



maximum prevention – minimum intrusiveness

## NSQH 2024

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Enhancing Patient Safety through AI Monitoring: Experiences and ethical Considerations from Two Pilot Studies in Helsinki

Valerio Signorelli, August 2024

# Patient Safety & Falls

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# Falls are among the most burdensome critical events

**1 in 3**

persons over 65  
fall at least once  
a year

**50%**

of persons over 80  
fall at least once a  
year

**80%**

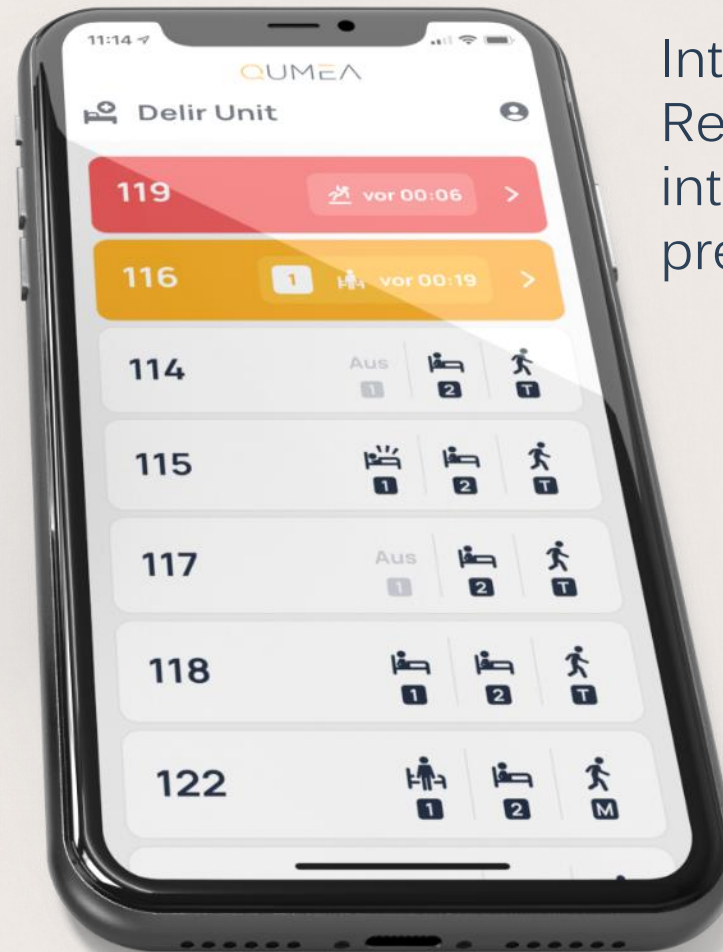
of accidents among  
people over the age  
of 65 are falls

**A fall predisposes to another fall, 50% of those who have fallen will fall again  
15% of the elderly fall repeatedly, i.e. more than twice a year**

Additional information on the consequences of falls can be found in the publications of the [UKK Institute](#).

# Respectful monitoring: Combining radar & AI

Anonymous, discreet and vigilant:  
The QUMEA 3D Radar Sensor



Intuitive user interface:  
Real-time alerts for early  
intervention and effective  
prevention

