Enhancing Rapid Response Systems in Australian Hospitals through Human-Robot Collaboration (HRC RRS) – Phase 2: Qualitative Data Collection

Coordinating Principal Investigator

- **Dr. Balaji Bikshandi**, Intensive Care Specialist, Yarralumla, ACT

Lead Investigator

- **Amir Asadi,** PhD Candidate, Australian National University, ACT

Other Investigators and Researchers

- **Dr. Elizabeth Williams**, Senior Lecturer, Australian National University, ACT
- **Dr. Damith Herath,** Associate Professor, University of Canberra, ACT
- **Grant Shaw,** BAppSc (Physiotherapy), BSc (Anatomy +Physiology), Physiotherapy and Exercise Physiology Manager, University of Canberra Hospital, ACT

Institutions responsible for the running of the study

- **Australian National University, Canberra, ACT 2601**
- **University of Canberra, 11 Kirinari St, Bruce ACT 2617**
- **University of Canberra Hospital/ACT Health, 20 Guraguma St, Bruce ACT 2617**

Author Contact Details:

Amir Asadi: amir.asadi@anu.edu.au

Dr. Balaji Bikshandi: balaji.md@gmail.com

Content list

Synopsis

Please note that this document adds to the main Project Description and only includes details relevant to Phase 2 of the project, which focuses on collecting qualitative data. For a full overview of this project, make sure to read the main document first.

Rapid Response Systems (RRS), also called Medical Emergency Response Teams (MERT or MET), are a crucial component of Australian hospitals to detecting and preventing patient deterioration. They function by monitoring the vital physiological signs of patients and by deploying specialized responder teams with sophisticated equipment if certain trigger factors are met. However, many factors that impact contemporary health care delivery, such as resource scarcity, increasing patient complexity and special situations like pandemics necessitate innovative approaches to sustain and improve the efficacy of RRS.

Our research project proposes to leverage the advancements in robotics and artificial intelligence (AI) to augment and enhance the capabilities of RRS through the development of an intelligent robotic system. The proposed robotic system would be designed to work in close collaboration with human healthcare professionals, complementing their skills and expertise. This approach, known as Human-Robot Collaboration (HRC), involves the synergistic integration of humans and robots working together to accomplish tasks more efficiently, safely, and effectively than either could accomplish alone.

The project is structured into three phases to ensure a comprehensive and iterative development process that incorporates stakeholder feedback:

- Phase 1 focuses on the initial evaluation of introducing a collaborative robot into the healthcare setting, identifying potential integration obstacles through quantitative data collection.
- Phase 2 builds on Phase 1 insights to design the collaborative robotic system, involving observations, interviews, and focus groups to collect qualitative data on RRS operations. This phase aims to refine the robot's design based on feedback and operational insights.
- Phase 3 is dedicated to prototyping and experimenting with the design, turning it into tangible prototypes for real-world testing and validation. This phase ensures the robot's functionality, usability, and effectiveness meet healthcare standards and stakeholder needs.

This document outlines the second phase of our research, which will focus on qualitative data collection through semi-structured interviews, focus groups and observations at the University of Canberra Hospital. By adopting a human-centred approach, this phase seeks to understand and analyse requirements more deeply. We will engage with staff directly involved in RRS operations to gain insights into the team's operational dynamics. This exploration aims to ascertain the most effective design strategies for the robot, ensuring it enhances the human elements of the RRS. Additionally, focus groups will be utilised to validate and iterate on the robot's design, incorporating real-world feedback from those on the frontline of patient care. This collaborative and iterative approach ensures the development of a robotic system that is

not only technically capable but also practically integrated into the healthcare setting, providing tangible benefits to both healthcare professionals and patients.

Abbreviations and Acronyms

HRC – Human-Robot Collaboration

RRS – Rapid Response System

ICU – Intensive Care Unit

MET – Medical Emergency Team

MERT – Medical Emergency Response Team

MEWS – Medical Early Warning Score

NSQHS – National Safety and Quality in Healthcare Standards

AI – Artificial Intelligence

ML – Machine Learning

1 Phase 2 - Project Design

1.1 Research Project Setting

The study will be conducted at the University of Canberra Hospital (UCH), a major healthcare facility in the Australian Capital Territory (ACT). As the largest purpose-built rehabilitation centre in the region, UCH is equipped with a rapid response system and is supportive of our research. This makes it an ideal setting for investigating Rapid Response Systems. The hospital's involvement in research initiatives presents a unique opportunity for in-depth study of Rapid Response Systems in a safe and realistic environment. This preliminary work at UCH is essential before expanding the research to other hospitals.

