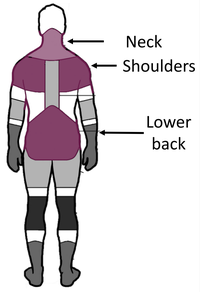
Acceptance of Exoskeletons in Intraoperative Environments: A Qualitative Analysis of Surgical Teams' Perspectives

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Introduction

- Operating rooms (ORs) can lead to pain for surgical teams (Figure 1)

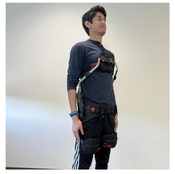


Areas of Pain

Neck: 77% of surgeons [1]
Shoulders: 74% of surgical technicians & 50% of central processing technicians [2, 3]
Lower back: 77% of surgeons, 58.8% of surgical residents, 62% of operating room nurses, 50% of central processing technicians [1, 2, 4, 5]

Figure 1: Areas of pain for surgical teams

- Passive exoskeletons (Figure 2) that support the shoulder or back are a potential intervention [6,7,8]
- However, barriers like workflow compatibility remain unclear [8]


(A)


(B)


(C)


(D)

Figure 2:
Back-support exoskeletons:
A) SuitX BackX™
B) B) HeroWear Apex Exosuit
Shoulder-support exoskeletons:
C) Paexo Shoulder
D) Ekso Evo™

Methods

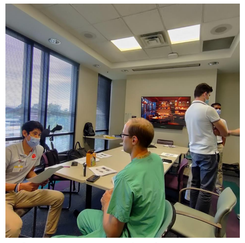
Exoskeleton demonstration

Population: 7 surgeons, operating room (OR) nurses, and surgical technicians (ST), 4 surgical residents, and 2 central processing technician (CPT)
Surgical team members/doffed (Figure 3):
- Two back-support exoskeletons
- Two shoulder-support exoskeletons


Figure 3: Surgeon dons a shoulder-support exoskeleton

Interviews

Surgical teams' perspectives were gathered (Figure 4):
- Workflow compatibility
- Acceptance factors
- Hinderances


Figure 4: Surgical residents being interviewed

Thematic analysis

- Interviews were coded by three raters
- Codes were generated until no new themes emerged
- Unique codes were created for each surgical member

Results: Implementation Factors for Exoskeletons Themes

		All	Surgeon	Surgical residents	CPT	ST	OR Nurse
Workflow	Job compatibility	✓	-	-	-	-	-
	Donning/doffing	-	✓	✓	-	✓	✓
	Spatial constraint	-	✓	-	-	✓	✓
	Unexpected & adverse events	✓	-	-	-	-	-
User needs	Benefits surgical team	✓	-	-	-	-	-
	Benefits my position	-	✓	✓	-	✓	✓
	Requirements of exoskeletons	-	✓	✓	-	✓	-
	Use cases	✓	-	-	-	-	-
Hinderances	Current state of technology	-	✓	-	✓	✓	✓
	Social resistance	-	✓	-	-	-	-
	Time is prioritized over safety	-	-	-	-	-	✓
	No ergonomic issues	-	✓	✓	-	✓	-
Motivation for intervention	Alternative intervention	✓	-	-	-	-	-
	Training	✓	-	-	-	-	-
	Retention	✓	-	-	-	-	-
	Physical demands	-	✓	✓	✓	✓	-
Acceptance	Value	✓	-	-	-	-	-
	Adapt to technology	-	✓	✓	-	✓	✓
	Educated on technology	-	✓	-	✓	✓	✓
	Administrative process	-	✓	✓	-	-	-

Discussion

- Nurses were concerned with time limitations of the exoskeletons due to their dynamic workdays [9]
- Access to new technology was a motivational factor for surgeons' willingness to adopt exoskeletons [10]
- Surgical assistants were more sensitive to spatial constraints that come from sterility requirements

Conclusion

- Most surgical team members believed these devices would be beneficial for their daily duties
- Themes for each population highlight factors that are most important to each population
- Unique requirements for each population should be considered when implementing exoskeletons

References & Acknowledgements

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