# Detecting and informing 24/7



**Bed Exit**  
(unrest, sit up, stand up)



**Falls**  
(all types throughout entire room)



**Zone Entry/Exit**  
(toilet, room)



**No Bed Return**  
(individual time thresholds)



**Presence**  
(room, bed)



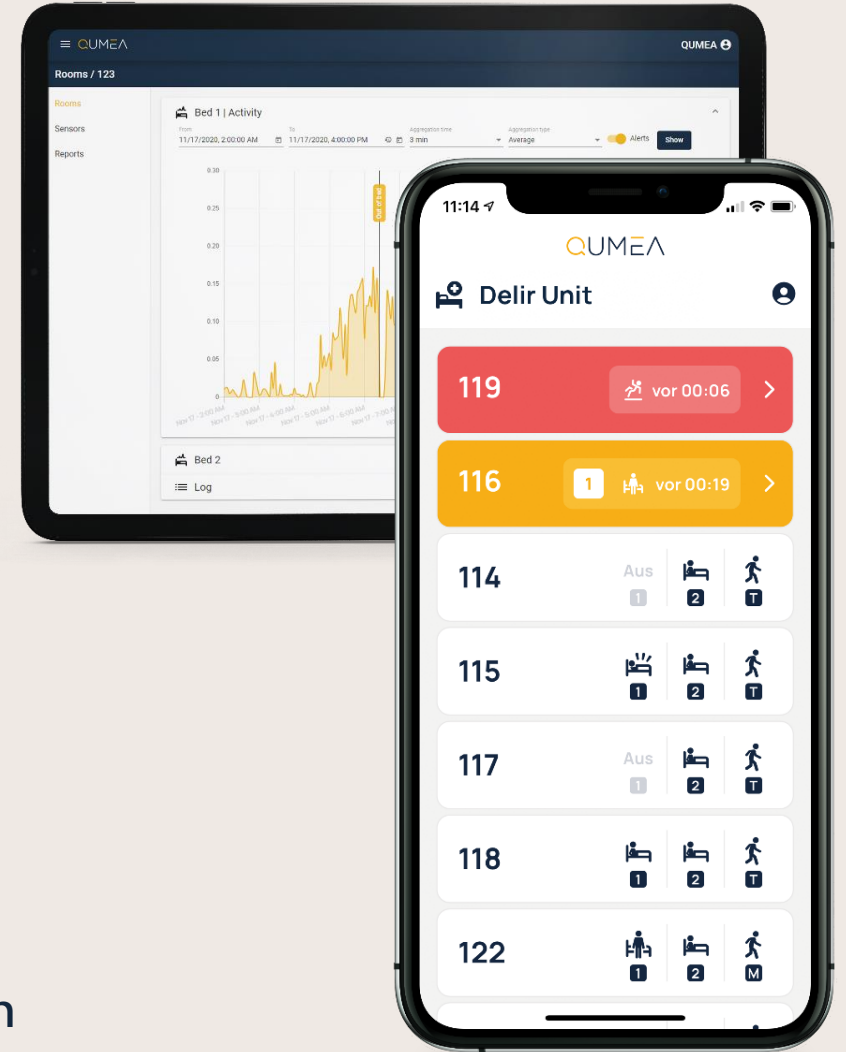
**Stand Up Attempt**  
(wheelchair, recliner, chair...)