Through our dialogues with the UCH management team, it has come to our attention that the hospital is in the process of introducing several new robotic systems within its infrastructure. This development presents a unique and timely opportunity for our research project. We aim to leverage this initiative by closely observing and analysing the hospital's approach to adopting these robotic systems. Collecting data on the integration process, from the initial implementation phase to the operational handover, will provide invaluable insights into the practical aspects of deploying robotic technologies in healthcare settings. This preliminary work at UCH is crucial for understanding the dynamics of technology adoption in healthcare and will serve as a foundational step before considering the expansion of our research to encompass other hospitals.

1.2 Project Phases Overview

The overall project is structured into three phases to ensure a comprehensive and iterative development process that incorporates stakeholder feedback:

- Phase 1 focuses on the initial evaluation of introducing a collaborative robot into the healthcare setting, identifying potential integration obstacles through quantitative data collection.
- Phase 2 builds on Phase 1 insights to design the collaborative robotic system, involving observations, interviews, and focus groups to collect qualitative data on RRS operations. This phase aims to refine the HRC system design based on feedback and operational insights.
- Phase 3 is dedicated to prototyping and experimenting with the design, turning it into tangible prototypes for real-world testing and validation based on the outputs of Phase 1 and Phase 2. This phase ensures the robot's functionality, usability, and effectiveness meet healthcare standards and stakeholder needs.

1.3 Phase 2 Goals

Phase 2 aims to achieve a deep understanding of the UCH's RRS operations and the interactions involved in it. It also seeks to explore how UCH adopts new technologies, focusing on the integration of robotic systems within the healthcare setting.

1.4 Methodological approach

In the second phase of our research, we will adopt a qualitative methodological approach, informed by the preliminary analysis of Phase 1 survey data. This will involve a mix of semi-structured interviews, focus groups, and direct observations within the UCH. These methods are chosen to allow for a comprehensive understanding of the Rapid Response System (RRS) from the perspective of those directly involved in its operation to inform the design of the HRC system. Additionally, we aim to explore the integration process of new technologies within UCH, focusing on the challenges and opportunities presented by the adoption of robotic systems.

1.4.1 Semi-Structured Interviews

These interviews will be carried out with staff members who are either part of the RRS team or directly engage with the team concerning its operations. Additionally, we will include personnel who interact with the new robotic systems being integrated at the hospital. This includes medical professionals, nurses, Allied Health professionals, support staff, and members of the administrative and management teams. The aim is to capture detailed insights into their experiences, perceptions, and suggestions for the integration of the collaborative robot within the RRS. The semi-structured format allows for flexibility in the discussion, enabling the exploration of topics that arise naturally during the conversation.

1.4.2 Observations

Our observational study within the UCH will be structured around two primary contexts to ensure a comprehensive understanding of both the current RRS operations and the integration of new robotic systems.

- **RRS Operations:** Observations in this context will focus on the RRS team's workflows, communication patterns, response strategies, and interaction dynamics during emergency scenarios. We aim to capture the nuanced, real-time challenges and efficiencies within the RRS operations. This will allow us to identify specific areas where the proposed HRC system could augment current practices, potentially improving response times, accuracy in patient monitoring, and overall patient outcomes. Considering that an RRS activation call may not occur during our observations, we plan to request the team conduct a simulation of an RRS activation. This will ensure we can observe and evaluate the system's response dynamics and team coordination in a controlled scenario, providing valuable insights into the potential areas for robotic augmentation.
- **New Robotic System Uses:** The second context of our observations will concentrate on how new robotic systems are being adopted and utilized within the hospital setting. This

includes observing the initial setup, integration into existing hospital workflows, staff training sessions, and daily use cases. Special attention will be paid to the interaction between staff and these robotic systems, including any adjustments made to accommodate the new technology, the technology's impact on staff workload, and the reception of these systems by both healthcare professionals and patients.

