Covigilant: Optimizing Digital Contact Tracing from End-User/Current Practice/Idealized-Solution perspectives.

A Proposal for the SFI Covid-19 Rapid Response Funding Call

Lero Technical Report: 2020-TR-05

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Section 1 – Summary

Lead Contact Details
Provide contact details for the academic lead on the project.

Team Lead Name: Dr. Jim Buckley

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Team Members and Collaborators
Provide the names and organisations of key members of your research team, collaborators or partners required to deliver the project.

1) Prof Derek O'Keeffe, Consultant Physician UHG / Professor MedTech NUIG
2) Prof Liam Glynn, GP / Consultant of General Practice, UL
3) Prof John Laffey, ICU Consultant UHG / Professor of Anaesthesia &Intensive Care Medicine, NUIG
4) Dr Bairbre McNicholas, Critical Care Physician, UHG, HSE
5) Dr Mike O'Callaghan, GP / Engineer, UL
6) Prof Brian Fitzgerald, Director Irish Software Research Centre Lero, UL
7) Prof Bashar Nuseibeh, Chief Scientist Irish Software Research Centre Lero, UL
8) Prof Ita Richardson, Principal Investigator, Lero, UL and volunteer Contact Tracer
9) Dr Jim Buckley, Principal Investigator Senior Lecturer, Lero UL
10) Dr Jane Walsh, Director of the mHealth Research Group, Behavioural Psychology
11) Dr Thomas Welsh, Irish Software Research Centre Lero, UL
12) Dr Kevin Johnson, Engineer, UL
13) Dr Andrew Simpkin, Statistician, NUIG
14) Dr Cristiano Storni, UX expert, Interaction Design Centre, UL
15) Dr Abdul Razzaq, Irish Software Research Centre Lero, UL

Project Summary
Provide a title and high-level summary of the project.

Project Title (max. 10 words): 10 words

COVIGILANT: Optimizing Digital Contact Tracing from End-User/Current Practice/Idealized-Solution perspectives.

Summary (max. 250 words):

The WHO has recommended Western countries apply the lessons learned by Asia in containing the spread of COVID-19: "Track, Test, Treat" [1]. These countries use manually-sourced data and location-tracking data from mobile devices to enable effective contact tracing. Currently Ireland's contact tracing strategy is moving from exclusively manual, to incorporate instantaneous, digital tracking: a more

optimum solution for containing the virus' spread [2,3]. This proposal focuses on instantaneous, digital tracing, through three parallel streams:

1] Identifying end-users' perceptions of digital contact tracing, via a large-scale public survey, coupled with focus-group studies. Analysis of these results will determine the relevant barriers/levers that the public consider when downloading a tracing app, towards optimally tailoring information campaigns, to promote engagement.

2] Developing a compare-and-contrast framework for analysis of existing contact tracing applications, and using it to review these applications, to identify best-of-breed practice. Results in this stream will inform modifications to the HSE's chosen application (TraceTogether) over time, resulting in increased levels of usability, adoption and effectiveness.

3] A blue-sky analysis towards an idealized contact tracing application. Here experts from the fields of health, user-experience and data analytics will explore design alternatives, targeted at developing evidence-based modifications of the HSE's chosen application.

Figure 1 illustrates how the team will aggregate these streams, providing a combined vision of optimized digital tracing. To do so, Lero brings together a team of leading international experts in software development, clinical medicine, empirical studies, behavioural science, mathematics, data security and privacy, user experience (UX) and digital health research.

References
1. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---16-march-2020
2. https://www.independent.ie/world-news/coronavirus/contact-tracing-big-move-to-reassign-public-service-workers-to-track-coronavirus-patients-movements-39050257.html
3. https://github.com/BDI-pathogens/covid-19_instant_tracing/blob/master/Manuscript%20-%20Modelling%20instantaneous%20digital%20contact%20tracing.pdf

[250 - not including references]

Timelines
Provide a start date and duration for the project. Note: The project must commence no later than XX/XX/2020.

What date can work on this project commence? 01/05/2020

What is the time frame for the work to be completed/solution to be delivered (from date of commencement)? Note: Projects proposing to deliver impact as rapidly as possible will be prioritised; solutions developed as part of projects must be operational and fully deployed within 6 months of project commencement; project awards should not extend beyond the end of 2020.

Initial results will be delivered after 3 months:

a) Analysis of the survey/focus groups on the public's perception of contact-tracing technology and isolation;

b) A compare-and-contrast framework, for comparing contact-tracing solutions;

c) A technical report on the four most popular, existing, open-source apps, based on that framework, and;

d) A "paper-prototype" idealized solution, based on expert analysis.

This early deadline is considered particularly important where the survey is concerned (stream 1), as results may direct the PR campaign to drive adoption of the HSE's chosen contact tracing application.

The study will employ an iterative design; for example refining and repeating the survey/focus group work, which will permit an evolving understanding of people's perceptions as they become familiar with the HSE app (stream 1).This will in turn permit further evaluation and reflection on the idealized app design (stream 3), as will an expanded compare-and-contrast analysis that encompasses more applications, as they become available (stream 2). *More importantly, it will enable a synthesis of the individual approaches proposed to produce an integrative systems report on best practice.* To accommodate this iteration. **Final expanded results will be delivered after 6 months.**

Total Budget (complete table in Section 4)

What is the estimated total budget to deliver the project?	€147,895

Section 2 – Problem & Solution

Problem

Describe the specific problem you will address. Why is it important now? How does this problem manifest? How is the effect of this problem measured? Provide concise and compelling evidence to substantiate any points.

