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Skill Improvement in Patient Safety through Training Strategy Implementation in Health-care Workers

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***Abstract*—**Currently, the sophistication of technology in the health-care industry offers advantages for the diagnosis and treatment of patients; however, the risks and adverse events that go with this new generation of technology are a growing tendency worldwide. There are many factors that contribute to this scenario, but especially the increase in human error in health-care institutions when the process of technological incorporation does not include appropriate personnel training. The objective of this project is to contribute to patient safety and offer quality healthcare. In order to offer a responsible, committed, and professional service,a strategy of training personnel in the appropriate use of technology must be implemented.

***Keywords*—** Training; Medical device; Patient safety; Appropriate use.

Mejora de habilidades en la seguridad del paciente implementando una estrategia de entrenamiento en el personal asistencial

***Resumen*—** En la actualidad, la sofisticación de la tecnología en el sector sanitario ofrece ventajas para el diagnóstico y tratamiento de los pacientes; sin embargo, los riesgos y eventos adversos que acompañan a esta nueva generación de tecnología son una tendencia creciente a nivel global. Hay muchos factores que contribuyen a este escenario, especialmente el error humano que aumenta en las instituciones de salud cuando el proceso de incorporación tecnológica no incluye la adecuada formación del personal. El objetivo de este proyecto es contribuir a la seguridad de los pacientes y ofrecer servicio de calidad en la atención sanitaria. Para ello debe implementarse una estrategia de capacitación del personal en el uso adecuado de la tecnología para ofrecer un servicio responsable, comprometido y profesional.

***Palabras clave*—** Capacitación; dispositivo médico; seguridad del paciente; uso apropiado.

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Melhora de habilidades na segurança do paciente implementando uma estratégia de treinamento no pessoal assistencial

***Resumo*—**Na atualidade a sofisticação da tecnologia no sector sanitário oferece vantagens para o diagnóstico e tratamento dos pacientes, no entanto, os riscos e eventos adversos que acompanham esta nova geração de tecnologias são uma tendência crescente a nível global. Existem muitos fatores que contribuem a este palco: especialmente o erro humano que aumenta nas instituições de saúde quando o processo de incorporação tecnológica não inclui a adequada formação do pessoal. O objetivo deste projeto é contribuir à segurança dos pacientes e oferecer atenção de qualidade na atenção sanitária, a implementação de uma estratégia de capacitação do pessoal no uso adequado da tecnologia para oferecer um serviço responsável, comprometido e profissional.

***Palavras-chave*—** Capacitação; Dispositivo médico; Segurança do paciente; Uso apropriado.

I. Introduction

The World Health Organization (WHO) recognizes the importance of medical devices for health care and improving the health of people and communities[1]. These devices are designed to directly benefit human beings in theintervention or prevention of health problems; however, their implementation includes components that can undermine the safety of a patient [2]. In the United States, the ECRI Institute considers that dangers in medical technology can occur, among other reasons, due to improper handling by personnel, the introduction of poor parameters, poor configurations, inadequate reprocessing, deficiencies resulting from poor maintenance and poor management [3].

The FDA has also recommended that manufacturers improve user interfaces, thereby minimizing errors during the use of this technology [4]. The United Kingdom's Medicines and Healthcare products Regulatory Agency (MHRA) reported 11,970 incidents related to medical devices between 2011 and 2012 [5]. Faced with this new challenge in the healthcare sector, different experts have discussed the impact of medical devices and the effect of the human factor on patient safety and the risks that this generates. In this regard, they have proposed different strategies to improve the use of technology, including enhancing training for end-users [6]. In the Health Institutions (in Spanish,Instituciones de Salud or IS) of Colombia, patient safety is a universal priority, and to that end, initiatives and strategies are built to strengthen it. One of them is the patient safety policy, which is driven by the Mandatory System of Quality Assurance in Health (in Spanish, Sistema Obligatorio de Garantía de Calidad en Salud or SOGCS), which seeks to protect the patient, have an impact on quality improvement, and make health-care processes safer [7]. In this regard, training strategies have proven to be efficient in minimizing risks and adverse events and increasing the efficiency of medical devices.