1.4.3 Focus Groups

Focus groups will be organized with various stakeholders, including healthcare professionals, ward support staff, and hospital administrators. These sessions are intended to gather collective feedback on the proposed robotic system design, understand the diverse perspectives on its potential impact, and discuss any concerns or suggestions for improvement. The interactive nature of focus groups can stimulate dynamic discussions, offering valuable insights for refining or redirecting the robot's design and intended purpose.

In our focus group sessions, we are considering the implementation of a hands-on approach, where participants will not only discuss the proposed robotic system but also interact with early-stage prototypes or conceptual models. This tangible interaction is intended to foster a deeper understanding and generate more detailed feedback from the group. By presenting different designs or prototypes, we aim to engage healthcare professionals, ward support staff, and hospital administrators in a more immersive evaluation process.

1.5 Participants

For a comprehensive understanding of the integration and impact of a collaborative robot within the RRS at the UCH, our participant selection strategy is designed to encompass a wide range of perspectives for individuals directly interacting with UCH's RRS team or new robotic systems. These participants are selected for their potential contributions to semi-structured interviews, focus groups, and observations, which are crucial methods in our research approach. Here is a breakdown of our chosen participants and the value of their perspectives:

- **Doctors, Nurses, and Allied health professionals:** Understanding the current workflows, needs, and requirements of primary healthcare providers, as well as their opinions on the feasibility and practicality of Human-Robot Collaboration (HRC) in Rapid Response System (RRS) operations, is crucial. Specifically targeting those who are part of or closely work with the Rapid Response Team will offer critical insights. Their firsthand experience with emergency responses will illuminate the operational challenges and opportunities for robotic assistance in acute care scenarios.
- **Ward Support Staff:** Including but not limited to, technicians, porters, and clerical staff who play a supportive role in the operation of RRS. Their perspectives will help identify how non-clinical processes might be enhanced or streamlined by integrating a collaborative robot.
- **Administrative and Management Team**: Executives and managers responsible for overseeing hospital operations, RRS coordination, and technology integration. Their views will shed light on the strategic and logistical considerations of incorporating new technologies into hospital workflows. Additionally, participation of those in charge of

policy, procedure, and the facilitation of new technologies within the hospital setting will ensure the project aligns with broader institutional goals, organisational risk profile, compliance requirements, and regulatory obligations and legislation.

For the observational component of our study, we will adopt a non-participant observation approach to examine the operation of the teams without direct involvement in its activities. This non-intrusive approach ensures that our presence does not impact the natural flow of the RRS operations in any way. Our focus will predominantly revolve around the interactions and workflows involving patients, doctors, nurses, allied health professionals and ward support staff. By observing these interactions, we aim to gain insights into the day-to-day challenges and opportunities within the hospital setting, understanding how processes unfold in real-time, and identifying areas where the integration of a collaborative robot could provide significant support and enhancement.

1.5.1 Inclusion Criteria for Interviews and Focus Groups

- Must be 18 years of age or older.
- Hospital staff who have direct interaction or involvement with UCH's
    - RRS team or its operations OR
    - New robotic systems being introduced at the hospital.
- Proficient in English to ensure the effective communication and understanding of the project details and objectives during interviews and focus groups.

1.5.2 Exclusion Criteria for Interviews and Focus Groups

- Individuals under the age of 18.
- Individuals who are not hospital staff or affiliated with the UCH in a professional capacity.
- Individuals without direct interaction or involvement with the RRS team or its operations, and those not involved with the new robotic systems being introduced at the hospital.
- Lack of English proficiency which would preclude understanding of the survey or study materials.

1.5.3 Inclusion Criteria for Observations

- Must be actively involved in the RRS operations or the newly robotic systems at UCH at the time of the study.

1.5.4 Exclusion Criteria for Observations

- Situations where the presence of observers could potentially interfere with the delivery of emergency care or the normal operation of the RRS team.
- Areas not directly related to RRS operations or newly introduced robotic systems or where patient privacy could be compromised, to respect confidentiality and ethical considerations.
- Individuals or areas where permission for observation has not been granted, either by the staff involved or through the hospital's administrative permissions.

