

# Revolutionizing Fall Detection: AI-Enhanced Accuracy for the Safety of Patients with Delirium

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## 1. Background

Patients with delirium are at higher risk of falling in comparison to other inpatient groups in the context of unattended bed-exits. At the same time falls can affect the safety of patients and leading to adverse events and injuries. In clinical settings, falls are often self-reported, observed by healthcare professionals, or go unnoticed. Neglecting the World Health Organization's definition, health care professionals' tent to classify falls often depends on the speed or injuries. This may cause underreporting of falls in the clinical setting.

In our hospital, patients with delirium are treated in a specialized acute geriatric ward with low-low beds and no bed rails. Although we use Qumea®, a 3D radar and AI-based system, to alert nurses via smartphone when a fall occurs (Figure 1), a scientific evaluation of its performance still is missing.



Figure 1: Bed-exit warnings (yellow) and fall alarms (red) trigger different sound signals

## 2. Aim

The aim of this study was:

- » to compare nurse-reported falls with Qumea®-detected falls,
- » calculate Qumea®'s psychometric data, and
- » describe fall patterns in delirium patients using low-low beds.

## 3. Methods

The study was conducted in the DelirUnit of the University Department of Geriatric Medicine, FELIX PLATTER. We included patients with delirium aged 65 and older who were admitted to the DelirUnit. Falls, indicated by Qumea®, were compared to the judgments of the research team (RT), serving as reference standard. Falls, indicated by Qumea®, were recorded during a 6-minute sequence with a thermal imaging camera (Figure 2). In addition, nurses' falsification of falls as non-fall events were taken into account. Furthermore, we compared the reporting from nurses, physicians, and therapists in our medical information system to the fall-events detected by Qumea®. Finally, we classified a bed-exit warning, not resulting in fall, as a non-fall event. Raw data were transferred into a cross-table. The performance was calculated by R version 4.4.1.

## 4. Results

### Sample:

- » N = 119 participants
- » 73 male | 46 female
- » Average age: 84.08 (SD ± 6.80)

### Fall pattern:

- » In total, 49 falls were identified
- » 33 falls happened in the surveillance zone of Qumea®

Qumea® correctly identified 70% of cases (sensitivity) and achieved a correct identification rate of 100% for non-cases (specificity). Among the cases marked positive by Qumea®, 96% were confirmed as true positives (positive predictive value), and 100% of the cases identified as negative were validated as such (negative predictive value). The likelihood of Qumea® accurately classifying a positive case was 12851.42 times higher than the likelihood of misclassifying a negative case as positive (positive likelihood ratio). Conversely, the probability of misclassifying a positive case as negative was 0.30 times lower than correctly identifying a negative case as negative (negative likelihood ratio) (Table 1).

