerably reducing the risks presented by the procedures to which the patient has been submitted.

Checklists were initially used in surgical and intensive care environments and have been shown to be an important patient safety strategy that can improve the safety culture [18].

High-quality institutions with a good safety culture anticipate adverse events as a way to prepare professionals to deal with them at all levels of the organization. In this way, they make tools available to professionals to develop skills to convert such adverse events into improved system resistance [19].

Patient safety assessment enables hospitals to prospectively identify and manage relevant safety issues in their work routines [20].

Care for patients receiving renal replacement therapy (RRT) is complex and technology dependent; patients have a high burden of comorbidity, polypharmacy, and the physiological consequences of established kidney disease means that patients on RRT are potentially vulnerable to errors [16].

Patient safety events can have costly consequences for patients and healthcare networks, increasing length of stay, readmissions to the hospital, and the risk of death [11].

Hemodialysis units are sites susceptible to the occurrence of adverse events (AE) because they have several risk factors, such as invasive procedures, use of complex equipment, water treatment, critical patients, high patient turnover and administration of potentially dangerous drugs, such as heparin. A study performed in four hemodialysis units in the USA identified that in a 17-month period 88 adverse events occurred during 64,541 dialysis treatments (01 case for every 733 treatments) [15].

The presence of infection in the SRT population is a complex and common problem, since the prevalence of sepsis in dialysis patients is more than 100 times higher than the general population, is multifactorial, associated with high hospitalization rates, infection risks, and immunosuppression as a consequence of renal impairment, comorbidity, and immunosuppressive therapy [16].

Bloodstream infections are the main causes of death and hospitalization among hemodialysis patients, in second place are cardiovascular diseases [21].

Among the main causes of AEs in hemodialysis patients, the patient's clinical condition is very important. Such conditions directly influence the occurrence of AEs, especially in critically ill patients, given the hemodynamic instability and the need for interventions, which make them particularly vulnerable to adverse events [22].

In addition, CKD is associated with pathophysiological changes such as anemia, osteopenia, susceptibility to hypervolemia, electrolyte changes and infection, which can increase the risk of complications and adverse events [10].

For the occurrence of AEs, there are psychological and physiological factors that can influence the behavior of professionals during care and interfere with patient safety [22].

In daily nursing care, it is clear that the number of professionals directly influences the implementation of measures related to the implementation of a culture of safety. Thus, an adequate dimensioning of the team is essential, as it interferes in the administrative process and consequent care planning [22].

About the weekly workload, 48% of nursing professionals in the hemodialysis unit work from 50 to 70 hours per week, increasing the risk of failures being committed during the provision of care. The risks of the professional committing an error increase significantly when the work day exceeds 40 hours per week, when work shifts exceed 12 hours or when overtime is performed [23].

Thus, it can be observed that the working hours and the dimensioning of nursing staff are factors that can interfere in the quality of the care provided, consequently influencing the safety of the patient on hemodialysis.

## **2. Factors affecting patient safety in hemodialysis**

A study aiming to assess the frequency of adverse events occurred in CKD patients, shows that about half of the participants had one or two safety events. Diabetic patients were 2.9 times more likely to have three or four adverse safety events compared to non-diabetic patients. In addition, patients with stage 5 CKD were 2.8 times more likely than patients with stage 3 CKD to have multiple safety events during the study period [11].

These data reinforce the assertion that patients with CKD are more vulnerable to safety failures related to their clinical condition. CKD is a significant risk factor for many safety events.

In the other study, direct complications of CRT accounted for 2.1% of deaths, and 3.5% of deaths of patients on CRT [16].

The Pennsylvania Patient Safety Authority, an independent agency in the United States of America (USA) charged with taking action to reduce and eliminate health care failures, developed a study to understand the types of errors and AEs occurring during hemodialysis. An analysis of 526 reports of events related to hemodialysis treatment over a one-year period was performed. Medication errors were the most prevalent (28.5%), followed by failure to follow protocol (12.9%) [24].

The conditions identified as predisposing to adverse events in hemodialysis patients are: hyperkalemia, hypoglycemia, prescription of medications in a safe manner, the presence of infection, and vascular access for hemodialysis [11, 16].