1.6 Sample size and data collection details

- **Interviews**: These sessions are designed to extract in-depth qualitative insights. By conducting **12-15 interviews**, we aim to represent a diverse array of perspectives while ensuring the richness of each interaction. Each interview is expected to have a duration between **30 to 45 minutes**.
- **Observation Sessions**: By conducting **4-6 sessions**, we can observe a variety of scenarios within the Rapid Response System, ensuring a comprehensive understanding without excessive intrusion. Each observation session is expected to have a duration between **2 to 3 hours.**
- **Focus Groups**: These interactive discussions aim to extract collective insights. By holding **2-4 sessions**, we ensure consistent feedback and the emergence of recurrent themes. Limiting each group to **4-6 participants** ensures focused, in-depth discussions where each voice is heard. Each session is expected to have a duration of approximately **90 minutes.**
-

1.7 Participant recruitment strategies

Considering that all of the targeted participants are hospital staff we will use internal communication channels such as emails and departmental meetings to reach out to them. These communications will detail the study's objectives, ethics details and participants. For interviews and focus groups, we will ask people who are willing to participate to share their availability so that we can arrange an appropriate time frame for the session(s) they have agreed to participate in. For observations we will coordinate with the UCH management to secure permissions and schedule times that minimise disruption to the operations of RRS team.

1.8 Timeframes

- **Initial Contact and Briefing**
    - **For interviews and focus groups**, once the ethics application is finalised and we obtain approval from UCH management, we will initiate our outreach to prospective participants. The focus groups will take place in the later stages of data collection.
    - **For observations**, our first point of contact will be UCH management to seek the necessary permissions. Once granted, relevant staff will be informed and briefed about the forthcoming observations to ensure transparency and cooperation.
- **Confirmation of Participation**
    - **For interviews and focus groups**, once interested individuals express their willingness to participate and discuss their availability, we will send them a confirmation email detailing the time, venue, and other specifics related to the session they'll be involved in.
    - **For observations,** once permissions are granted by UCH management, we will not seek individual consent from participants as we will not collect any identifiable data or pictures from the individuals involved. Our focus will solely be on observing the interactions within teams or with the technological systems,

ensuring privacy and confidentiality are maintained. Detailed schedules for observation sessions will be established in consultation with UCH management to align with hospital operations and ensure minimal impact on staff duties and patient care.

- **Data Collection**
    - All data collection sessions are anticipated to be conducted over a period of 2-3 months once ethics approval has been obtained.
- **Follow-up and Debriefing**
  All participants will have the email addresses of the researchers and are encouraged to share any concerns, queries, or other matters with the research team as required. Furthermore, below are the specific details pertaining to each data collection method.
    - **For Interviews**: Upon completion of an interview, participants will be asked if they wish to review the transcript and make clarifications, redactions, or additions. Should they opt to proceed, they will have two weeks from the time the transcript is prepared and shared with them to review it and provide feedback.
    - **For Focus Groups**: Following the focus group discussions, participants will receive an immediate debriefing. Debriefing for focus groups involves a wrap-up session where the facilitator summarizes the main points of discussion.
    - **For Observations:** Given the nature of the observation method, there will not be a direct debriefing with the observed parties, ensuring minimal disruption of participants' work.
- **Sharing of Publication**
    - Participants will be granted access to a project webpage containing the research findings pertinent to their specific mode of participation. This webpage will encompass all related publications and reports.

1.9 Approaches to provision of information to participants and consent

1.9.1 Information Provision

To ensure that participants are fully aware of the nature and requirements of the study, each will be provided with a Participant Information Sheet tailored to the data collection method they are invited to join. This document will comprehensively cover the aspects such as purpose of the study, procedures involved, potential risks and benefits, rights to confidentiality and data protection, rights to withdraw from the study at any point up until the commencement of data analysis.

1.9.2 Consent process

This section outlines the procedures and responsible parties involved in confirming or re-negotiating consent throughout the study.