**Activity & Restlessness**  
(real time and historical)



**Pressure Ulcer Prevention**  
(mobilization indication)



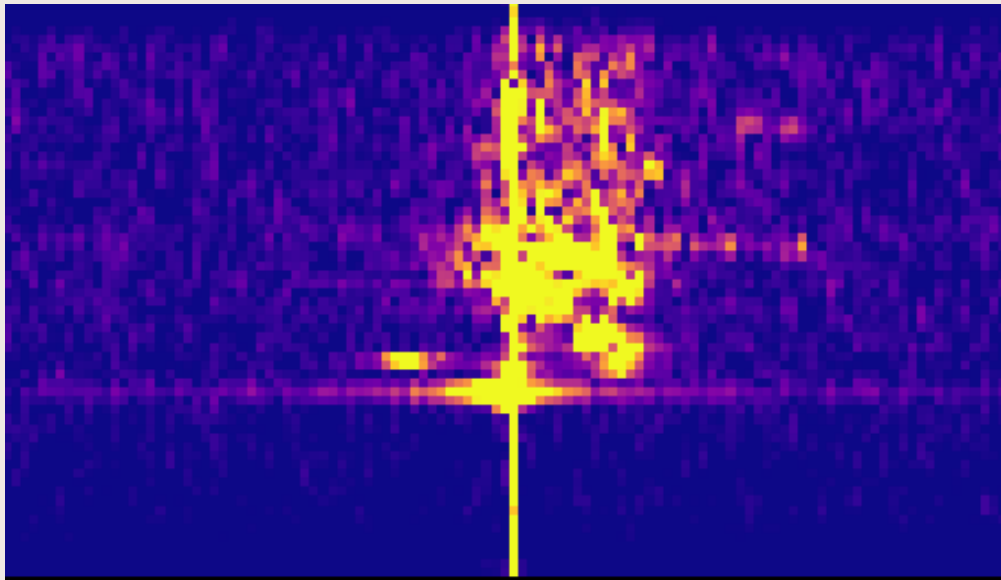
Medical Device  
Class I

# Radar: Technology & Capabilities

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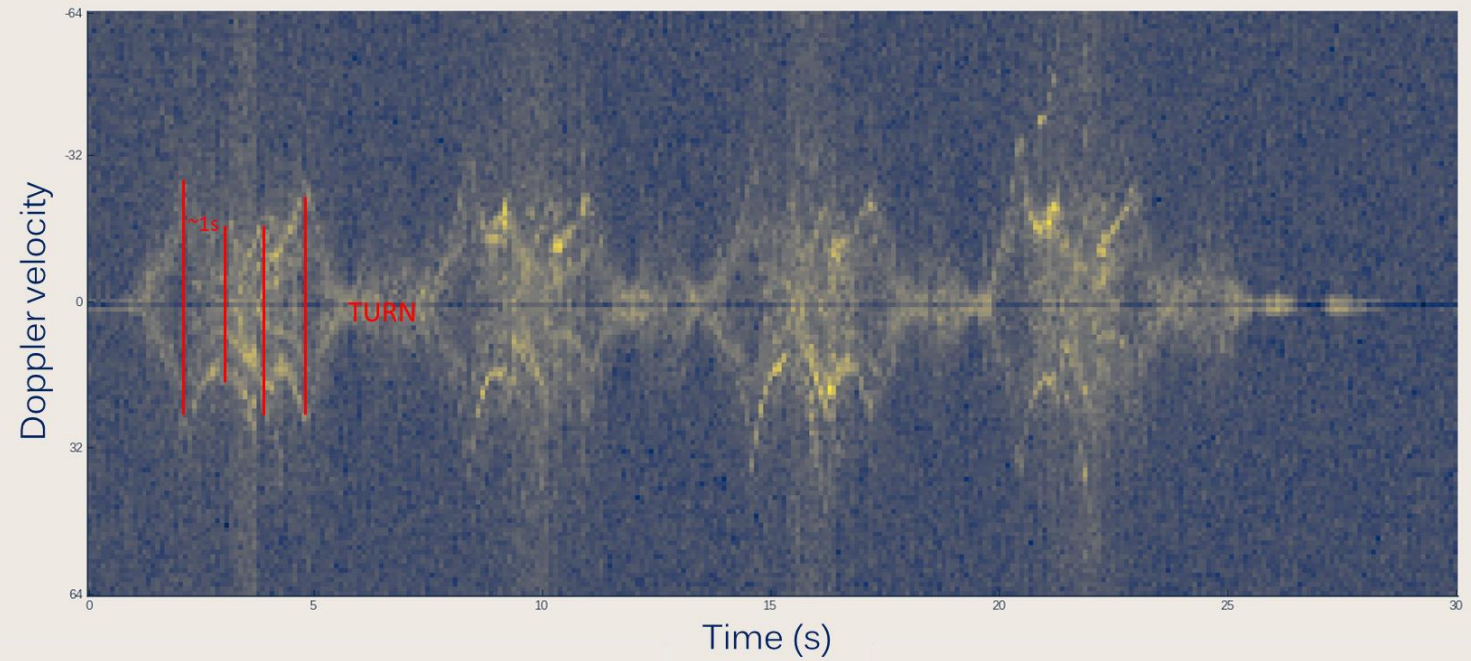
# QUMEA radar raw data: Point Cloud & Doppler signals

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walking speed  $\approx 0.55\text{m/s}$

step length  $\approx 0.55\text{m}$





# Radar capabilities – Literature



Article

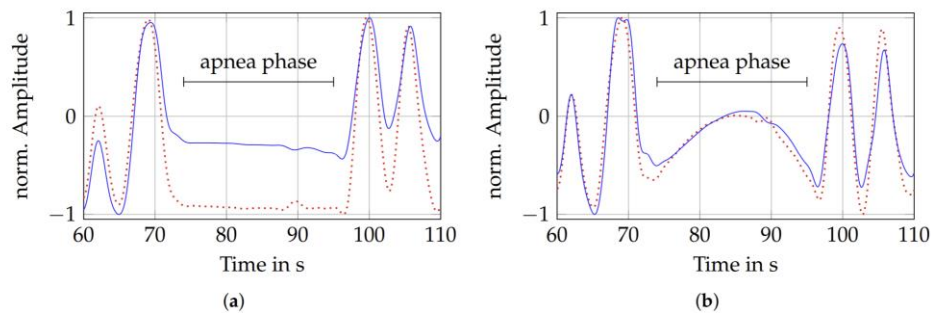
## A Clinically Evaluated Interferometric Continuous-Wave Radar System for the Contactless Measurement of Human Vital Parameters

Fabian Michler <sup>1,\*</sup>, Kilin Shi <sup>1,†</sup>, Sven Schellenberger <sup>2,†</sup>, Tobias Steigleder <sup>3</sup>, Anke Malessa <sup>3</sup>, Laura Hameyer <sup>3</sup>, Nina Neumann <sup>3</sup>, Fabian Lurz <sup>1</sup>, Christoph Ostgathe <sup>3</sup>, Robert Weigel <sup>1</sup> and Alexander Koelpin <sup>2</sup>

- <sup>1</sup> Institute for Electronics Engineering, Faculty of Engineering, Friedrich-Alexander University Erlangen-Nürnberg, Cauerstraße 9, 91058 Erlangen, Germany; kilin.shi@fau.de (K.S.); fabian.lurz@fau.de (F.L.); robert.weigel@fau.de (R.W.)
- <sup>2</sup> Chair for Electronics and Sensors Systems, Brandenburg University of Technology, 03046 Cottbus, Germany; sven.schellenberger@b-tu.de (S.S.); alexander.koelpin@b-tu.de (A.K.)
- <sup>3</sup> Department of Palliative Medicine, Medical Faculty, Friedrich-Alexander University Erlangen-Nürnberg, 91054 Erlangen, Germany; Tobias.Steigleder@uk-erlangen.de (T.S.); Anke.Malessa@uk-erlangen.de (A.M.); laura.hameyer@fau.de (L.H.); nina.neumann@fau.de (N.N.); Christoph.Ostgathe@uk-erlangen.de (C.O.)