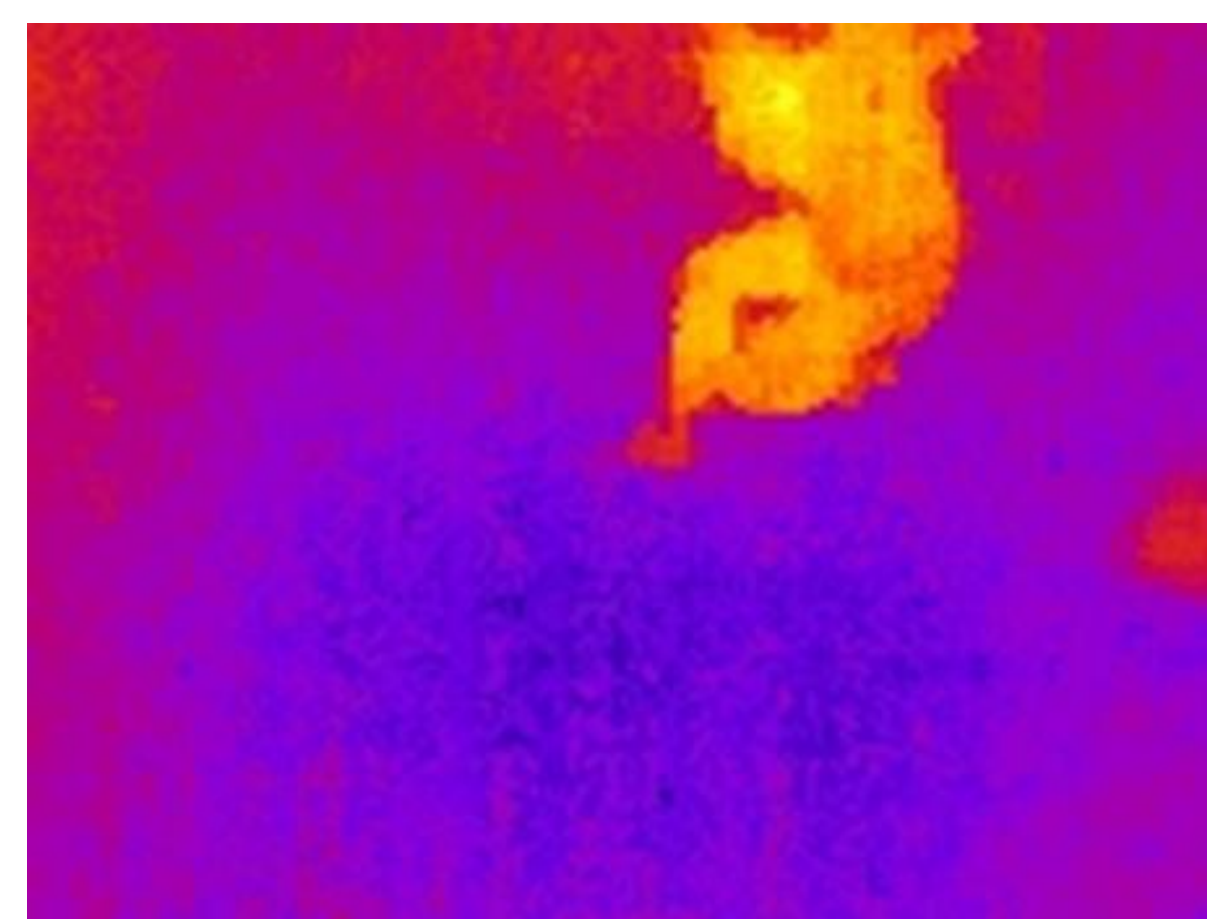


Figure 2: Thermal picture of a simulated fall. The upper right section of the image shows the outline of a person. The right leg is bent, the left is already in the air. The upper body is rotated

Table 1: Qumea® Performance in the detection of falls

Sensitivity	0.70 (0.51, 0.84) *
Specificity	1.00 (1.00, 1.00)*
Positive predictive value	0.96 (0.79, 1.00)*
Negative predictive value	1.00 (1.00, 1.00)*
Positive likelihood ratio	12851.42 (1787.24, 92409.99)*
Negative likelihood ratio	0.30 (0.18, 0.51)*

Qumea®'s Fall Alarm	Reference Ratings	
	Fall	No Fall
Fall	23	1
No Fall	10	18438

\* = 95 % Confidence Interval

## 5. Conclusion

The study shows a high accuracy in the identification of falls among patients with delirium, especially in detecting bed-exits as non-falls (specificity of 100%).

Qumea®'s high positive likelihood ratio (12851.42) indicates it is highly reliable in confirming falls when detected. The system's 96% positive predictive value and 100% negative predictive value demonstrate its effectiveness, making it superior to traditional nurse assessments for

improving patient safety. However, 30% of actual falls are not recognized, which reflects the sensitivity of 70%. This low sensitivity is caused by atypical fall patterns, such as rolling from the low-low beds and were not categorized as falls by Qumea®. New adaptations and improvements are constantly being incorporated into the algorithm, which lead to an increase in sensitivity and detection of falls.

### Literature:

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