Does continuous arterial blood pressure monitoring during surgery benefit patients who are high risk, particularly those who are older and living with frailty? A Project Outline

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Background: Danjoux Intra-operative hypotension (low blood pressure during surgery) occurs in two-thirds of operations and is associated with morbidity and mortality. Older patients living with frailty are at elevated risk, including many patients requiring anaesthesia and surgery for a hip fracture. Emerging evidence suggests that continuous arterial blood pressure monitoring during surgery may reduce exposure to intra-operative hypotension compared to intermittent blood pressure measurements. However, this has not been shown in older patients living with frailty, nor that it reduces harm.

Objectives: To ask: 'Does continuous arterial blood pressure monitoring during surgery benefit patients who are high risk, particularly those who are older and living with frailty?'

Methods WP1: A prospectively registered systematic review and meta-analysis will evaluate whether continuous blood pressure monitoring reduces exposure to intra-operative hypotension, perioperative morbidity, and mortality. WP2: Clinician attitudes towards continuous arterial monitoring in older patients living with frailty will be assessed through surveys and focus groups within a research framework. Key stakeholders will be purposively sampled to ensure a full range of opinions are captured. WP3: We will undertake a feasibility study of continuous invasive arterial blood pressure monitoring vs standard care (intermittent monitoring) in patients ≥65y and living with frailty requiring hip fracture surgery. Up to 100 patients will be randomised (1:1) across four sites during 15 months of recruitment to continuous monitoring or standard care. We will collect feasibility data (including recruitment rate, treatment crossover, retention rate), baseline patient characteristics, intra-operative anaesthetic and surgical data, perioperative complications, adverse events, clinical outcomes and patient-reported quality of life at 120 days. The flow of participants will be reported in a CONSORT diagram, and outcomes will be summarised by group. Anticipated Impact and Dissemination. The key impact will be determining whether a full trial is feasible- if so, we will progress to a researcher-led application. Data from all WPs will be presented at conferences and published in peer-reviewed journals with open access. We will communicate directly with the Royal Colleges of Anaesthesia and Surgery and other relevant groups. At the end of the study, we will report back to our stakeholders. Pre-grant PPIE focus groups informed design. A patient advisory group has been formed. Funder: NIHR RfPB.

Does continuous arterial blood pressure monitoring during surgery benefit patients who are high risk, particularly those who are older and living with frailty? Project Outline of The CAREFUL Study.

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Background

Most patients experience low blood pressure during surgery, which can harm their heart, kidneys or brain, particularly in older patients who may also be frail (e.g. need support in everyday activities). This may affect their long-term health and well-being.

We may be able to prevent low blood pressure by measuring blood pressure every beat rather than the usual practice of every 5 minutes during surgery (see info box).

Patients who have broken their hip are at very high risk of complications during and after surgery, as many are older and frail.

We know that only 1 in 10 of these patients receive continuous beat-to-beat monitoring of their blood pressure. This means 90% may be missing out on a treatment which could benefit them. However, there is limited research supporting this approach.

Here our aim is to ask, 'Does measuring blood pressure continuously during surgery benefit patients?'

Information box

Standard blood pressure cuff

'Intermittent'- normally every 5 minutes during surgery

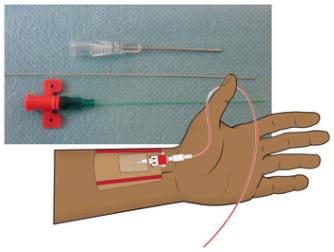
Long periods where changes low blood pressure may not be detected or acted on

Continuous beat to beat

Extra drip inserted with local anaesthetic

Able to react quickly to low blood pressure

May be uncomfortable & small risk of complications



Planned work streams

Three work streams will inform if a large-scale trial is needed and if it is possible.

1: We will undertake **a systematic review** assessing the current research in this area and publish a summary of our findings.

2: We will ask clinical teams about their current practice using a **national survey and focus groups**. We will aim to understand what may help or stop them from changing to continuous blood pressure monitoring in patients who may benefit.

3: We will recruit 100 patients over 65 years old living with frailty and needing surgery for a broken hip into **a feasibility study**.

Patients will be randomised (1:1) receive beat-to-beat or usual (intermittent) measurements during surgery. We will assess how practical the study is, record blood pressure measurements during surgery, complications and ask patients about their well-being.

CAREFUL - Feasibility study overview

Inclusion criteria:	1. ≥65 years old 2. Living with frailty (Clinical Frailty Scale Score ≥5) 3. Need hip fracture surgery

Screen → Consent → Randomise 1:1

Standard care	Continuous arterial blood pressure monitoring
Intermittent blood pressure monitoring every 3-5 minutes	Insertion of an invasive arterial blood pressure monitor prior to either general, neuraxial or regional anaesthesia

Timepoint	Data recorded
Day of surgery (Day 0)	Medical history Baseline patient or carer reported quality of life (EQ5D) Exposure to intraoperative hypotension and perioperative management Delirium screening (4AT tool) Intervention compliance
Day 3	Delirium screening
Day 120	Mortality Comprehensive complications index (CCI) Rate of return and days alive at home in original place of residence Patient or carer reported quality of life (EQ-5D)

Assessment of feasibility

PPI and dissemination plans

The study was developed with RSS York, the Royal College of Anaesthetists (RCoA) patient and public involvement group (PCPIE) and local focus groups and funded through an NIHR RfPB Tier 2 grant (NIHR208843).

Patients, the public, including those with lived experience, will be fully embedded in all aspects of the project.

We will share results widely through conferences, journals, and news articles. These will include leaflets, videos and social media postings. We will hold a stakeholder event at the project's end to discuss findings and agree next steps.

For further details please email Andrew.kane@nhs.net. Follow us on X @CAREFUL_STUDY

CAREfUL

Continuous ARterial monitoring in Elderly and Frail patients for hip fractUre surgery to prevent Low blood pressure

Key references: Kane *et al.*, The use of invasive arterial blood pressure monitoring in routine anaesthesia practice: an analysis from the NAP7 project. *Anaesthesia*, online early view, 2025. https://doi.org/10.1111%2Fanae.16679; Kouz *et al.*, Continuous intra-arterial versus intermittent oscillometric arterial pressure monitoring and hypotension during induction of anaesthesia: the AWAKE randomised trial. *British Journal of Anaesthesia*, 2022 129(4):478.

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