Sensors 2019, 19, 2492

10 of 19



**Figure 8.** Comparison of low- and bandpass filtered respiration signals. (a) Reference (dashed) and radar (solid) respiration signal after applying a lowpass filter; (b) Reference (dashed) and radar (solid) respiration signal after applying a bandpass filter.

POSTER

## A Contactless and Non-Intrusive System for Driver's Stress Detection

Authors: Salman Muhammad, Hyunkyung Jang, Youngtae Noh, Seungwan Jin, Dayoung Jeong, Hovoung Choi, Kyungsik Han, Hyangmi Kim

[Authors Info & Claims](#)

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## mm-Pose: Real-Time Human Skeletal Posture Estimation using mmWave Radars and CNNs

Arindam Sengupta, Feng Jin, Renyuan Zhang and Siyang Cao

Department of Electrical and Computer Engineering, University of Arizona, Tucson, AZ, USA

Email: {sengupta, fengjin, ryzhang, caos}@email.arizona.edu

Received May 6, 2019, accepted May 26, 2019, date of publication June 6, 2019, date of current version June 20, 2019.

Digital Object Identifier 10.1109/ACCESS.2019.2921240

## High-Accuracy Real-Time Monitoring of Heart Rate Variability Using 24 GHz Continuous-Wave Doppler Radar

VLADIMIR L. PETROVIĆ<sup>1</sup>, (Student Member, IEEE), MILICA M. JANKOVIĆ<sup>1</sup>, (Member, IEEE), ANITA V. LUPŠIĆ<sup>1,2</sup>, VELJKO R. MIHAJLOVIĆ<sup>2</sup>, AND JELENA S. POPOVIĆ-BOŽOVIĆ<sup>1</sup>, (Member, IEEE)

<sup>1</sup>School of Electrical Engineering, University of Belgrade, 11120 Belgrade, Serbia

<sup>2</sup>Novelic, 11060 Belgrade, Serbia



# Fall prevention evaluations & ongoing studies

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# Using technology to help prevent falls

## Proof of Concept – City of Helsinki

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**FORUM  
VIRIUM  
HELSINKI**

A Proof of Concept (PoC) using **Qumea's state-of-the-art radio wave-based sensors** was conducted at the SoTePe (Social, Health and Rescue Services) Senior Center in Helsinki from 18.1. - 18.5.2024.

The PoC was conducted to **evaluate the effectiveness of radio wave technology in detecting falls and monitoring elderly patients in 24/7 assisted living environments** in Helsinki. The main goal of the PoC was to prove that technology can be successfully used to enhance proactive care by **identifying potential falls and reducing unnecessary disturbances** during nighttime checks.

The PoC was funded by Forum Virium, the City of Helsinki's innovation company. It was a continuation of a pilot conducted in 2022 at the Laakso Emergency Geriatric ward. The city of Helsinki wanted to prove that the same technology that already works effectively in a clinical setting, can also work in elderly care settings.

The full report in Finnish can be found [here](#).



Uudenmaan liitto  
Nylands förbund



QUMEA

# Outcomes of the pilot project

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7A. Health and Well-being	7B. End Users and Relatives	7C. Employees and Organization
<p>During the pilot phase, there were only a small number of falls, which is as well due to the small cohort in the study; no pre/post evaluation was conducted on this data basis</p> <p>The resident's undisturbed sleep and increased privacy, when the nighttime visits of the staff did not have to make nursing rounding</p> <p>Faster access to help when needed</p>	<p>Very suitable for use in residential units for the elderly residents</p> <p>It is not possible to assess whether it affected the "burden" of the family members of the residents in the unit. According to verbal feedback, it was perceived as good and increased safety (the family member was often present when the client was asked for permission to participate)</p>	<p>Changes the operating culture to more resident's-oriented = better quality: alarms were responded quickly, which makes it possible to anticipate and prevent falls.</p>

# Outcomes of the pilot project

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## 7D. Coordination and Technology

QUMEA's system was deliberately not installed on the same phone as other's alarm system. This is how we wanted to get the "mere" QUMEA user experience related to the system.

## 7E. Economy and Scalability

Significant financial and personnel effects, if the system can be used to reduce the number of staff on night shifts and at the same time improve response rates

# Region Västra Götaland – QUMEA evaluation



## Report

Date: 2023-08-30

Document number: SÄS 2022-00087-  
9

**Region Västra Götaland**

**Södra Älvsborg Hospital**

**Sahlgrenska University Hospital**

Administrator: Petra Linderholm

Petroff Phone: 0700-816747

E-mail: [petra.petroff@vgregion.se](mailto:petra.petroff@vgregion.se)

## Final report

Project model level between

Project: Fall prevention innovation project

by: Project owner Pauline Ahl Date: 2023/08/30

Approved by: Project owner Terese Dalåsen Date: 2023/08/28

Coordinated with: Project Manager Petra Linderholm Petroff Date: 30 August 2023.