- **Procedures for Initial Consent**

    - **Written Consent:** Written consent forms will be distributed and collected either in person or via secure electronic means. This form of consent will be collected prior to the data collection session.
    - **Verbal Consent:** In certain cases where written consent is not feasible or not convenient, verbal consent will be audio-recorded as a formal acknowledgment of the participant's agreement to partake in the study. This form of consent will be collected prior to the commencement of the data collection session.
- **Confirmation and Re-negotiation of Consent:** Participants have the right to change their decision after having given their consent. If, at any point, a participant wishes to withdraw their consent or make any modifications to the extent of their participation, they may reach out to the researchers. If at any time, the researchers sense the participant in question is uncomfortable with continuing to participate, we will cease data collection and remind them they can stop participating or withdraw their consent if they so choose. We will ensure they understand that requests for data removal should be made prior to the publication or submission of findings. This ensures their data can be withdrawn in time.
- **Modifications to Study Protocol:** In the event of significant changes to the study protocol, participants will be informed through updates on the designated webpage. This ensures that participants remain informed about any pivotal changes to the research they are a part of, and they can always refer to this webpage for the most up-to-date information regarding the study.

1.10 Participant commitment

This subsection outlines what is expected from participants in terms of time commitment, participation in different research activities, and ongoing engagement with the study.

- **Time Commitment**
    - **Semi-Structured Interviews:** Approximately 30–60 minutes per participant.
    - **Focus Groups:** Each focus group is expected to last about 90 minutes.
    - **Observational Research:** Healthcare professionals and UCH staff will be observed during their regular work shifts, with no extra time commitment required.
- **Activity Involvement**
    - Participants may be involved in one or multiple research methods, based on their willingness.
- **Ongoing Engagement**
    - Participants will be kept informed about the study's progress and findings via the project’s webpage shared with them in the participant information sheet.

1.11 Further Subject Follow-up

Participants will not be followed up after their involvement in the study and confirmation of their data, unless they choose to review the transcript of the interviews. However, if any participants express distress or concerns during the study, they will be provided with

appropriate support and resources in the Participant Information Sheet. They can also contact the researchers to seek clarification, withdraw, make changes to their participations, discuss their feelings, or be directed to additional resources and support avenues if needed.

1.12 Project duration and timeline

The data collection and analysis for this phase of the project is anticipated to be 12 months long, with the outlined timeline below. However, the timeline for each stage may be subject to change due to factors such as study complexity, resource availability, and unforeseen events. Nevertheless, this framework serves as a broad reference for the expected timeline of the study.

Duration	Stage	Activities
Month 1 -4	Recruitment and Data Collection	Development and dissemination of recruitment materials Administering the survey to the participants
Month 4-12	Data Analysis and Synthesis, Write up	Initial data cleaning and sorting Comprehensive data analysis
		Synthesis of findings, identification of key themes, and preliminary conclusions
		Drafting initial findings and results Review and refinement of draft

1.13 Impact of and response to participant withdrawal

Participant withdrawal is a possibility in any research study. This section outlines the potential impact of such withdrawals on the study and the measures that will be taken to address them.

1.13.1 Withdrawal Details and Policy

- **Interviews**: Participants of interviews are entitled to withdraw their participation at any point before the analysis of collected data begins. The specific timeline for this will be clearly communicated on the project webpage.
- **Focus Groups**: Participants have the right to withdraw at any point prior to the conclusion of the focus groups. If they wish to do so during the focus groups, they can leave the focus group sessions or stop participating. Due to the interactive nature of focus groups, once a session has occurred, it is not feasible to entirely remove a participant's contributions without affecting the group's collective data integrity. Participants are made aware during the consent process that their input during sessions cannot be withdrawn after the session is concluded.
- **Observations**: Given the non-intrusive nature of the observations and the commitment to not collecting identifiable data or images, participants involved in observational studies implicitly consent by continuing their regular duties within the observational settings. However, if an individual explicitly expresses discomfort or wishes to opt out from being observed, their preference will be respected, and they will be excluded from the observational data. Since observations focus on team interactions and system usage without identifying individual contributions, withdrawing specific data post-observation does not apply.