Due to the importance of providing safer care and contributing to the patient safety policy, it is necessary to propose tools that promote the efficient, safe and rational use of health technologies. This article presents the design of a training strategy for health-care personnel based on the identification of best institutional practices through comparative benchmarking, then selecting a health institution to implement the strategy through a pilot test, thus demonstrating positive results in the reduction of corrective costs and reports of adverse events due to misuse of biomedical equipment.

II. Methodology

The study was conducted in three stages. The first consisted of identifying, through comparative benchmarking, those health institutions that showed the best practices and training experiences for health-care personnel in the use of medical equipment at a regional level. For this stage, the following selection criteria were established: a) institutions with more than 50 beds, b) experience in technology management, c) accredited in health care, d) best qualified in Latin America e) with state-of-the-art technology and/or f) willing to participate in the study. The study had the participation of eight (8) health institutions in total, located in two (2) departments (Antioquia and Valle del Cauca).

For the second stage, a comparative analysis of the strengths of each participating health institution was carried out, which laid the groundwork for the design of a training strategy that links guidelines, tools, and plans focused on health-care personnel. In addition, the sequence of steps to be followed in training and the actions that the personnel should know for the proper use of biomedical technology was compiled.

Finally, a pilot test was carried out at a health institution in the municipality of Itagüí, Antioquia, Colombia. At this stage, training and evaluation instruments were designed for four pieces of biomedical equipment (infusion pump,

defibrillator, electrocardiograph and autoclave), which were selected based on the criticality of the equipment for the institution, failure reports, and need for knowledge in handling. The trainings were scheduled to last 40 minutes each and were aimed at strengthening the development of health-care personnel competencies in the proper management of biomedical technology. As a control for the process, an evaluation stage was designed in which understanding of the information presented in the training for each piece of biomedical equipment was checked, as well as a follow-up or tracking stage to ascertain the consequences the training has brought about in the personnel, meaning whether there were positive or negative results afterwards, whether there were changes that improved the use of the device, or whether there was simply no change.

III. Results

A. Comparative Benchmarking

Comparative benchmarking was carried out in eight health institutions, which allowed for the identification of the strengths of the training processes in use of medical equipment and their level of importance. This exercise revealed that for 75% of health institutions, it is a high priority to implement training strategies in the proper use of biomedical technology, the results are illustrated in Fig. 1.

The participating health institutions also expressed that a training strategy could have a positive impact on costs and reducing adverse events.

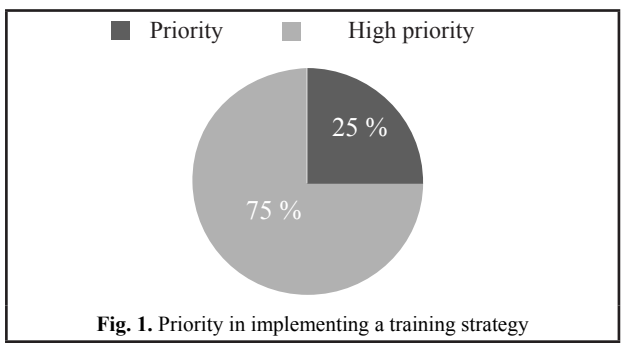

Fig. 1. Priority in implementing a training strategy

A comparative analysis of the identified processes made it possible to quantitatively evaluate variables (frequency, care, and applied information from the manufacturer, see Table 1) and select what was considered most appropriate from each one to construct a quality training strategy.

It was determined that the institution that has the best training process, according to parameters established in the matrix, is the Clínica del Prado in the city of Medellín. This is due to the fact that its process is widely implemented in all services, it presents positive results for the proposed goals, and they have indicators that support it.