# Region Västra Götaland – QUMEA evaluation

## Southern Södra Älvsborg Hospital (Borås) Stroke Department

### SÄS

We have compared the case statistics during the sample set-up with the corresponding eight-week period for 2019-2022 at SÄS:

- The proportion of cases compared to the number of hospitalisations in 2019-2022 was 6.1%.
- The proportion of cases compared to hospitalisations in the 2023 sample set-up decreased to 2.0%.
- The proportion of cases decreased by 67.0% during the test setup of the radar sensors.
- If we exclude the Covid year 2020, when hospital beds varied with both number and patient groups due to the pandemic and specific occupancy structure of the hospital, the proportion of cases decreased by 68.5% during the sample set-up.

## Sahlgrenska University Hospital Department of Medicine and Pulmonary Medicine

### Sahlgrenska

We have compared the case statistics during the sample set-up with the corresponding period for 2021-2022 at SU. The department with the current patient group started up in 2020 but got a new name in Elvis and Melior in September 2020, which makes it difficult to find the right statistics for 2020 and back in time.

- The proportion of cases compared to the number of hospitalisations in 2021-2022 was 10.9%.
- The proportion of cases compared to hospitalisations in the 2023 sample set-up decreased to 3.7%.
- The proportion of cases decreased by 66.5% during the test set-up of the radar sensors.

# Region Västra Götaland – QUMEA evaluation

## Statistics

Below are statistics regarding hospital admissions and cases for both SÄS and SU during the eight-week period in which the trial was conducted.

SÄS, Strokeavdelningen  
*OBS! Endast under tidsperioden 22 mars - 17 maj (8 veckor)*

År	Vårdtillfällen	Fall totalt	Fall med skada	Fall utan skada
2019	196	11	1	10
2020	125	6	0	6
2021	170	9	3	6
2022	199	16	8	8
2023	199	4	2	2

The figures above are derived from MedControl and have been verified by also conducting a journal review in Melior. In this way, duplicate documentation was also detected and the number of cases was adjusted for 2022.

Please note that the statistics only apply to the eight-week period to which the sample set relates (applies to both SÄS and SU).

Sahlgrenska, avd 1932  
*OBS! Endast under tidsperioden 7 mars - 2 maj (8 veckor)*

År	Vårdtillfällen	Fall totalt	Fall med skada	Fall utan skada
2021	202	19	6	13
2022	155	20	6	14
2023	164	6	2	4

These statistics are produced via Melior and have also been reviewed manually.

## Confidence interval and p-value

A confidence interval (CI) should be interpreted as the amount of uncertainty in the estimate. In a new or larger context, the true estimate has a 95% probability of being within the interval indicated.

During the years 2019-2022, 690 cases were treated<sup>5</sup> at the Stroke Department at SÄS, of which 42 (6.1%) involved falls. In 2023, there were 199 cases of care, of which 4 (2.0%) were fall-related. This results in an absolute difference of 4.1% (95% CI 1.4 - 6.7, p 0.0184) and a relative risk of  $2.0/6.1=0.33$  (95% CI 0.12 - 0.91), a 67% reduction in risk.

During the years 2021-2022, 357 cases were treated<sup>6</sup> on ward 19/32 at SU, of which 39 (10.9%) contained cases. In 2023, there were 164 cases of care, of which 6 (10.9%) involved falls.

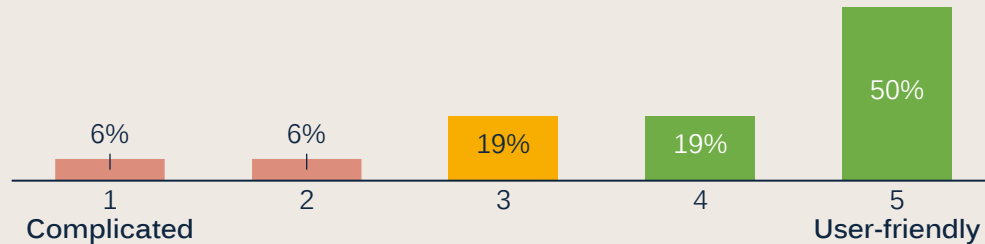
# Result: 80% of nurses want to keep using QUMEA

## Sahlgrenska University Hospital (n = 16)

Would you like to have QUMEA installed in your department in the future?



How easy/simple is it for you to use the QUMEA app?

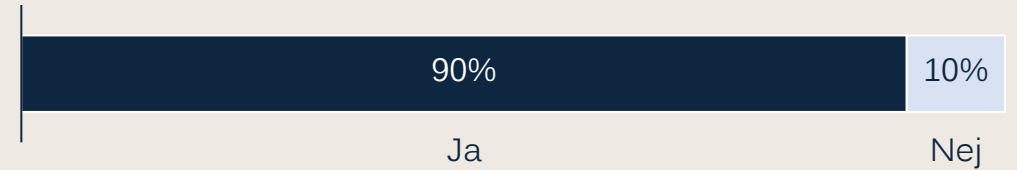


Twelve out of sixteen employees want to have QUMEA installed in the department according to the evaluation of employees at Sahlgrenska. The average score for ease of use is four out of five.