1.13.2 Impact on the Study

- **Interviews**: The potential withdrawal of participants could lead to a lesser depth of data. However, the qualitative nature of interviews, supplemented by other data collection methods, ensures that the overall validity of the study is maintained. The diverse

approaches to gathering information bolster the study's resilience against the loss of individual contributions.

- **Focus Groups:** Participants are informed that withdrawal is possible either before or during the focus group session, leading to two distinct scenarios:
    - **Withdrawal Prior to the Session**: If a participant withdraws before the session begins, efforts will be made to find a replacement to ensure the group's composition remains intact.
    - **Withdrawal During the Session**: Should a participant decide to leave or cease participating during the session, the quality of the collected data will be evaluated post-session. If deemed insufficient, an additional focus group session may be organised to ensure the robustness of the data.
- **Observations:** The withdrawal of participants from observations might lead to a decrease in the volume of information collected. Nonetheless, the study's methodological framework is designed to ensure that as long as the remaining sample is representative, the overall integrity of the study will not be affected. Similar to focus groups, should the data's integrity be compromised by withdrawals, additional observation sessions may be conducted to gather the necessary data.

1.13.3 Response to Withdrawal

- **Immediate Action**: In the event that a participant decides to withdraw within the specified timeframe for withdrawals, their entire set of data will be quickly separated and flagged for exclusion from the research.
- **Ethical Consideration**: Participants maintain the right to withdraw from the study at any time, in accordance with the terms set out in the withdrawal policy, without facing any adverse effects.
- **Data Replacement:** If feasible, a new participant fitting the original participant's profile may be recruited to replace the withdrawn participant, especially if the withdrawal significantly impacts the study.
- **Communication:** Participants who choose to withdraw will be asked (but not required) to provide a reason for their withdrawal to help the research team understand any potential issues within the study design or execution.
- **Study Adjustment:** The research team will periodically assess the impact of any withdrawals to determine if adjustments to the study design or methodology are necessary.

1.14 Data Management

This section outlines the comprehensive Data Management Plan developed in accordance with National Statement 3.1.45 and 3.1.56.

1.14.1 Data Management Plan

- **Data collection:**

    - **Interviews and Focus Groups**: Will be conducted online using handheld recording devices or via Zoom, with recordings stored temporarily before transcriptions are reviewed and confirmed.
    - **Observations**: Will involve detailed note-taking, complemented by the possibility of researchers recording their own voices for note-taking purposes. Additionally, photographs may be taken of devices, tools, or the setting, provided these images do not include any identifiable individuals.

- **Form of Data Storage:** Data will be stored in digital format only. Digital data will be encrypted and stored in a secure server provided by Australian National University (ANU).
- **Purposes for Data Use/Disclosure:** Data will be used solely for this research. Aggregated data may be published, but individual responses will remain confidential.
- **Conditions for Data Access**: Access to the data will only be granted to authorized members of the research team.
- **Information to be Communicated to Participants:** Participants will be informed of the data management plan, specifically how their data will be used and stored in the Participant Information Sheet.
- **Disposal and Destruction:** Upon completion of the study and analysis, any identifying information will be irreversibly destroyed. Non-identifying data will be retained for a period of five years following the latest date of any publication associated with this data, after which it will be securely disposed of in accordance with ethical guidelines and institutional policies.

1.15 Future Research and Data Sharing

- **Permission from Review Body:** If needed, permission will be sought from the ethics review body to waive the requirement for consent for future, yet unspecified, research.

1.16 Data Analysis

This section outlines the methodologies that will be employed for measuring, manipulating, and analysing the data gathered through various methods such as semi-structured interviews, focus groups, and observational research.

- **Qualitative Data Analysis**
    - **Semi-Structured Interviews and Focus Groups**
        - **Method**: Thematic Analysis
        - **Tools**: Offline transcription services will be used to transcribe the audio files. Software like NVivo may be used for coding and theme extraction.
        - **Procedure**: Transcripts will be coded to identify recurring themes, which will then be grouped to form overarching categories.
    - **Observational Research**
        - **Method**: Content Analysis
        - **Tools**: Manual coding or specialized software for observational data.

