



Safety of machinery in hospitals: An exploratory study in the province of Quebec, Canada



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A B S T R A C T

Safety of machinery is a major concern in the manufacturing sector, but machines are also present in many other fields of activities, including healthcare. With the importance of machine-related accidents, the risk management practices related to the safety of machinery in the manufacturing sector are well known and documented. However, there is very little knowledge about the importance of machinery-related risks and their management practices within the hospital sector. The exploratory study presented in this paper addresses (i) the context of safety of machinery in hospitals; (ii) the characteristics of the machines used and their inherent hazards; and (iii) the level of integration of risk management practices for the safety of machinery in hospitals, such as risk assessment, machine safeguarding, lockout/tagout, inspection, and training. Five hospitals were visited and a questionnaire was used to collect the opinions and perceptions of non-medical managers and workers regarding machinery risk management. A total of 17 managers and 17 workers were interviewed. Documents related to machinery risk management practices, and information regarding the machines used and their hazards, were also collected. The results show that machine-related risks are a reality in this sector and that safeguarding of machinery is often deficient. None of the visited facilities had machine risk assessment procedures, a lockout/tagout program, or any specific document on safety rules related to machine hazards. Yet, the majority of managers and workers agree to say that these practices are relevant and can be implemented in the hospital sector. The results suggest that the hospital sector is generally aware of the best practices in machinery risk management, but that their level of implementation is lower than what can be observed in the industrial sector.

1. Introduction

1.1. Context of the research

Occupational Health and Safety (OHS) in the healthcare sector has been an important preoccupation for many years. In the province of Quebec, in Canada, there were, in 2013, 117 hospitals employing 200,000 workers (ISQ, 2014). Almost half of these workers comprises nursing staff (nurses, practical nurses, orderlies). The statistics of the *Commission des normes, de l'équité et de la santé et sécurité du travail* (CNESST, the governmental organization that focuses on the prevention and recovery of work accidents) show that between 2002 and 2011, general medical and surgical hospitals in the province reported 38,241 work accidents or occupational diseases involving on average 59 days of absence (CNESST, 2016). In the United States, the Occupational Safety and Health Administration (OSHA) indicates that hospitals are among the most hazardous sectors for the workers. In 2011, this sector recorded 253,700 work accidents and occupational diseases, which

corresponds to 6.8 injuries and diseases per 100 workers. In comparison, the manufacturing industry reported, for the same year, 4.3 injuries and diseases per 100 workers, and the construction sector, 3.9 injuries and diseases per 100 workers (OSHA, 2013). Still according to the OSHA, the healthcare sector has shown improvement regarding OHS in the last years, but did not do as well as other sectors (OSHA, 2013).

Many authors obviously concentrated their efforts on the numerous hazards that affect the workers in this sector. These include: biological risks (contagious and infectious diseases, needle stick injuries), ergonomic risks (patient handling, bad postures, repetitive movements), chemical risks (various chemicals used for disinfecting and sterilizing, anesthetic gases, drugs, or medications), physical risks (radiation from X-rays and radioisotopes, lasers), psychosocial risks (stress, burnout, violence), and mechanical risks (slips, trips and falls, equipment-related hazards) (Gorman et al., 2013). The vast majority of these studies often focused on the risks affecting the medical staff such as doctors, nurses, orderlies, etc. Since they represent a significant portion of the workers

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in this sector, it is normal to pay particular attention to them. However, it is important to note that many other workers are exposed to different risks, and that these risks can sometimes seem of second order within this sector.

It is notably the case with respect to equipment and machine risks. With the importance of machine-related accidents, the risk management practices for safety of machinery in the manufacturing sector are well known and documented. However, there is very little knowledge about the importance of machine risks and their management practices within the hospital sector. In fact, in a hospital, there are many areas where workers are exposed to machine hazards. For example, the laundry room, kitchen, mechanical workshop, boiler room, HVAC installations, as well as waste management are a few services in a hospital that present machine-related risks for the workers, in particular the non-medical staff (Tweedy, 2005).

1.2. Safety of machinery

All around the world, accidents caused by machinery are an important issue for prevention and compensation organizations. In the United State, from 1980 to 1989, 8505 machine-related deaths were reported, which corresponds to 0.8 deaths per 100 workers (Pratt et al., 1996). Machine-related accidents would thus be responsible for one third of the deaths at work in the United State (Etherton et al., 2008). More recently, the US Bureau of Labor Statistics reported 717 deaths associated with machinery in 2013 (US Bureau of Labor Statistics, 2014). In Turkey, fractures and amputations account for 64.9% of the injuries and diseases caused by agricultural machinery (Akdur et al., 2010). In Germany, 37% of the safety devices on metalworking machinery are voluntarily neutralized (Lüken et al., 2006). In Quebec, the CNESST reports that machine-related accidents represent approximately 15% of all compensated accidents, leading to 71.5 million dollars in annual disbursements (CNESST, 2014).

