RESCU – A Mixed-Methods Pilot Intervention Development Study Assessing the Function of a Respiratory Biosensor to Prevent Drug-Related Deaths

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Aims:

Most drug-related deaths are caused by opioid induced respiratory depression.

- This study investigates whether a chest-worn accelerometer sensor can dependably capture respiratory patterns of people who use drugs to determine trigger points for an emergency response.
- The study assesses device acceptability to people who use drugs and stakeholder groups to create an intervention pathway.

Design:

RESCU is a mixed-methods observational cohort study launched in January 2022.

Setting:

Participants are recruited on a rolling basis from a needle exchange in the city centre of Dundee.

Participants:

- Quantitative study participants (n=70) are individuals who currently use illicit substances and who are accessing needle exchanges or opioid substitution therapy clinics in NHS Tayside.
- Qualitative study participants are RESCU participants (n=21) and stakeholder groups (n=8)

Intervention – Quantitative study

Participants received a sensor and a gateway device (a "hub") to passively monitor their respiration when in range of the device.

During the study, participants record their substance use.

Participants are monitored over a period of four weeks, returning to the exchange weekly for data download (a total of 5 visits).

Intervention - Qualitative study

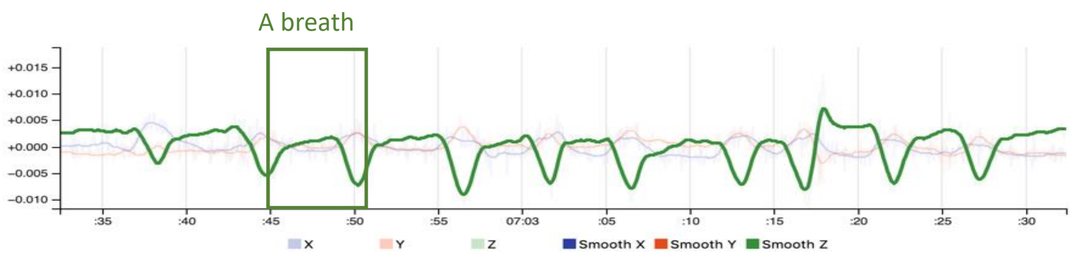
Semi structured interviews and focus groups were carried out with quantitative study participants and stakeholder groups.

Verbatim interview and focus group transcripts were analysed using Reflexive Thematic Analysis.

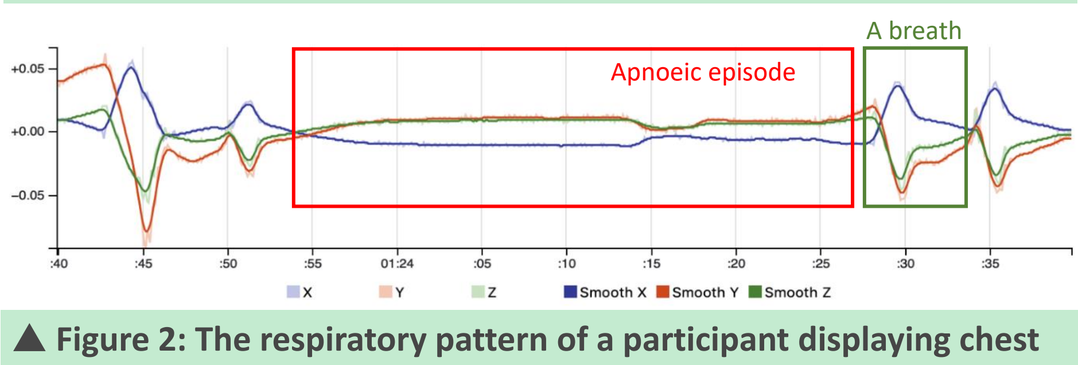
Factors influencing device acceptability by participants were mapped onto the COM-B Model of Behaviour. Normalisation Process Theory was used to assess device integration into existing services.

Measures:

During February – December 2022, 70 participants had either completed or partially completed the study protocol. Data was reviewed after running prototype apnoea detection and movement artefact algorithms.



▲ Figure 1: The chest movement of a participant who did not display a breathing disorder. The participant's chest movements are consistent with regular breathing. The participant was a 36-year-old male who stated he was homeless and living on the streets. The participant's drug use questionnaire noted a history of intravenous heroin use.



▲ Figure 2: The respiratory pattern of a participant displaying chest movement consistent with severe apnoea (>30s duration, red box). Participant was a 45-year-old male living in his own home, whose drug diary showed extensive intravenous heroin use in the groin, oral diazepam and pregabalin with occasional smoking of crack cocaine.

Capability	
Physical	Ability to attach device to their body Ability to rotate sites for device attachment
Psychological	Cognitive faculties Executive function Mental Health
Motivation	
Automatic	Witnessing OD/drug-related death Denial of risk Attitude to risk Mental health
Reflective	Desire to live Feeling at risk of an overdose Therapeutic Relationship with staff Personal priorities
Opportunity	
Physical	Housing Security Access to Services Access to electricity Income
Psychological	Relationship with friends and family (positive vs negative)

◀ Figure 3: The COM-B Model of Behaviour
Motivational factors to participants decision to wear the device were experiences with overdose or drug-related death.

Health Behaviour

Wearing the respiratory monitoring device and adhering to intervention plan

▼ Figure 4: The Normalisation Process Theory framework
Focus group members stressed importance of device accuracy. Ambulance was the favoured emergency response method due to consent issues and potential negative effects on mental health of friends and family as emergency responders.

Coherence:
- Focus group participants understood intervention.
- Spoke about comparable interventions: e.g., safe consumption rooms, Glasgow virtual spotting phone line.
- Spoke about assertive outreach, stressed importance of immediacy.
- Device accuracy paramount for emergency response

Cognitive Participation:
- Death of a friend or family member identified as a motivating factor for participation
- Some patients may not be ready for an intervention of this type; intervention is not a cure-all.

Collective Action:
- Incentivisation – transport and electricity identified as a barrier
- Issue of responder consent and mental health
- Nurses/Overdose prevention workers need to be trained
- Device may not be a priority for areas with low funding
- Intervention needs to be integrated into existing interventions such as Assertive Outreach

Reflexive Monitoring:
- Main outcome – lowering overdose fatalities
- Secondary outcomes – improved engagement with substance use services; engaging patients in their own healthcare

Findings and Conclusions

8,614 apnoeic episodes of >10s duration were detected at the highest probability level in 6,202.08 hours of respiratory data. Of the 70 participants recruited, 48 participants engaged fully or partially in the study.

The mean coverage per participant was 28.06% (SD: 18.67), the average respiratory rate was 11 breaths per minute (SD: 3.36).

Participants used the device for an average of 189.79 hours (SD: 132.70), over an average capture period of 673.38 hours (SD: 184.57).

Ongoing data analysis suggests successful respiratory anomaly detection. A future aim is trigger point identification. The evaluation highlighted positive therapeutic relationships and patient choice.

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DISCLOSURE OF INTEREST:
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