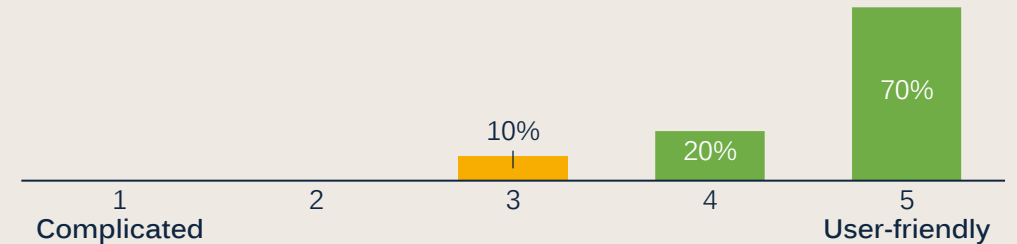
A focus group confirmed the results of the employee survey.

## Södra Älvsborg Hospital (n = 10)

Would you like to have QUMEA installed in your department in the future?



How easy/simple is it for you to use the QUMEA app?



Nine out of ten employees wanted to have the fall sensors installed in the department in the future and is seen as a very good rating of the system.

Five interviews conducted resulted in the same conclusions as the employee surveys.

# Ethical & Legal considerations

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# Ethical & Legal considerations: Principle of data minimization

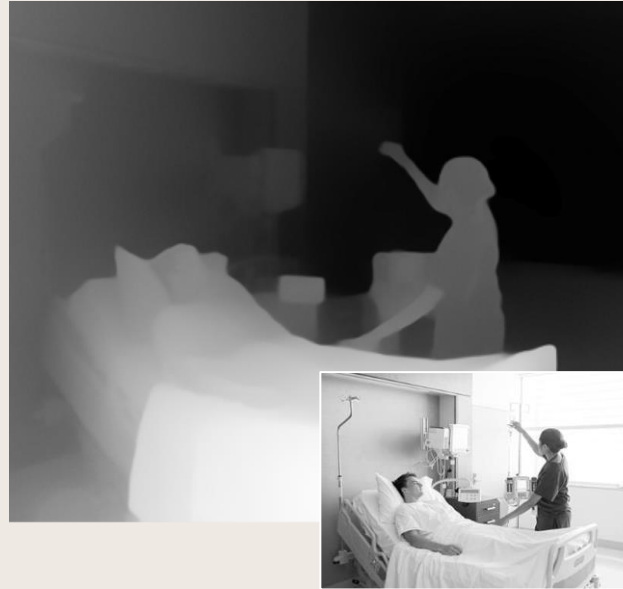
Camera  
→ RGB-Image



Optical Systems

Always create and process personal data

Optical 3D Sensor  
→ Depth Image & Intensity Image



Radar  
→ Motion Points



QUMEA (Radar)

Does not generate or process personal data at any time

The Article 5 of the GDPR requires mandatorily that data minimization principle is to be followed in any processing of personal data. (Kalliolaw)



# Radars & AI? The ethical & legal choice vs. camera surveillance

Example from Finland



Aluehallintovirasto

Ohjauskirje  
29.11.2023

1 (5)  
ESAVI/43775/2023

Peruspalvelut, oikeusturva ja luvat

## Kameravalvonta sosiaalihuollon toimintayksiköissä

Etelä-Suomen aluehallintovirastoon saapuneiden hyvinvointialueiden sosiaali- ja terveydenhuollon järjestämisestä annetun lain (612/2021; jäljempänä järjestämislaki) 44 §:n perusteella toimittamien tarkastuskertomusten, aluehallintoviraston suunnitelmaperusteisten tarkastuskäyntien ja hyvinvointialueiden yhteydenottojen perusteella useissa sosiaalihuollon toimintayksiköissä on käytössä kameravalvonta.

Hyvinvointialueesta annetun lain (611/2021; jäljempänä hyvinvointialuelaki) 7 §:n mukaan hyvinvointialue vastaa sille lailla säädettyjen tehtävien hoitamisesta, hyvinvointialueen asukkaana laissa säädettyjen oikeuksien toteutumisesta ja palvelukokonaisuuksien yhteensovittamisesta sekä järjestettävien palvelujen ja muiden toimenpiteiden:

- 1) yhdenvertaisesta saatavuudesta;
- 2) tarpeen, määrän ja laadun määrittelemisestä;
- 3) tuottamistavan valinnasta;
- 4) tuottamisen ohjauksesta ja valvonnasta;
- 5) viranomaiselle kuuluvan toimivallan käyttämisestä.