In the trainings, they follow the manufacturer recommendations for good use and cleaning, and they perform them frequently (once a month), so it is demonstrated that the trainings are a process that the institution keeps constant.

B. Training Strategy

The design of effective training begins with clear and specific objectives that are relevant to the work of the users and the working environment [8]. The strategy links relevant issues such as alarm management in the equipment and usability by nurses. [9] The second requirement for effective training is that users should have the suitable opportunities to turn their intellectual knowledge into functional knowledge [6]. The third requirement is that metrics and tools must be defined to allow for a traceability analysis of the information learned. This is how health-care staff, after being trained, must demonstrate their knowledge and ability in the proper use of a medical device before being authorized by the health institution to use it with patients [8].

Based on this, a simple and effective training strategy is designed that allows staff to develop competencies so their performance within the organization is more efficient and safe. Fig. 2 illustrates the proposed strategy, which consists of the identification of need, the selection of the training equipment, the training itself in the prioritized topics, and an evaluation and a follow-up to the process.

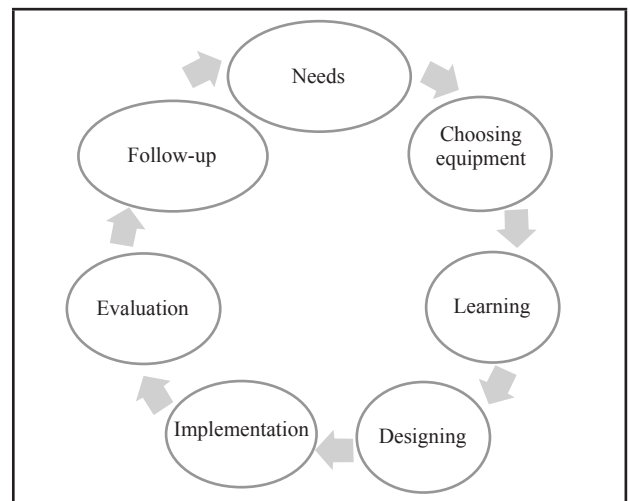

Fig. 2: Training strategy

Table 1. Comparative analysis of identified processes

Institution	*Process implementation*	*Process evaluation*	*Frequency*	*Duration*	*Manufacturer's instructions*	*Information on care and cleaning*	*Value*
Hospital General de Medellín	3	3	-	3	4	3	3,2
ESE Hospital del Sur-Itagüí	3	5	3	4	4	4	3,8
Clínica del Prado de Medellín	5	5	5	4	5	5	4,8
Clínica Palma Real de Palmira	5	2	5	4	5	5	4,3
Clínica CES de Medellín	3	2	3	4	4	5	3,5
Fundación Valle de Lili-Cali	4	3	5	4	5	5	4,3
Centro clínico Sicor Medellín	3	2	3	4	4	4	3,3

Table 2. Strategy implementation

Subject	Technology	Needs	Personal	Participants	Evaluation	Achievements
Autoclave	Automat 2400 Dental x ray	Support requests, usage errors, unhappy with the technology	Dentists, dental assistants	8	87.50%	They know the correct usage instructions, how to solve possible errors.
Defibrillator	Beneheart D6 Mindray	Unfamiliarity with all physical parts, incorrect gel use	Doctors	17	92.2%,	They recognize correct use, physical parts of the equipment and appropriate gel to use.
Electrocardiograph	CM300 Comen	Frequent support, usage errors	Nurses and nurse assistants	9	96.42%	They are familiar with the operating instructions and proper gel to use.
Infusion pump	SK-600II Mindray	Permanent use, staff unhappy	Nurses and nurse assistants	17	90.20%	They know the correct use, possible errors and how to solve them.

C. Strategy implementation

In this phase of the study a pilot test was carried out at a health institution in the municipality of Itagüí, Antioquia. For this part, training and evaluation instruments were designed following the guidelines defined in the strategy and four pieces of biomedical equipment were chosen: infusion pump, electrocardiograph, defibrillator and autoclave.

