



# AI for accident prevention at home, at leisure, and in sports

## Separating science from fiction

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# Leisure and home accidents

75% of accidents in households and leisure (AT, KfV)

Household victims often belong to the most vulnerable population

- Children (~4000 babies and young kids in AT)
- Elderly (~200,000 over 65 in AT) #1 type: falls
- ~2000 people die (AT)

~200,000 estimated sports accidents (AT, KfV), 200 die

- Costs of sports accidents (only AT): estimated at € 5.3 bn
- Football, skiing, team sports

**Potential to apply artificial intelligence?**



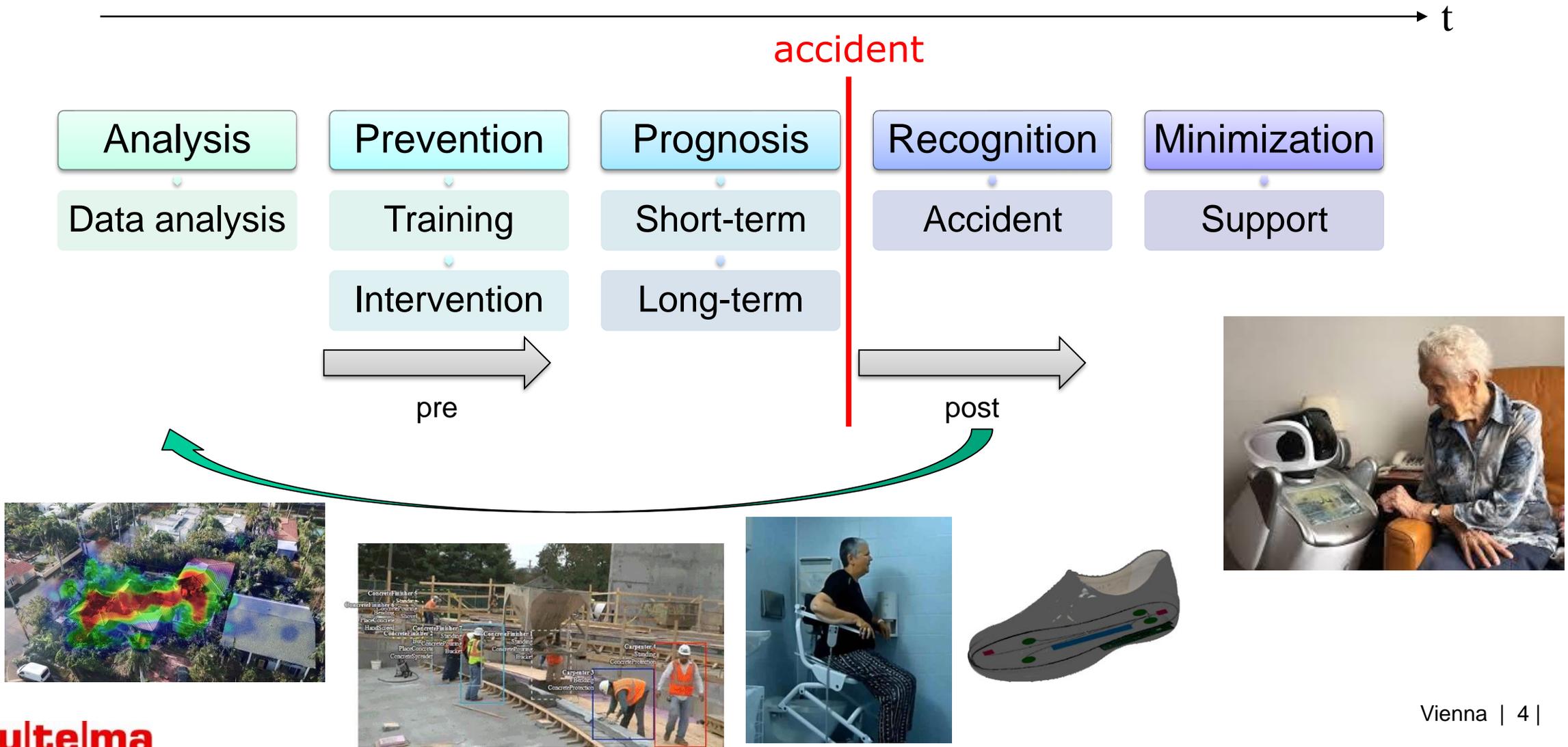
# Why AI now? Trends and expectations

- Massive general trend towards AI
  - push from autonomous cars
- New types of sensors
- Low cost components: memory, sensors, processing
- New AI tools, standards, robustness
- More data & knowledge
  - Self-tracking trend: fitness, sports, health, ...
  - Smart homes, smart devices, new interfaces (speech)