Hyvinvointialue voi hoitaa tehtävät itse tai sopia järjestämisvastuun siirtämisestä toiselle hyvinvointialueelle. Lisäksi hyvinvointialueiden tehtävien järjestäminen voidaan koota yhdelle tai useammalle hyvinvointialueelle, jos se on välttämätöntä palvelujen laadun ja saatavuuden parantamiseksi, riittävien henkilöstö- ja muiden voimavarojen tai tehtävässä tarvittavan erityisasiantuntemuksen turvaamiseksi taikka muusta vastaavasta ja perustellusta syystä. Hyvinvointialue vastaa tehtäviensä rahoituksesta, vaikka järjestämisvastuu on siirretty toiselle hyvinvointialueelle tai tehtävän hoitamisesta vastaa lain nojalla toinen hyvinvointialue.

“The Regional Administrative Agency states that the legislation on camera surveillance used in social care operational units is deficient in relation to the protection of residents’ privacy. **The Regional Administration Office refers to the decision of the Data Protection Commissioner (539/451/2011), according to which camera surveillance in residential premises strongly interferes with the protection of people's privacy and private life.**”

“The Regional Administration Office considers that the resident’s own room and the common spaces intended for the use of the unit’s residents together form the resident’s home, which is why the resident must also be given the opportunity to carry out activities that fall within the scope of private life in the unit's common spaces **without his privacy being violated by unauthorized camera surveillance.**”

# Radars & AI? The ethical & legal choice vs. camera surveillance

Example from France

## Ehpad : les caméras de surveillance interdites dans les chambres rappelle la CNIL

Société

Publié le 14 mai 2024 | 3 minutes | Par : [La Rédaction](#)

### Une interdiction de principe de la vidéosurveillance

Saisie de plusieurs demandes de conseil pour installer des caméras dans les chambres des résidents d'[Ehpad](#), l'autorité administrative précise les conditions d'utilisation de ces dispositifs après une consultation publique organisée en 2023.

La CNIL rappelle qu'il est **interdit d'installer des caméras de surveillance dans les chambres des Ehpad**, que cela soit pour :

- améliorer le "confort" des résidents (l'établissement doit plutôt utiliser des enquêtes de satisfaction ou le cahier de doléance, par exemple) ;
- assurer la sécurité des personnes en cas de chute ou d'accident (d'autres dispositifs existent comme les capteurs de présence sous le sol ou les bracelets).

### A general prohibition on video surveillance

In response to several requests for advice on installing cameras in the rooms of nursing home residents (Ehpad), the administrative authority clarifies the conditions for using these devices following a public consultation organized in 2023.

*The CNIL emphasizes that it is prohibited to install surveillance cameras in Ehpad rooms, whether for:*

- Improving the "comfort" of residents (the facility should instead use satisfaction surveys or a grievance book, for example);
- ***Ensuring the safety of individuals in the event of a fall or accident*** (alternative devices such as floor sensors or bracelets are available).

Source: [Ehpad : interdiction de la vidéosurveillance dans les chambres | vie-](#)

[publique.fr](#)

# Outlook

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# Research Areas

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## Delir

- Early Detection
- Therapy Validation

University Department of Geriatric Medicine Felix Platter Basel, Cantonal Hospital Baselland, University Basel, Dr. Wolfgang Hasemann



## Distress

- Pain, Anxiety, Discomfort in Patients with Limited Communication

University Basel, Prof. Dr. Jan Gärtner  
University Department of Geriatric Medicine Felix Platter Basel, Dr. Wolfgang Hasemann



## Vitals

- Respiration Frequency, Patterns, Apnea/Arrest
- Hypoglycemia

University Hospital Bern (Inselspital), Prof. Dr. Lilian Witthauer  
University of Applied Science Bern BFH, Prof. Michael Lehmann



## Neuropathologies

- Gait and Behavioral Analysis
- Early Detection of Dementia, Alzheimer's, Parkinson's, Epilepsy

University Bern, Prof. Dr. Tobias Nef  
University Psychiatric Services Bern, Prof. Dr. Stephan Klöppel  
University of Applied Science Bern BFH, Prof. Dr. Friederike Thilo

