The feasibility of arterial blood pressure monitoring with wearable devices: The influence of reduced sampling rates

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Abstract Rationale: Post-stroke haemodynamic monitoring is effective and validated within secondary care but community settings present challenges. Remote patient monitoring (RPM) beat-to-beat blood pressure (BP) presents blood pressure variability (BPV) insight, linked to poor prognosis post-stroke, when elevated. BP sampling rate (SR) influences ambulatory care BPV, but RPM BP SR optimisation research is limited. SR and device battery compromise is commonplace meaning reduced SR impacts require investigation.

Objectives: This study aimed to optimise BP SR, accurately assessing healthy, ischaemic stroke (AIS) and intracerebral haemorrhage (ICH) stroke BPV. Also, to aid event-of-interest identification, including BP ‘spikes’, potentially aiding cardiovascular event prediction, namely recurrent stroke.

Methods: Both intra-subject and inter-patient standard deviation represented individual variability alongside population values alongside synthetically altered SR. A matched-filter approach, based on cross-correlation function, was implemented detecting sudden BP rises or drops within healthy/stroke datasets.

Results: BPV, normalised to SR1s (every 1s) in an AIS sample, increased at SR30s (26%-131%) and SR120s (1%-274%). Cross-correlation systolic BP change analysis showed healthy/AIS BP rise and fall detection accuracy reductions with decreasing SR. Positive BP spike detection, normalised to SR1s, fell 48.48% at SR10s up to 78.79% at SR75s in healthy participants and 67.5% at SR10s and 100% at SR75s in AIS. Negative BP spike detection fell 50% at SR10s up to 82.35% at SR75s in healthy participants and 52.27% at SR10s and 95.45% at SR75s in AIS.

Conclusion: Altering BP SR caused marked BPV and indicates SR reduction reduces measurement accuracy/validity. However, BP spike detection reduction requires further investigation regarding RPM device capabilities compromise.
Pulmonary rehabilitation and movement behaviours: a step in the right direction?  
A network meta-analysis

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Abstract Rationale: Novel pulmonary rehabilitation (PR) models have led to innovations and adjuncts in PR components which may lead to differential responses in physical activity (PA), sedentary behaviour (SB) and/or sleep.

Objectives: To examine the relative effectiveness of different PR-based interventions on PA, SB and sleep.

Methods: Randomised trials in chronic obstructive pulmonary disease, where at least one intervention arm received a PR-based intervention, were systematically searched for on three electronic databases. Network meta-analyses compared PR-based interventions against usual care (UC) and centre-based PR (CBPR) for pre-post changes in movement behaviours.

Results: 40 articles (k=38) were included, with most common outcomes being steps/day (k=29), time spent in moderate-to-vigorous PA (MVPA; k=13) and sedentary time (k=8). There were insufficient data reported to analyse sleep quality (k=3). 'CBPR+PA promotion' resulted in significantly greater increases in steps/day compared to both UC and CBPR, with greater increases in MVPA and reductions in sedentary time compared to UC only (Fig.1a-d). 'Home-based PR' resulted in greater increases in steps/day and decreases in sedentary time, whereas CBPR resulted in greater MVPA and reduced sedentary time compared to UC (Fig.1a-c). Greater increases in steps/day were observed for 'CBPR+nutrition', and 'CBPR+non-invasive positive pressure ventilation' compared to UC (Fig.1a). When compared to CBPR alone, no PR-related intervention resulted in significantly greater increases in MVPA or reductions in sedentary time (Fig.1e-f).

Conclusion: Differential responses in PA and SB were observed between PR-based interventions. Findings may facilitate the tailoring of PR-based interventions to individual needs relating to movement behaviours.

Figure 1. Forest plot showing changes in steps/day (a and d), moderate-to-vigorous physical activity (MVPA; b and e), and sedentary time (c and f) compared to usual care (left) and centre-based pulmonary rehabilitation (CBPR) alone (right).
Involving health and social care professionals in the process of designing an interactive user interface for visualising AI-generated health information: the case of the DECODE project.

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Objectives: The DECODE project throughout its durations is expected to produce several different types of Artificial Intelligence-driven outputs that will help us better understand the role of multiple long-term conditions in adults with intellectual disabilities (ID). Designing a user-friendly interface to present the outputs of Artificial Intelligence (AI) analysis in a meaningful and accessible way to different stakeholders is a major challenge. The main objective of this study is to capture the needs and requirements of health and social care professionals (HSCP) that will inform the interface design of a dashboard that allows interactive visualisation of disease trajectories and clusters of multiple long-term conditions in people with intellectual disabilities. To achieve this, six rounds of participatory design focus groups are expected to take place throughout the project duration. Understanding which data or information is of relevance to the participants in the focus group and how this could be visualised and interrogated is going to be the main aim of these focus groups.

Methods: Each participatory design focus group involves the use of a combination of creative techniques to help elicit user needs and requirements and stimulate ideation in regard to the design of the dashboard, such as sketching, mood boards, card sorting and voting activities.

Results: Early findings from first two rounds of participatory design focus groups helped generate a series of user personas (key user characteristics, needs and goals), derive a list of design principles that should guide the design of the dashboard and design an initial prototype of a dashboard that allows the visualisation of disease clusters and trajectories in this context.