The training strategy was implemented with the staff in the dental and emergency departments. Table 2 shows the information on the biomedical equipment selected, the specific needs that were diagnosed for each piece of technology, the target group, the number of assistants, the average number of questions approved in the evaluation and the achievements obtained during the training.

The pilot test was conducted over a period of two months and allowed for a knowledge level increase in good use of the medical equipment by 90%. The staff who underwent the training became involved with the strategy, generating positive impacts on the internal indicators of the institution such as a 30% reduction in corrective maintenance reports and a 50% increase in equipment usability, plus there were no reports of misuse of the equipment during the timeframe measured.

In addition, the strategy served as support in meeting the technology management standard for the healthcare accreditation process, benefiting the institution in obtaining the renewal of accreditation.

Finally, a document was developed with the most relevant information that the staff should know in order to correctly use the equipment, focused on the user manual of each device.

Videos and presentations were also created with information on the physical parts, button functions and operating instructions for safe use. Additionally, this information was made digitally available on the

web through the construction of a blog using the Google Blog application, the website address is http://trainingbiomedicaldevice.blogspot.com.co/ With this format users can access and consult the training material 24 hours a day as this a tool to prevent problems due to unfamiliarity with the technology.

IV. Conclusion

A strategy was developed for training in the proper use of biomedical technology for personnel involved in health care, thus contributing to the generation of health-care services that are safer and delivered with responsibility, commitment and professionalism. Likewise, it provides a tool that supports compliance with the patient's safety policy. It is concluded, therefore, that training strategies adjusted to the needs of health institutions contribute to the proper use of biomedical equipment, thus reducing adverse events, as well as the incidence of complaints and support requests; costs for corrective maintenance are lessened and service life is increased as well. All of this results in better quality attention given to the patients.

It is important the creation of a culture of training in health institutions since there is the permanent need to acquire knowledge to improve the performance of the personnel, in addition to the fact that all individuals need to update their knowledge to advance both professionally and personally.

For the health institutions where the pilot test was conducted, 51 people total were trained, and opportunities for improvement were created in the training process established with respect to the other seven entities in the comparison. It is recommended that staff training not be occasional but an ongoing process as it promotes the strengthening of the training processes in institutions, thus improving present and future performance levelsof the personnel working in them..

Conflict of Interests

The authors declare that there is no conflict of interest in the production of this article.

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References

[1]. OMS. Dispositivos médicos: Gestión de la discordancia, 2012.

[2]. INVIMA, «INVIMA,» (2012). Consulted on 2015 in: https://www.invima.gov.co/component/content/article.html?id=768:seguridadde-los-dispositivos-medicos.

[3]. ECRI Institute. El Hospital (June 2015). Consulted on September 27, 2015 in: http://www.elhospital.com/temas/Los-10-primeros-riesgos-de-latecnologia-medica-para-el-2015-Parte-1+105791.

[4]. Food and Drug Administration. Applying Human Factors and Usability Engineering to Medical Devices. 2016.

[5]. MHRA. «MHRA,» (2011). Consulted on September 20, 2015 in: http://www.fdanews.com/ext/resources/files/archives/c/con129234.pdf.

[6]. Cassano A., Trbovich P., Griffin M., Ling L., Easty T. Human factors for health technology safety: Evaluating and improving the use of health, 2015.

[7]. Ministerio de Salud. Lineamientos para la implementación de la seguridad del paciente en la República de Colombia. Bogotá, 2008.

[8]. Hyman W. *A practicum for biomedical engineering & technology management Issues*, pp. 141-154, 2008.

[9]. Honan L., Funk M., Maynard M., Fahs D., Clark T., David Y. Nurses' Perspectives on Clinical Alarms. *American Journal of Critical Care*, 24(5), pp. 387-395, 2015.