[www.vox.com](http://www.vox.com)  
[www.terabee.com](http://www.terabee.com)  
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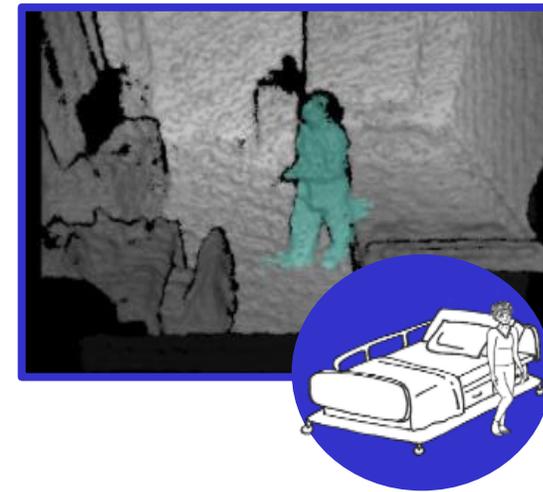
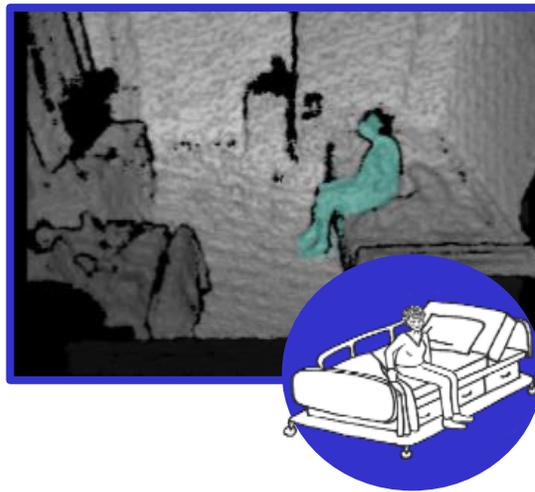
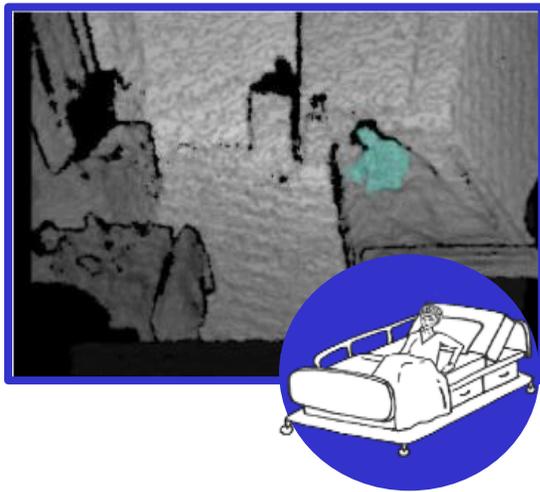
# Conceivable AI Applications for Accident Prevention



# Data analysis and classification of situations

- Scenario 1: support for medical institutions: estimation of fall risk
- Analysis of fall risk with big data analytics (Qventus, USA)
- Situation analysis for forecasting critical actions: app. 1/3 fewer falls

## Scenario 2: In-room surveillance and situation analysis



# Fall prevention

- iToilet: individual configuration, speech interface, automatic emergency calls
  - Commercial offer Austrian company
- WC Buddy: guidance for people with dementia through visual user guidance (workflow recognition)
  - Cooperation TU Vienna with Dutch company



[www.aat.tuwien.ac.at/wcbuddy](http://www.aat.tuwien.ac.at/wcbuddy)

# Household accidents with children

AI system for child face and body recognition

- Objective: AI-supported monitoring of babies in the nursery; location, prevent suffocation
- Research prototype based on convolutional neural networks for image recognition.

Training on 31,000 images; facial recognition rate 95%, body 85% (Lee et al. 2019)

Extensions in the direction of leaving the bed, reaching dangerous areas (windows, pool) conceivable



# Smart home technology for fire prevention

Smart Home enables buildings to be monitored, and increasingly also sensors for fire alarms

Simple systems for switching off forgotten cooking zones ("stove guard")

Intelligent extensions are conceivable

- improved assessment of the fire risk
- distinguish between different users
- if necessary, distinguish between user behavior