Machine-related accidents can have different causes. The main cause is the absence of a protector or protection device (54% of the cases) that is lacking at the design level, or that has been neutralized by the users (Backström and Döös, 2000). It represents a high proportion, that is actually confirmed by researchers from the *Institut national de recherche et de sécurité pour la prévention des accidents du travail et des maladies professionnelles* (INRS) in France, who estimated that 32% of the accidents are due to the absence of protective measures (Dei Svaldi and Charpentier, 2004). Since neutralizing protective measures can sometimes be tolerated by the employer, its frequency is increasing. The neutralization done by the workers is often the result of a flaw of the human-machine interface, or an inadequate integration of the safety measures at the design stage (Lüken et al., 2006). Another important cause of accidents is the machine’s residual movements, often of pneumatic or hydraulic nature, that have not been taken into account. In France, 20% of the machine-related accidents would be due to the inopportune movement of an automated machine (Dei Svaldi and Charpentier, 2004). Poorly designed protective devices that prevent only partial access to the hazardous areas can also explain many accidents.

1.3. Management of machine risks

Considering the importance of the risks posed by machines, the manufacturing sector has, for a long time, put in place many approaches aiming at managing the risks inherent to their utilization. This sector is well documented and equipped regarding machine risk management. Machinery manufacturers first need to comply with a number of standards and design their machine in a way to eliminate or reduce the risks at the source and, where necessary, add safeguards and inform the users of the residual risks and on the measures that need to be taken to control them (CSA, 2004; ISO, 2010). Other risk management approaches also need to be implemented by the users of the machine (i.e.

companies and employees that use them), in order to reduce the risks related to their specific utilization on the field. Among them, machine safety literature generally states (i) risk assessment, (ii) safeguarding, (iii) lockout/tagout procedures, (iv) machine inspection, and (v) training (Parker et al., 2016; Poisson and Chinniah, 2015; CPSSTQ, 2004; CSST, 2006; European Union, 2006). The following sections summarize each of these risk management approaches.

1.3.1. Risk assessment

Risk assessment is a process that is part of risk management, as proposed by international standard ISO 31000 – *Risk Management – Principles and guidelines* (ISO, 2009). This general standard, that provides principles, a framework and guidelines to manage all kinds of risks (such as environmental risk, professional reputation, economical risks, etc.), promotes risk assessment as a structured method to identify hazardous situations and evaluate their level of severity. For machine risks, the international standard ISO 12100 (ISO, 2010) *Safety of machinery – General principles for design – Risk assessment and risk reduction*, explains the different aspects of machinery risk assessment. This standard defines risk analysis as the combination of: (i) determination of the limits of the machinery, (ii) hazard identification, and (iii) risk estimation (Fig. 1). Risk analysis provides the necessary information for risk evaluation, which completes the risk assessment process and allows to make decisions regarding the necessity to reduce the risk. Although this standard is aimed mainly at the designer of the machine, its principles can also be implemented by the user, who is responsible for the safety of the machine in its context of implementation and utilization. For its part, the Canadian Standard CSA Z432-04 (2004) *Safeguarding of Machinery* provides indications with respect to the requirements that need to be followed by machine designers and machine users regarding risk assessment.

Risk assessment has been integrated to risk management practices within many organizations for several years. Risk assessment tools are well known, adapted and used in the chemical, nuclear and aeronautical industries since the 60s (Main, 2004). In response to machine risks, the mining and manufacturing sectors have also adopted this risk management practice (Pelchat and Gauthier, 2015; Mrugalska and Kawecka-Endler, 2011). The investigation reports on severe and fatal

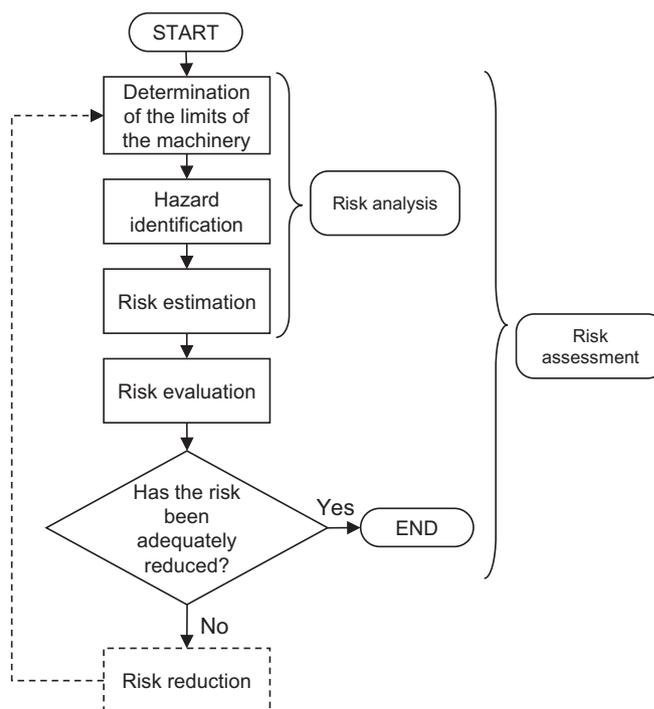


Fig. 1. The risk assessment method according to the Standard ISO 12100 (ISO, 2010).

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