        - **Procedure**: Behaviours, interactions, and events will be categorized and analysed for patterns and variances.
- **Integrative Analysis**
    - **Method**: Meta-Synthesis
    - **Procedure**: Findings from the qualitative, quantitative, literature, and technical data will be integrated to provide a comprehensive understanding of the current state and future potential of HRC in RRS.

1.17 Sampling strategies

To ensure the representativeness of the sample and to achieve robust findings, the following matching and sampling strategies will be implemented**:**

- **Stratified Random Sampling:** Considering the varied roles and affiliations of potential participants within the UCH, the population will be divided into distinct strata (e.g., medical team, nurses, ward support staff, and administrative and managerial team members.). A random sample will then be drawn from each group. This approach ensures representation from all key groups and can lead to more accurate and insightful conclusions.
- **Purposeful Sampling for Focus Groups**: In addition to stratified random sampling, purposeful sampling will be used to select participants for focus groups. This strategy involves intentionally selecting individuals who have specific knowledge, experiences, or perspectives that are particularly relevant to the research questions. By doing so, we can ensure that the focus groups are composed of participants who can provide in-depth and varied insights into the design, implementation, and impact of the collaborative robot within the RRS.
- **Snowball Sampling for Hard-to-Reach Participants:** Recognising that some key participants may be difficult to identify or reluctant to participate through conventional sampling methods, snowball sampling will be utilised as a complementary approach. This technique involves existing study participants referring future participants from among their peers.

1.18 Identification and Minimization of Bias

To ensure the integrity of the research findings and mitigate the effects of potential biases the following strategies will be implemented.

- **Selection Bias:** To counteract selection bias, the stratified random sampling and purposeful sampling strategies will be carefully executed to ensure a representative cross-section of the University of Canberra Hospital (UCH) population. By diversifying our participant base across different roles and departments, we aim to reduce the likelihood of over-representing certain perspectives.
- **Confirmation Bias:** Researchers will undergo training to recognize and mitigate confirmation bias during data collection and analysis. This includes developing neutral interview guides, employing open-ended questions in semi-structured interviews, and

adopting a systematic approach to data analysis that checks for alternative explanations.

1.19 Addressing Confounding Factors and Missing Information

To ensure the integrity of the research findings and mitigate the effects of confounding factors, and missing information the following strategies will be implemented:

- **Matching and Control Groups**: Where possible, matching participants on key characteristics (such as role, experience level, and department) will help control for confounding variables that might otherwise skew the findings. In focus groups, ensuring a mix of roles and experiences can similarly help illuminate diverse perspectives and reduce the impact of any single confounding factor.
- **Comprehensive Data Collection:** By employing a multi-method approach, including interviews, focus groups, and observations, the study aims to capture a broad spectrum of data, reducing the impact of missing information from any single source.

1.20 Data Linkage

In the second phase of our study, we are advancing the process of data linkage that was initiated during the first phase. Our current focus involves the integration of quantitative data collected from surveys with the qualitative data obtained from observations, interviews, and focus groups. This integration will enable us to construct a rich, multi-dimensional dataset that is crucial for a thorough analysis of the implementation and impact of collaborative robots RRS in healthcare settings.

1.21 Outcome measures

In the overall project, we plan to measure a variety of outcomes to capture the multifaceted impact of integrating HRC into RRS. Some of the outcome measures we intend to include are metrics such as Efficiency of Response, Quality of Patient Care, Healthcare Professionals' Workload and Stakeholder Acceptance. Given that we are still in the process of collecting data to understand the requirements and needs for the design, the primary outcome of interest within this phase of the research to understand how the introduction of robotic systems might affect the daily workflows, communication patterns, and overall efficiency of the RRS team.

1.22 Plans for dissemination and publication of project outcomes

The research team is dedicated to ensuring that the dissemination of study results and publication policy follows ethical guidelines. This includes sharing the findings of the study not only within scientific media, but also with the broader community and study participants. Ensuring open access where possible, we'll also share results directly with participants and stakeholders, supporting transparency and the widespread application of our research insights.

1.23 Project closure processes

Upon completion of the study, our project closure processes will involve a thorough review and documentation of the outcomes, the consolidation of findings, and the archiving of data in accordance with ethical and institutional guidelines. We will ensure all contractual and reporting obligations are fulfilled, participant and stakeholder communications are concluded, and resources are reallocated or decommissioned as necessary. A final project report will be compiled, encapsulating the research insights, lessons learned, and recommendations for future studies, thus formally concluding the project lifecycle.