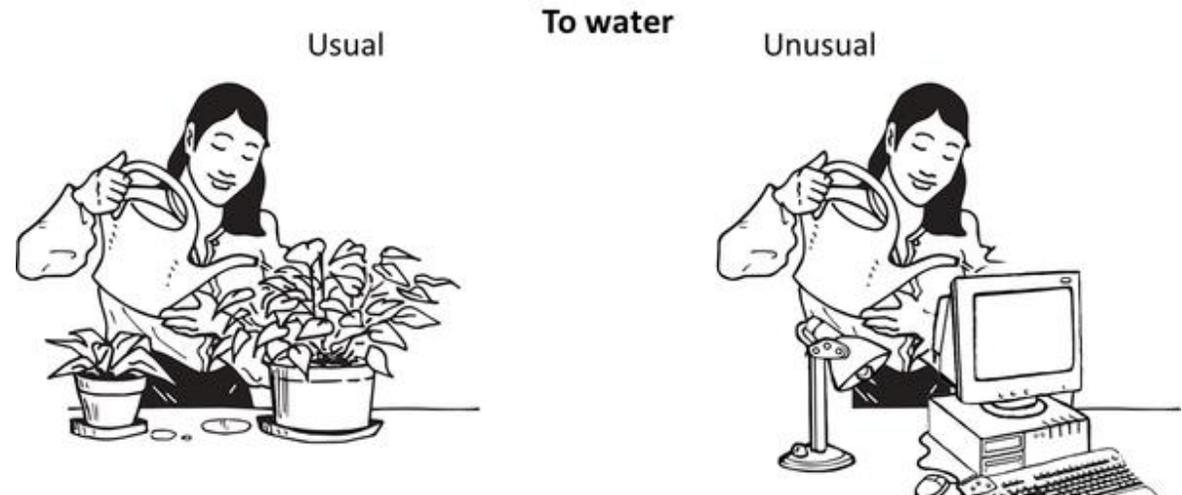
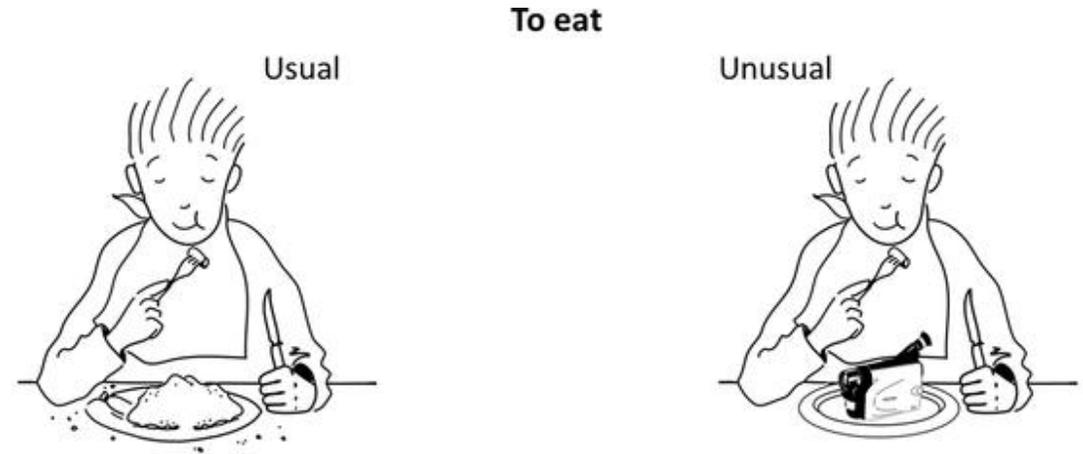
# Why is it so hard?

## Household (and often sport) situations

- Context-dependent situation assessment
- Highly dynamic
- “non-clean”: cluttered, dirty, shaking
- “non-digital natives”: elderly, visually impaired, loss of hearing, trembling...

Human understanding of context conceals the challenges.

