Project Title

Accuracy of a wearable motion device to detect patient bed-exit in a general medical ward

Project Lead and Members

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Organisation(s) Involved

National University Hospital

Aims

To evaluate the accuracy of a bed exit alarm motion detection system in detecting patient trying to get out of bed

Background

See poster appended/ below

Methods

See poster appended/ below

Results

See poster appended/ below

Conclusion

See poster appended/ below

Project Category

Technology

Keywords

Technology, Sensors, Wearable, Care & Process Redesign, Safe Care, Nursing, National University Hospital, Fall Prevention, Fall Detection, Bed-Exit

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P0060

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BACKGROUND

- Fall can lead to injury, lengthened hospital stay, and bone fractures especially for vulnerable populations such as the elderly and infirmed.
- Falls remain a challenge to healthcare facilities managing patients who are at risk of falls associated with cognitive and mobility impairment who require assistance with ambulating.
- However, due to their cognitive impairment or preference, they may not seek assistance and may result in them falling.
- Bed exit alert devices have been used as a fall prevention strategy.
- Wearable motion sensors bed exit alert systems have been investigated in recent years.
- There have not been sufficient data to support its use for longer than 4 hours and in the inpatient wards.

AIM

The aim of the study is to evaluate the accuracy of a bed exit alarm motion detection system in detecting patient trying to get out of bed.

TABLES

Table 1: Characteristics of the patients (N=32)

Patient characteristics	Phase 1 (n=5)	Phase 2 (n=27)
Gender		
Male	4 (80)	16 (59.25)
Female	1 (20)	11 (40.74)
Race		
Chinese	3 (60)	23 (85.18)
Malay	1 (20)	4 (14.81)
Indian	1 (20)	0
Fall risk factors		
Altered mental status	0 (0)	7 (25.9)
Lower limb weakness	5 (100)	20 (74.1)
Develop skin Injury	0	0

RESULTS

- A total of 32 patients participated in this study (Phase 1 n=5, Phase 2 n=27). (See Table 1)
- The average bed-exit alarms triggered ranged from 0.5 to 3.75 per patient per shift. (See Table 2)
- The sensitivity for phase 1 and 2 were 0.653 (95% CI, 0.513 to 0.771) and 0.637 (95% CI, 0.583 to 0.687) respectively. (See Table 2)
- The specificity for phase 1 and 2 were 0.68 (95% CI, 0.542 to 0.792) and 0.553 (95% CI, 0.522 to 0.583) respectively. (See Table 2 & Figure 2)
- Patients who participated in this study did not sustain any fall relating to getting out of bed.

METHODS

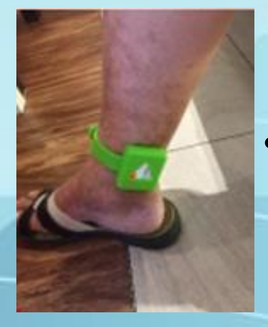
Study design	*Phase 1:* Clinical research diagnostic accuracy study *Phase 2:* Clinical evaluation
Setting	Tertiary hospital (approximately 1200 beds), Academic Health Institution
Sample	Patients identified with fall risk factors associated with: • Lower limb weakness and/or • Altered mental status
Intervention	Wear the wearable motion device at their right lower limb (see Figure 1) • The device is a motion analyzing algorithm to determine the gesture of the subject such as resting, restless, getting up, sitting up, walking and fall.
Data collection	Data captured by the wearable device which included alarm triggered when patient was trying to get out on bed (Eg get up, sit-up, sitting at edge of bed, standing next to bed)
Ethics	*Phase 1:* Study approval obtained from the Singapore National Healthcare Group Domain Specific Review Board *Phase 2:* Ethical approval is not require as this project was conducted in accordance with the hospital clinical quality improvement policy.

