IDENTIFYING BARRIERS AND FACILITATORS OF EXOSKELETON IMPLEMENTATION IN THE OPERATING ROOM

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INTRODUCTION

Members of the surgical team experience musculoskeletal (MS) symptoms that impact occupational health. Although the prevalence of MS symptoms in this population is well-recognized, limited interventions with sustained success exist for the operating room (OR) environment. The purpose of this work was to determine the facilitators of and barriers to exoskeleton technology in the OR, as a potential intervention to reduce upper-body MS pain and discomfort for surgical team members.

METHODS

After providing informed consent, participants completed a two-part study: focus groups and a simulated laparoscopic skills task while wearing a passive arm-support exoskeleton (Levitate AirFrame™). Seven surgical residents, four surgical technicians, and two attending surgeons participated in this study. A script including questions on technology adoption, supporting workers tasks/job, and safety and health (adapted from Kim et al., 2016) was used to guide each focus group. Content analysis of the focus groups was completed by three study team members to identify relevant themes from participants' responses, and two raters coded all remaining sessions. Subsequently, nine participants completed repetitions of the Fundamentals of Laparoscopic Surgery peg transfer task for 10 minutes wearing the noted exoskeleton. Afterwards, their overall impressions of the exoskeleton were assessed using the System Usability Scale (SUS; Brooke, 1996).

RESULTS/DISCUSSION

Four main themes related to the adoption of exoskeletons in the OR were identified: characteristics of individuals, benefits, barriers, and intervention characteristics.

Theme 1: Characteristics of individuals. It was noted that implementation of exoskeletons would require a champion at an institution to spearhead the efforts. Additionally, individual curiosity and awareness of MS ergonomics problems were found as facilitators of adoption.

Theme 2: Benefits. Expected long-term benefits of an exoskeleton were mentioned. Specifically, stakeholders anticipated a decrease in MS symptoms and expected that it would help with workforce retention and prevention of early retirement. The user role that was identified to most benefit from exoskeletons were the surgical assistants (n = 9).

Theme 3: Barriers. Seven categories of barriers were found. Safety and sterility were major concerns in the OR. Main concerns included ensuring that the arm cuffs were not in the area of surgical scrub (i.e., below the elbows) and the added bulk to wear inside the surgical gown. Furthermore, the factors of familiarity, perception, buy-in, and immediate results were noted to influence the use of an exoskeleton.

Theme 4: Intervention characteristics. The theme of intervention characteristics was identified separately from benefits and barriers, as the categories in this theme could either help facilitate or hinder the adoption of exoskeletons in the OR. Workers reported that investment, specifically monetary, and maintenance of the equipment would likely influence wide-spread adoption.

Usability of the exoskeleton was indicated as having a large influence on adoption. Workers in all roles noted that whether they adopt the exoskeleton during surgical procedures would depend on usability. The mean SUS score for the exoskeleton tested was 82.2 out of 100 (SD = 7.9), which was within the acceptable range of usability.

Passive exoskeleton technology has the potential to minimize MS symptoms and fatigue for the surgical team (Liu et al., 2018). The current work identified themes for adopting exoskeletons in the OR, and thus builds a better understanding of facilitators of and hinderances to stakeholders using this technology. Exoskeletons were suggested as having the potential to improve workforce retention and decrease MS symptoms. These results suggest that the use of arm-support exoskeletons can be valuable, though barriers such as cost and team member buy-in need to be addressed.

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