Conclusion: Applying participatory or co-design approaches can benefit the design of digital interventions that are relevant to user needs and help understand and interrogate the complex outputs of Artificial Intelligence algorithms and help integrate these tools in clinical practice and care coordination for people with Intellectual Disabilities.
Genomic analysis of circulating tumour cells for guiding treatment decisions in patients with metastatic breast cancer.

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**Abstract Rationale:** Tumoral heterogeneity fuels resistance to treatment, therefore the ability to detect and characterise this could help guide treatment decisions and minimise exposure to toxic, ineffective therapy.

**Objectives:** Here we report use of shallow whole genome sequencing (sWGS) for detecting somatic copy number alterations (sCNAs) in individual circulating tumour cells (CTCs) in follow up of patients with metastatic breast cancer for guiding treatment decisions.

**Methods:** Three patients with metastatic breast cancer (MBC) underwent serial blood sampling over a mean duration of 277 days (range 210-377); 68 single CTCs were recovered by CELLSEARCH®/DEPArray™ and sequenced for sCNA using the Ion ReproSeq PGS™ kit and compared with matched cfDNA samples (300 pg).

**Results:** Across the 3 patients, 62/68 (91%) CTCs and 17/17 (100%) cfDNA samples sequenced successfully, with mean productive reads of 157,658 and 186,724 for CTCs and cfDNA, with median absolute pairwise difference (MAPD) of 0.236 and 0.197, demonstrating high coverage uniformity. 100% of CTCs had genome wide sCNAs detected whereas, only 8/17 (47%) cfDNA samples showed sCNAs. sCNAs detected in CTCs included amplification and deletion of actionable targets ERBB2, FGFR1, RB1, JAK2 and CDK6, not consistently seen in matched cfDNA. Of significance, one patient with triple negative breast cancer, had emergence of ERBB2 amplification in CTCs not evident in matched cfDNA.

**Conclusion:** Longitudinal analysis of CTC by sWGS may offer a new approach for monitoring disease progression, to direct therapy in patients with advanced MBC, at a time when they are coming towards the end of other treatment options.
Greater hepatic lipid saturation is associated with impaired glycaemic regulation in men with MASLD but is not altered by six-weeks of exercise training

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Abstract Rationale: Greater hepatic lipid saturation may underpin worse metabolic and hepatic complications in metabolic dysfunction-associated steatotic liver disease (MASLD); however, whether this relationship exists in humans and if exercise can alter hepatic lipid composition is unclear.

Objectives: This study examined the impact of impaired glucose regulation and exercise training on hepatic lipid composition in men with MASLD.

Methods: In Part A, 40 men with MASLD (liver fat ≥5.56%) were recruited to: 1) normal glucose regulation (NGR; HbA1c<6.0%; n=14); 2) impaired glucose regulation (IGR; HbA1c≥6.0%; n=26). In Part B, the IGR group were randomised to one-of-two six-week interventions: 1) moderate-intensity exercise training (EX); 2) control (CON). Hepatic lipid indices of saturation (SI), unsaturation (UI), and polyunsaturation (PUI) were determined using 1H-MRS and were compared between groups (Part A) and in response to the interventions (Part B). Other secondary outcomes included liver fat (1H-MRS), HbA1c, fasting glucose, HOMA-IR, and plasma cytokeratin-18 [CK18].

Results: In Part A, hepatic SI was higher and hepatic UI was lower in the IGR vs. NGR group (p=0.038). HbA1c, fasting glucose and plasma CK18-M65 were also higher in the IGR vs. NGR group (p≤0.008). All other outcomes were similar between groups (p≥0.137). In Part B, hepatic SI, UI and PUI were unchanged after EX vs. CON (p≥0.137). Fasting glucose was reduced after EX vs. CON (p=0.006). All other responses were similar between interventions (p≥0.083).

Conclusion: The presence of IGR in MASLD is associated with greater hepatic lipid saturation; however, this composition is not altered by exercise training.
Characterisation of volatile organic compounds in hospital indoor air and exposure health risk determination

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Abstract Rationale: Volatile organic compounds (VOCs) have negative impacts on human health, but few studies are available about concentrations in the hospital environment. There is, however, evidence that the occurrence of adverse respiratory symptoms is higher in hospital workers compared to other occupations.

Objectives: This objective of this study was to identify VOCs present in indoor air in two hospitals and determine their potential impact on healthcare workers.

Methods: VOCs were quantified at two hospital sites; >600 air samples were collected over 31 months (2017-2020) and analysed by two-dimensional gas chromatography. Hazard quotient (HQ) and cancer risk (CR) were calculated to identify the potential risk of VOCs exposure to the health of healthcare workers.

Results: Our results suggested the most frequently detected and highest concentration VOCs are most likely released by healthcare activities or the ingress of vehicle emissions. Measured VOCs did not breach UK Health and Safety Executive (HSE) guidelines. No HQs were measured above 1, compared to inhaled US Environmental Protection Agency (US EPA) and the California Office of Environmental Health Hazard Assessment (OEHHA) health guidelines for non-cancer chemicals. However, the trichloroethylene CR was above 1E-06 using inhaled US EPA cancer risk values, suggesting possible risks to healthcare workers with long-term exposure.

Conclusion: Whilst VOC concentrations were lower than UK workplace exposure limits, long-term exposure at moderate concentrations could still have an impact on healthcare workers, especially those with pre-existing conditions. More studies are needed to better characterise exposures and risks, both to healthcare workers and patients.