CONCLUSION

- The fall alarm motion detection system demonstrated moderate sensitivity and in detecting patient getting out of bed and is effective in preventing fall during hospitalization.
- This study has reported real-time alarms triggered when patients are attempting to get out of bed.
- This might improve patient safety, quality of care, reduce length of stay and financial cost associated with hospitalization as a result of fall injury.
- Limitation to this study is mainly related to small sample size
- Feedback from users provide opportunity for further development of the wearable device to improve its accuracy

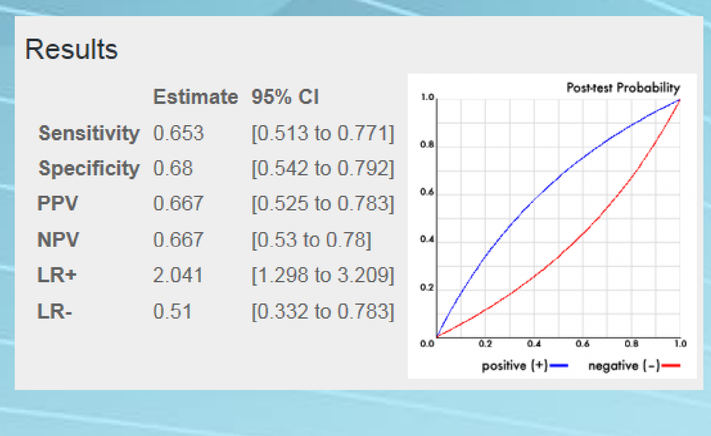
FIGURES

Figure 1: Wearable device



- Prototype of a wearable device that can be placed on the ankle to detect the motion of the wearer.
- Uses a motion analyzing algorithm to determine the gesture of the subject such as resting, restless, getting up, sitting up, walking and fall

Figure 2:
Phase 1: Sensitivity and specificity (n=99)



Phase 2: Sensitivity and specificity (n=662)

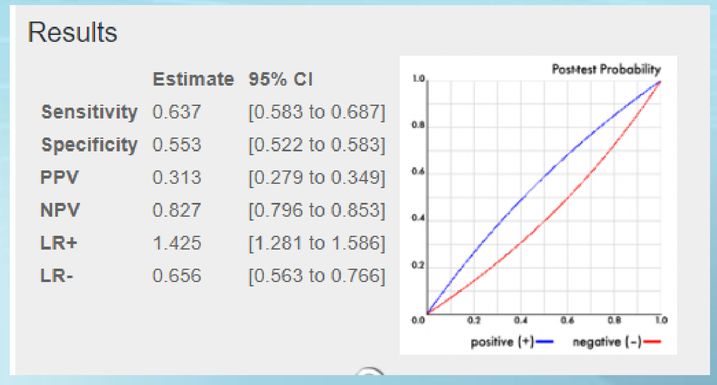


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Table 2: Sensitivity (Sn) and specificity (Sp) of audible alarms triggered

Project phase	Period	No of patients	No. of audible alarms	Sn	Sp	Ave alarms per patient per shift			No. of Falls
						AM	PM	ND	
I	08 Feb to 19 Dec 2017	5	99	65.3%	68%	0.69	0.5	0.81	0
II	6 Jun to 7 Jul 2018	27	662	64%	55%	1.625	2	3.75	0

REFERENCES

Capezuti, E., Brush, B. L., Lane, S., Rabinowitz, H. U; Secic, M. (2009). Bed-exit alarm effectiveness. Archives of gerontology and geriatrics, 49(1), 27-31.
Ferrari, M., Harrison, B., Rawashdeh, O., Rawashdeh, M., Hammond, R. & Maddens, M. (2012). A pilot study testing a fall prevention intervention for older adults: determining the feasibility of a five-sensor motion detection system. Journal of Gerontological Nursing, 38(1), 13-16.
Seifer, C. M.,; Parry, S. W. (2002). Monitoring devices for falls and syncope. Clinics In Geriatric Medicine, 18(2), 295-306.
Wu, F., Zhao, H., Zhao, Y., & Zhong, H. (2015). Development of a wearable-sensor-based fall detection system. International Journal of Telemedicine And Applications, 2015, 1-11.