Ethical, social, psychological concerns



<http://www.cndp.fr/crdp-dijon/clic-images/>

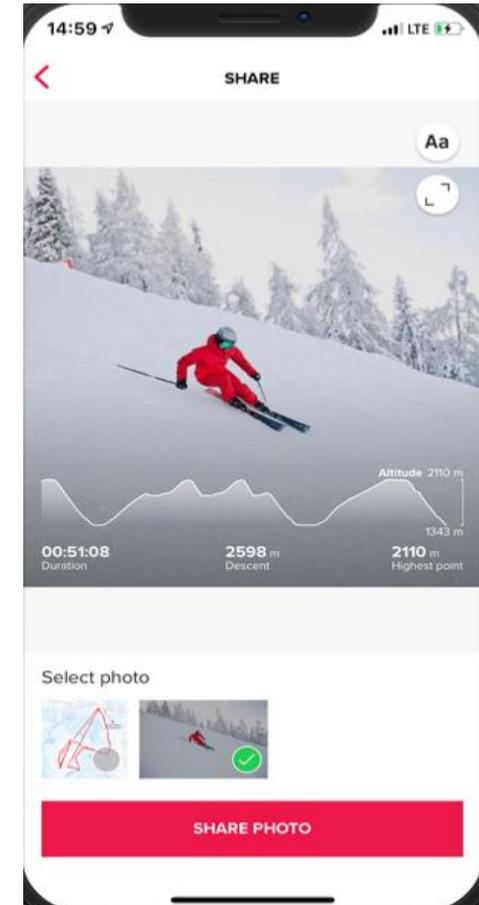
# Sports accidents and injuries: skiing

Sensors on the body and/or on the ski -  
development currently targeting driving fun /  
driving technique optimization

- Atomic Austria ski boot HAWX *Ultra Connected* –  
Development in cooperation with Salzburg Research

Detection of falls and fatigue possible in  
principle, especially with a heart rate monitor

Reluctance of companies for legal and  
marketing reasons



## Sport accidents and –injuries: team sport

High risk of injury, especially in professional sports due to collisions

- Cumulative effects from many impacts
- Systems for rugby or ice hockey to measure clashes, estimate cumulative effects - intervention
- Sensors on the helmet or on the bit guard

Diffusion into mass markets likely starting with advanced amateurs as early adopters



<https://fitguard.me/the-tech/>

## Sport accidents and –injuries: other sports, running

Systems with monitoring of physiological sensors (integrated in sportswear) against fatigue, dehydration, overload

Conceivable: wearable sensors in running shoes, soles or socks for measuring running parameters