In dialysis services, hand hygiene is an important infection control measure, since, in this scenario, several patients undergo dialysis treatment at the same time, in the same environment, which can contribute to the spread of microorganisms. This dissemination can occur through direct or indirect contact, through devices, equipment, surfaces or through the hands of health professionals [12].

Central venous catheter infections for hemodialysis are much more frequent when compared to arteriovenous fistulas [21].

Complications associated with vascular access can be severe, causing a high risk of morbidity and mortality for patients. Bloodstream infections represent a major impact on the morbidity and mortality of this population. Nurses must monitor, detect and intervene in complications that occur during hemodialysis sessions [22].

The arteriovenous fistula (AVF) is the most appropriate and safest venous access, because it is the long-standing access that enables effective dialysis with fewer interventions [25].

Thus, the use of double-lumen catheter can lead to a higher occurrence of adverse events, interfering with the safety of the patient on hemodialysis. CDL infection is one of the main adverse events in hemodialysis. The largest number of infections in patients undergoing hemodialysis procedure is related to the Temporary Double Lumen Catheter (TDCL). Bacteremia in patients with a catheter during HD varies from 4–18% and in most cases associated with hyperthermia. Infectious complications are causative agents of increasing morbidity and mortality in hemodialysis patients [26].

CKD is also characterized by impaired renal clearance of numerous medications, increasing the risk for incorrect dosing and toxicity of therapeutic agents [10].

In the hemodialysis community, medication errors are reported as the most common patient safety event. Medication errors are common among dialysis patients and often occur as errors of omission [11, 21].

In addition to medication omission errors, errors also occur during medication administration and communication errors among the team [21].

Obstruction of the venous catheter is a very frequent adverse event in hemodialysis sessions. It occurs when a clot forms in the catheter lumen, preventing blood flow from the patient's body to the hemodialysis machine, which leads to the loss of the blood volume that fills the system [22].

The blood clotting of the extracorporeal system usually occurs in sessions performed without heparin, due to contraindication of the drug [22].

Problems in vascular access that lead to adequate blood flow interfere directly in the dialysis dose, reducing the Kt/V, consequently interfering with the patient's health status.

Events of hyperkalemia and hypoglycemia were found individually, are common adverse events, as well as risk factors for mortality of patients with CKD [11].

In a hemodialysis session, it is necessary to check vital signs to avoid episodes of hypotension, consequently, the cramps, headache and nausea, verification of blood glucose to avoid episodes of hypoglycemia and, plus correct checking and noting of weight and body temperature; anticoagulation, proper functioning of the dialysis machines (temperature, roller, blood flow, dialysate flow), being important the use of a checklist to avoid negligence.

Failure to comply with this verification routine is considered negligence, which is an action diverging from the correct one, arising from the professional's passivity or omission, which can lead to episodes of hypotension, hypoglycemia, among others, thus configuring the occurrence of an adverse event [25].

Accidental removal of the needle that punctures the arteriovenous fistula can be considered one of the most dangerous AEs in hemodialysis units, as the patient can bleed to death in a few minutes. Therefore, it is necessary for nursing to adopt measures that reduce the risk of this event occurring [22].

Infiltration of the hemodialysis access and coagulation of the hemodialysis circuit are some adverse events that can occur.

About dialysis programming, one can highlight the definition of the dry weight, the  $kt/v$  and the programming of the parameters in the dialysis machine.

The quality of the dialysis offered to the patients can be measured by the  $Kt/V$ . The  $Kt/V$  represents the adequacy of dialysis. In this study, it is observed that there is no record of  $Kt/V$  in 94% of the analyzed medical records.

There is a correlation between hemodialysis (HD) dose and patient morbidity and mortality, so to estimate whether CKD patients on HD receive adequate treatment, the HD dose should be measured. Clinical signs and symptoms are very important, but they are not sufficient indicators of dialysis dose [27].

$Kt/V$  assessment is nursing care and refers to providing quality dialysis to the patient. There are several factors related to achieving an ideal  $Kt/V$ , and it is important to emphasize that the patient needs to adhere to the treatment as recommended, i.e., perform the dialysis time, follow the diets, take medications, take care of the vascular access.

The other part is up to the multidisciplinary team, which includes providing guidance. The dialysis service must be committed to the treatment, offering an ideal capillary according to the body mass, performing good venous access, correct adequacy during treatment [28].