# QUMEA: The Company

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103

institutions

7

countries

36

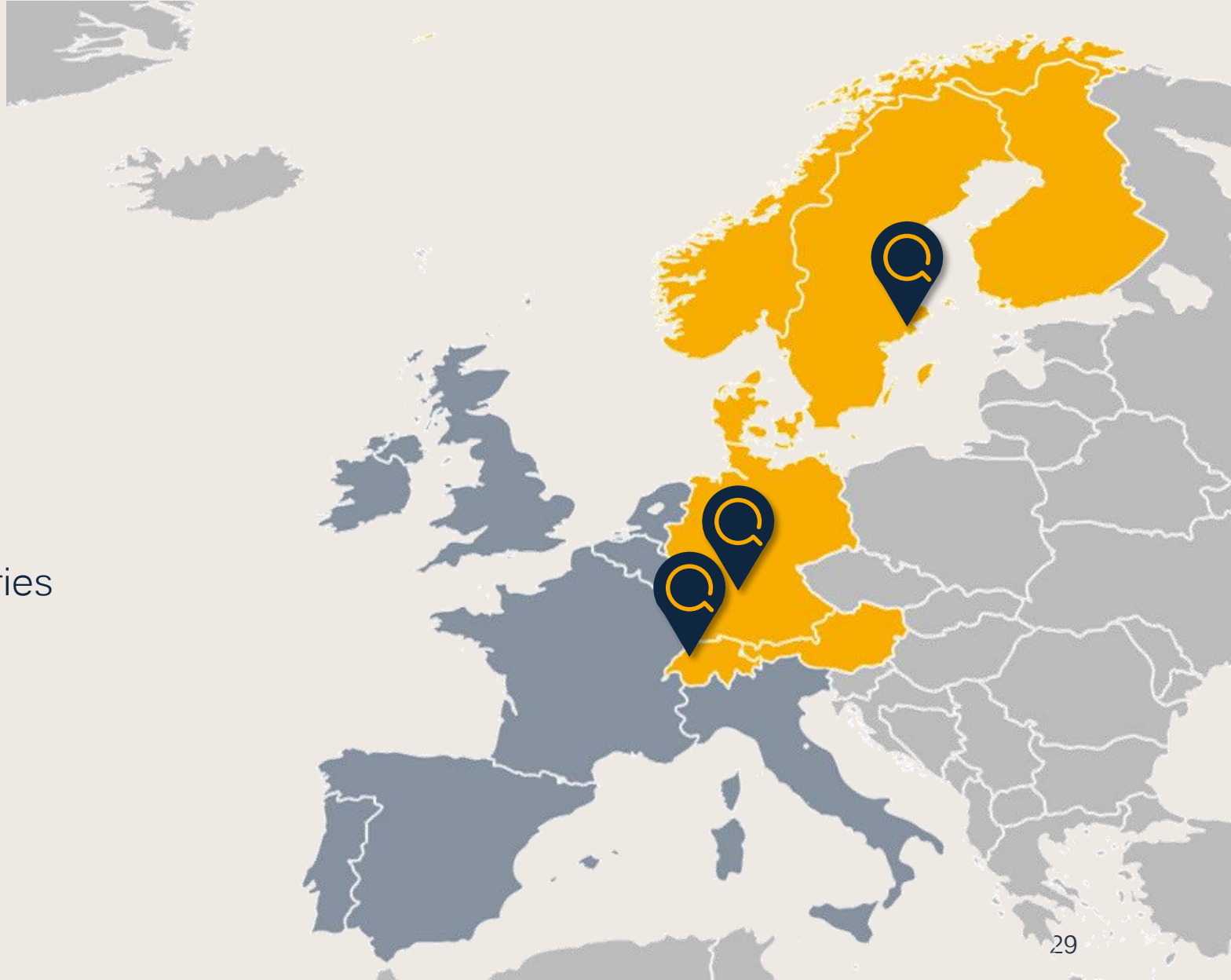
employees

3

Subsidiaries

CE

certified medical device







### **Terese Dalåsen**

Area Manager and Project Owner  
Västra Götaland Region, Sweden

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With QUMEA, we achieved a significant 67% reduction in falls. The simplicity and reliability of the system led to a high and sustained acceptance among the caregivers. Supported by the fact that the system is 100% anonymous and completely refrains from using cameras and microphones, QUMEA is an invaluable tool for patient safety.



### **Dr. Phil. Wolfgang Hasemann**

Head of Basel Dementia Delirium Program  
University Department of Geriatric Medicine  
Felix Platter

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Thanks to QUMEA, we have been able to reduce falls and improve patient outcomes. We can completely dispense patient sitters. The nursing staff benefits enormously.



### **Cornelius-Monroe Huber**

Chief Nursing Officer (CNO)  
Member of the Executive Board  
Cantonal Hospital Baselland

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QUMEA's early detection of potentially dangerous situations is impressive. Thanks to the system, we have been able to significantly increase patient safety. At the same time, the system enjoys full acceptance among our staff thanks to the robust alerting. The added value in in-patient care is enormous. I am convinced that QUMEA will become the standard in hospitals and that all wards will benefit.



### **Dr. med. Bettina von Rickenbach**

Deputy Chief Physician  
Center for Geriatric Medicine and Palliative  
Care, Affoltern Hospital

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QUMEA has become indispensable in our work processes. Effective fall prevention is of utmost importance for our vulnerable patients. The fact that they do not have to wear anything additional on their body is another advantage. With QUMEA, we simultaneously reduce the risk for the patient and improve the treatment outcome.



# Team



**Viktor**  
Presented by Johnson & Johnson  
**Winner 2021**

**Microsoft Startup of the Year**  
Runner-up 2022




**Winner**  
2021



**GZS**  
**Winner 2021**

**SWISS EXCELLENCE**  
PRODUKT AWARD  
FINALIST  
2021

**campus**  
energy & technology

 Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra  
Swiss Confederation  
Innosuisse – Swiss Innovation Agency



# Thank you!

# QUMEA



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