1.24 Plans for sharing, future use of data, and follow-up research

At present, there are no definitive plans for the sharing or future use of data collected in this phase of the research. Follow-up research initiatives, where applicable, will be considered independently and will seek separate ethics approval. Our immediate focus remains on the successful completion of the current study and the thorough analysis of its findings.

1.25 Anticipated secondary use of data

There are no anticipated secondary uses of the data collected in this phase of the study. The data will be gathered, analysed, and reported solely for the purposes outlined in the research protocol.

1.26 Risk and Benefit

The risks associated with participating in the study are minimal, and steps will be taken to ensure the safety and privacy of all participants. Some potential risks include:

- **Data Privacy:** Potential risk of personal information breach.
    - *Mitigation:* Implementation of robust data protection protocols and not collecting identifiable information.
- **Participant Discomfort:** Individuals may encounter inconvenience or discomfort during data collection.
    - *Mitigation:* Ensuring supportive measures are in place and the process is as non-intrusive as possible.
- **Indirect Identification**: Participants might be identifiable due to the nature of the study.
    - *Mitigation*: Clear communication about confidentiality limits and the use of data anonymisation where possible.

Some of the potential long-term benefits of the overall project include:

- **Improved Patient Care:** Enhanced rapid response systems effective Human-Robot Collaboration (HRC) could lead to better patient outcomes.

- **Professional Support**: Alleviation of staff workload and reduction of stress through effective HRC.
- **Academic and Social Value:** The study's findings are expected to contribute to the body of knowledge in healthcare robotics and potentially influence future technological integration in healthcare settings.

It is important to note that in the initial phases of our research at UCH, we are focusing on a preliminary survey to gather requirements and needs regarding the integration of robotics and AI in healthcare. It is crucial for participants to understand that the beneficial impacts of this research, such as improved patient care and more efficient healthcare practices through the use of robotics and AI, are anticipated to be long-term developments. The current stage primarily aims to collect and analyse data on healthcare professionals' perspectives, which will inform future stages of our research. To ensure clarity, we will explicitly communicate this information in our Participant Information Sheet, maintaining transparency about the long-term nature of the research benefits and the immediate objectives of this initial phase.

1.27 Partnership requirements

In addition to the cooperation and participation of hospital staff and patients and visitors, the research team may require partnerships with other organizations or companies to achieve the objectives of the study. These partnerships will be determined based on the study's needs and objectives and will be established in collaboration with relevant stakeholders. The team will work closely with the UCH's management and research team to ensure that these partnerships are aligned with the hospital's goals and objectives and are beneficial for all parties involved.

1.28 Quality assurance, monitoring & safety

To ensure the quality and safety of the study, the research team will implement several measures for quality assurance, monitoring, and safety. These measures include adhering to ethical guidelines, ensuring data confidentiality and security, and mitigating risks and discomfort associated with participation in the study.

As this is a small-scale research project, there will not be any external committees overseeing the study. However, the research team will reassess this decision as the project proceeds and may seek external oversight if deemed necessary to ensure the quality and safety of the study.

1.29 Finance and resource use

This research project is currently in the exploration stage for external funding. We are targeting prominent grants like the Medical Research Future Fund (MRFF) to secure financial backing for the later phases of the project, which will involve design, implementation, and evaluation. At this initial stage, external funding is not yet essential for the project's progress.

In terms of internal funding, all researchers involved in this study receive compensation through salaries from their respective workplaces and organisations.

In particular, Amir Asadi who is currently a PhD candidate at the Australian National University (ANU), is supported by ANU's Higher Degree Research (HDR) Fee Merit Scholarship, University Research Scholarship, and the Florence McKenzie Supplementary Scholarship in a New Branch of Engineering.

As the research is in the data collection stage, no specific budget is required at this time. However, there may be potential costs associated with transcription services, which can be managed using the resources available at the Australian National University (ANU). The research team will explore cost-effective options to minimize expenses while ensuring the quality and integrity of the study.