The National Kidney Foundation considers the ideal hemodialysis dose a  $Kt/V$  greater than 1.2, for the patient who performs hemodialysis three times a week and for four hours each session [28].

Incorrect programming is an adverse event and can lead to significant losses to the patient, even death.

Checking the schedule is the nurse's role, since this is the professional of the health team responsible for managing care in dialysis units. Nursing in hemodialysis treatment has great relevance regarding the uninterrupted observation of patients during the period in which the hemodialysis session occurs [29].

In the Renal Physicians Association survey, 17 percent of patients indicated that they had problems with the settings on their dialysis machines. In this study, the authors point out that patients involved in their dialysis care are significantly less likely to report having had problems with machine settings [30].

Dry weight is the target weight to be achieved post hemodialysis below which all, or most of the excess fluid has been removed, without developing symptoms of hypotension [25].

Adherence to adequate fluid intake is commonly measured by interdialytic weight gain (GPID). The adequate dry weight prevents the occurrence of hypotension or hypertension.

Studies have shown a relationship between elevated GPID and complications such as hypertension, congestive heart failure, and even death. In addition, the removal of this excess fluid during hemodialysis (HD) can result in episodes of hypotension, muscle cramps, nausea, and headache [31].

The nurse has a fundamental role as an educator, providing the necessary guidance for patients to maintain their interdialytic weight gain within the recommended values.

Adherence to dietary and fluid restrictions improves laboratory parameters, reduces complications such as hospitalizations for acute pulmonary edema and improves the quality of life of patients on HD [32].

The conventional treatment regimen of three sessions per week implies long periods without hemodialysis, especially on weekends, when the patient can consume a larger amount of fluids and not follow the diet as he should. Thus, there is an oscillation in the volume of liquids and biochemistry during the following week,

where it is possible to observe an increase in complications in the sessions at the beginning of the week. The ideal would be more frequent or longer sessions, to offer more security and increase the life expectancy of these patients [33].

The mechanicity present in hemodialysis treatment leads professionals to present a posture of “doing for doing”, which lends to the activities a feeling of accommodation, which is summarized in, every shift, putting the patient on the machine, pushing the button and supervising its operation [34].

Nursing in nephrology is specialized care, but the nursing action should not be reduced to the performance of a set of techniques. In HD, it is necessary to provide care based on the training of professionals to seek the best conditions to provide quality of life for the patient. Therefore, nursing care in this scenario also involves interactive action, supported by the ethical dimension between the one who cares and the one who is cared for [35].

### **3. Strategies for patient safety in hemodialysis**

Patient safety deals with the risks involved in health care and seeks to minimize these risks and reduce or eliminate Adverse Events, which are incidents that result in harm to the patient [1].

Preventing adverse events can improve the quality of care and patient outcomes [11].

Quality comprises the relentless search for identifying flaws in procedures and practices that organize actions, leading to improved processes and results, aiming at the conformities established by regulatory agencies and user satisfaction [12].

Reducing errors and improving patient safety have become a national priority. Patients with chronic kidney disease (CKD) may be at higher risk for adverse consequences of medical care, but few studies have evaluated this issue [10].

The occurrence of AEs can be minimized by changing managerial and professional attitudes, strengthening leadership, improving access to information, quality, maintenance and use of equipment and environments as well as knowledge and encouraging continuing education [7].

Safety culture has received increasing attention in the field of healthcare organizations. Healthcare is becoming increasingly complex, raising the potential for incidents, errors, or failures to occur. Injuries or harm resulting from the care provided are a serious problem related to the performance of health services; unsafe health care causes significant morbidity and mortality worldwide [6].

From this perspective, health institutions must develop strategies for a patient safety culture. The development of protocols that standardize procedures makes the work process safer and more efficient [22].

Professionals should have knowledge about adverse events and their impact on health care, since the incidence of these events is an important indicator of quality [22].

Currently, there is a greater awareness, nationwide, that professionals need to be trained about the measures to be taken in case of failures, in addition to being encouraged to take an honest attitude towards the error, without fear of punishment and effectively involved in the search for safe patient care [36].

Nursing professionals are responsible for most of the care actions and, therefore, are in a privileged position to reduce the possibility of incidents affecting the patient, as well as to detect complications early and perform the necessary procedures to minimize damage [22].