Detection of deviations from the norm, overload, fatigue



# Leisure accidents with bikes

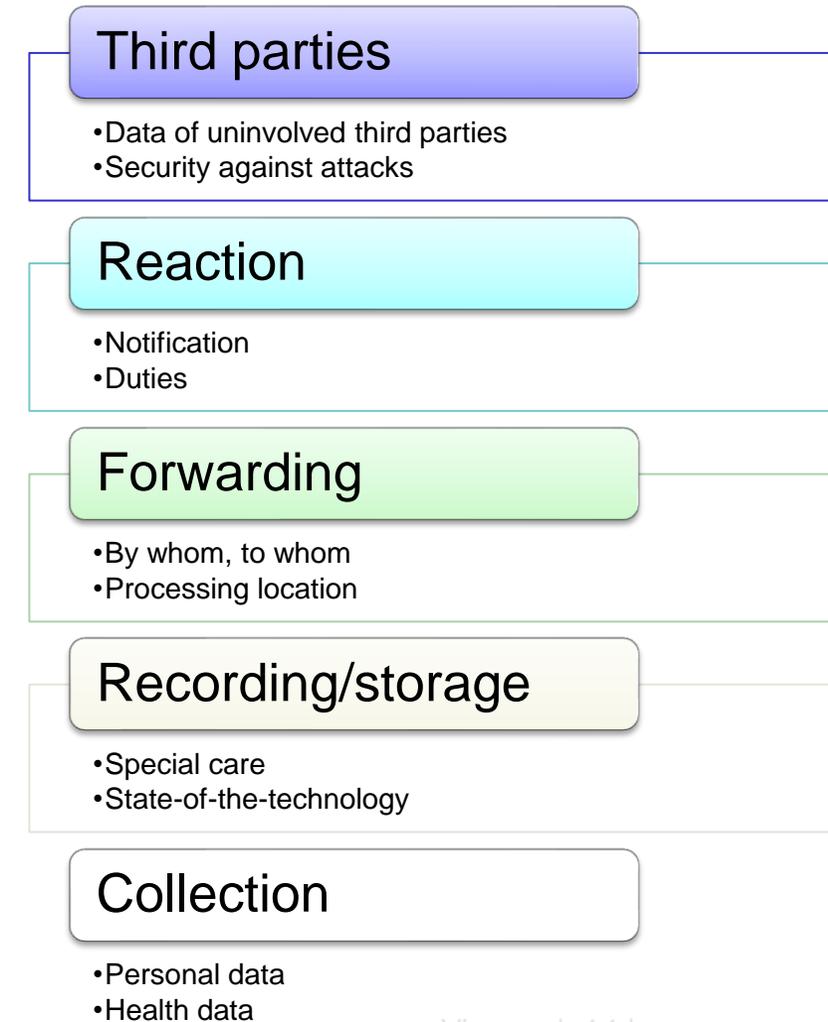
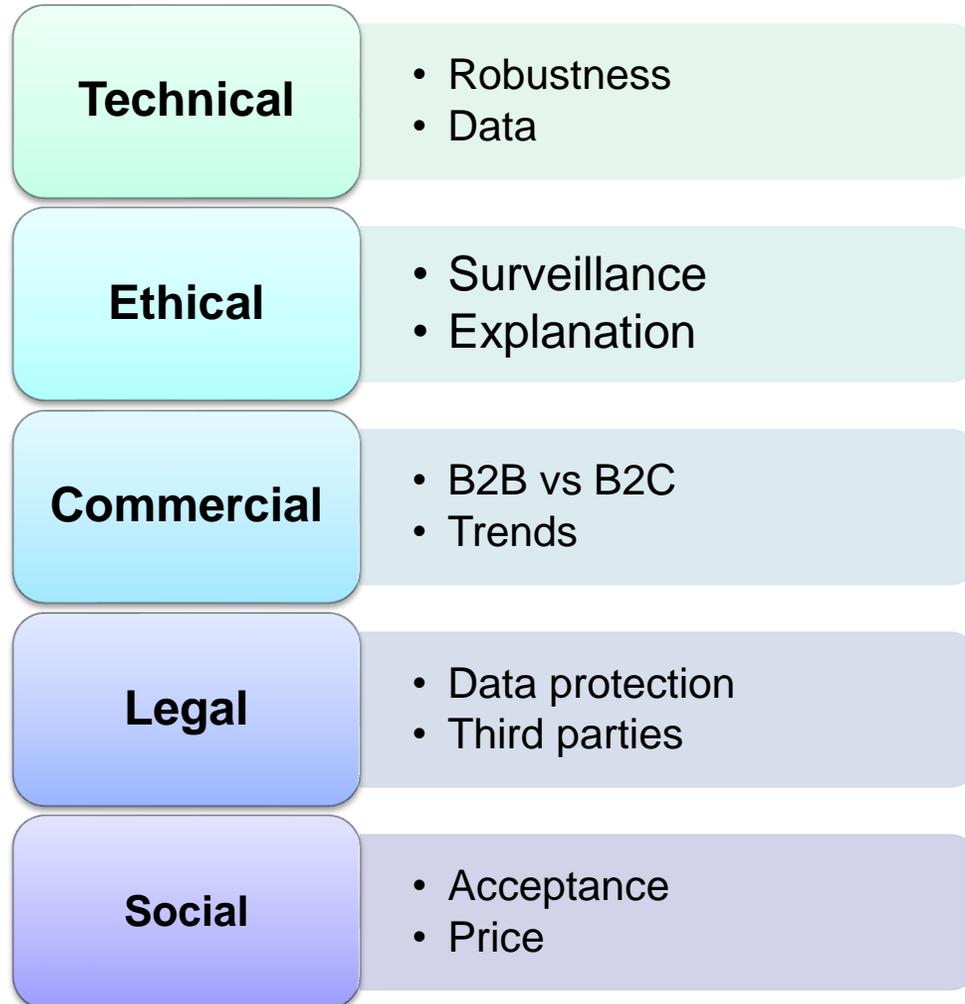
## Significant increase in e-bike accidents

- Causes: speed, lack of practice, wrong braking
- Obvious support from ABS systems for e-bikes (non-AI)
- Further systems for danger detection, fatigue detection (as above) are conceivable
- Diffusion of other smart systems from other mobility areas



e-Bike with ABS by Bosch

# Framework conditions



# Summary

With a few exceptions,  
AI cannot prevent  
accidents in the home.

Diffusion of technologies  
that can be used today  
in standardized and  
limited contexts is to be  
expected.

In sports, systems from  
professional sports will  
become interesting for  
amateurs – but focus not  
yet on accident  
prevention.

A further development of  
today's very simple  
technical systems  
towards more  
intelligence is likely.

# Recommendations

|  |  |
|--|--|
| <b>Differentiated picture</b>                                      | Demographic development, market environment and socio-economic as well as socio-technical evaluation   |
| <b>R&amp;I push</b>  | New possibilities: VR, sensors, etc. offer opportunities for education and training, training, early detection. Important: involve users, realistic scenarios; role of standardization |
| <b>Encourage collaboration between research and early adopters</b> | Innovation-savvy first-time users are a key to the development of the technologies.  |
| <b>Promote the development of marketable systems</b>               | Improvement of market conditions, e.g. legal aspects, cross-border marketability, EU standards   |
| <b>Contextual embedding</b>  | Consider ethical, social, political and other boundary conditions for successful development and deployment of AI for accident prevention  |

## How to reach us.

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