The maintenance of good adequacy of hemodialysis in patients with chronic kidney disease depends directly on an efficient Vascular Access (VA), whose complications have great representativeness among the morbidities in this group. And, considering the importance of the VA, it is worth noting that the effectiveness

of therapy is closely associated with its implantation, handling and proper monitoring, affecting the quality of dialysis and, consequently, the well-being and survival of the patient [12].

Adverse events related to vascular access can be avoided using improvements in the care processes used by Nursing, as well as constant evaluation of the results of the practices adopted.

Studies show that catheter-related infections can be reduced when prevention measures are properly applied, such as the use of aseptic technique before insertion, in each manipulation of the device and dressings, antisepsis at the catheter exit site with 2% alcoholic chlorhexidine, adequate staff paramentation (sterile gloves, masks, goggles and aprons), care in catheter maintenance, monitoring of infection signs, continuing education of staff professionals and self-care guidance for the patient [37, 38].

Considering that vascular accesses are an important care practice and are closely related to the quality of care and quality of life of CKD patients, it is believed that the use of checklists can be an important ally in the evaluation of vascular access, ensuring the quality of this therapeutic modality [22, 39].

The Nursing team that works in hemodialysis units must have knowledge about adverse events to be able to identify the risks and the situations that favor their occurrence, to seek alternatives to minimize failures, adopt risk analysis methods and thus ensure the quality of the services [22].

Many hospitalizations may be preventable with better care planning, adequate patient education, and early detection of complications [40].

Strategies to improve patient safety in dialysis units have emphasized the importance of effective communication, reduction of medication errors, correct dialysis, equipment preparation, and infection control [16].

Encouraging the practice of hand hygiene constitutes one of the nine solutions for patient safety, launched in 2007, in the Nine Patient Safety Solutions program, considered the primary preventive measure to avoid harm to patients [12].

The Nine Patient Safety Solutions program is based on patient safety strategies and best practices that have been identified by the WHO World Alliance for Patient Safety. They were developed with feedback from more than 50 patient safety experts from over 100 countries. The strategies come in nine titles and are being made available to WHO member states. The intention is that the strategies will be used to reexamine patient care processes to improve safety [1].

The nine points covered by the program are: Identical medication names; Patient identification; Communication; Correct procedure in the correct place; Control of concentrated electrolyte solutions; Medication accuracy; Care with connections; Single-use of injection and hand hygiene devices [1].

The theme described above is recurrent in health services and treated as a priority by programs and initiatives that focus on safety in patient care, such as the World Alliance for Patient Safety, an initiative of the WHO, which has dedicated efforts in the development of guidelines and strategies for implementation of measures, including adherence to the practice of hand hygiene and, more recently, in Brazil, by the Ordinance of the Ministry of Health No. 529/2013, which establishes the National Program for Patient Safety [41].

Organizations must safely structure the system, helping professionals not to make mistakes. All causes should be analyzed by the risk management service for the development of corrective actions, aiming at the prevention and reduction of adverse events [22].

Among the suggestions to prevent the occurrence of adverse events, continuing education was mentioned as the main measure and as an important action for human resource training and development. The nursing staff of a hemodialysis unit

should develop skills to detect and prevent adverse events, adopting strategies to improve the care processes developed in daily practice [22].

Health education can also contribute to patient safety. A good level of understanding of the disease and treatment aspects also positively influences the patient's adaptation and adherence to treatment [42].

This factor could reflect a lower occurrence of adverse events related to hemodialysis treatment.

Dialysis centers must function as high-reliability organizations to improve patient safety. These services must establish a culture of safety, which is based on communication based on mutual trust, common perceptions about the importance of safety and confidence in the effectiveness of preventive measures [21].

In the occurrence of an incident, what is important is the assimilation that the cause of errors and adverse events is multifactorial and that healthcare professionals are susceptible to committing them when technical and organizational processes are complex and poorly planned [22].

The high frequency of different events observed reveals the specialized care needs for the CKD population. Providing safe care for this population, therefore, provides some unique challenges.

Research must advance in understanding the cause of harm, identifying solutions, impact, and transposing evidence to the organization of care. They reinforce that measuring harm is fundamental to know the patient safety problem [43].

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