Max. 250 words.

There are two problems addressed by this proposal:

- Deriving design insights towards the best possible contact tracing approach;
- Optimizing that approach for stakeholders' concerns; in particular, public stakeholders, with a view to increasing uptake.

In terms of 'best possible contact tracing', there are many (often contradictory) factors at play, making design difficult. For example, accurately determining people's GPS location is not always easy, making Bluetooth-discovery seem a more desirable, if battery-draining, alternative. Through assessment of existing offerings and a wealth of researcher experience, streams 2 and 3 will identify best-of-breed capabilities, to inform evolution of the HSE's chosen contact-tracing application over time. This is important because tracing will play a vital part in the longer-term solution, containing the virus after "Peak Covid-19", and building confidence in a society/economy trying to return to normality, before a vaccine or antibody treatment is available.

Addressing end-users' concerns will also be a difficult task, but the first step is identifying those concerns, as well as motivators to engage. This is the goal of stream 1. For example, for optimal containment, the HSE would like to identify people's virus-status and location. The public are likely to have concerns about the security and integrity of this sensitive data, but may well be willing to override those concerns, for a period, in the national interest. This research will permit a more in-depth understanding of psychological barriers and motivators to engage, thus permitting an evidence-informed approach to app design, and effective message-framing for public information campaigns.

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Solution

Describe the solution proposed to address the problem (described above). How will the solution address this problem? What is different/innovative about this approach in comparison to current approaches?

Max. 250 words.

This research group envisages that the project will inform decision makers on the desirable evolution of contact tracing applications going forward (both within the HSE and internationally), and inform them on public perceptions of contact tracing. Thus, the solution provided by this research is:

1] Detailed information on the public's perception regarding a host of contact-tracing concerns, from societal and isolation concerns (such as appropriate data-usage, data security, data privacy and data correctness) through to technical concerns (battery life, installation difficulties). This, in addition to age-

specific, focus group feedback, will inform app designers as they evolve applications, and the health service/advertising executives, as they tailor the information campaigns charged with driving continued uptake of those applications;

2] Identification of best-practices in other existing applications, and comparing those best practices to TraceTogether, thus identifying potential UX, societal, functional, data-security, data integrity-checking, data analysis and GDPR improvements; improvements that can then be triaged for incorporation into the Irish version of TraceTogether;

3] Identification of idealized best practice from a blue-skies perspective, integrating existing scientific knowledge with multidisciplinary expertise spanning medicine, psychology, software, security and UX, providing innovative, outside-the-box thinking, which will identify key factors required to create an effective contact tracing application.

Ultimately the three strands will be synthesised, providing a core evidence-base for the contact tracing application's development and evolution, thus ensuring a highly effective solution to contract tracing (see Figure 1). Additionally, we will make the outputs of the project freely available, to spread best-practice internationally;

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Section 3 – Impact

Impact

Describe the difference (qualitatively and quantitatively) your solution will make if successful.
Max. 250 words.

We anticipate that the solutions provided will:

1] Impact quantitatively in increasing the uptake of the app, towards greater coverage of contract tracing in the Irish population and;

2] Impact quantitatively in increasing the accuracy of contact tracing, thus allowing for more accurate targeting of to-be-tested individuals, and saving precious testing resources while getting more-timely, accurate information on the virus spread.

These are contributed to by the following ancillary impacts:

1.1] Impacting qualitatively in directing any information campaign associated with the uptake and usage of contract tracing apps, through the identification of barriers and levers that end users may perceive;

1.2] Impacting qualitatively in easing people's minds regarding the data security, data integrity and meaningful, appropriate use of their sensitive data;

2.1] Impacting qualitatively in providing a better understanding of the systems currently being offered (compare and contrast analysis) and of what is needed by the various stakeholder in the fight against COVID19 (stakeholders design requirements).

2.2] Impacting qualitatively in prioritizing functional and non-functional requirements for future evolutions of contact-tracing applications, to address end-users, health-practitioners and societal requirements.

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Feasibility

Describe why this solution will succeed. Is access to the necessary expertise, collaborators/partners available to ensure successful delivery of your solution? How does this proposed project build on the team expertise, prior work/data or other resources available? Have the necessary ethical/regulatory considerations been taken into account?
Max. 500 words.

A high-level, expert team has been formed with extensive experience across medical, software and data-analysis disciplines. Medical expertise is provided by practitioners including Prof O'Keeffe, Prof Glynn, Prof Laffey, Dr McNicholas and Dr O'Callaghan. Their professional competencies span intensive care, critical care, general medicine, medical technology, and general practice, cumulatively making them a rich source of domain knowledge for this project. Prof Glynn and Dr Walsh have multiple

previous collaborations in the areas of mHealth and connected health utilising HRB and European funding.

Prof Fitzgerald (Director Lero), Prof Richardson (Lero PI), Prof, Bashar Nuseibeh (Chief Scientist Lero) and Dr Buckley (Lero PI) bring extensive research coordination experience on the software side. They are experts in software process, medical device software-regulations, software requirements/security, and empirical studies respectively. Additionally, Dr Buckley worked as a systems analyst at the HSE for a number of years and Prof Richardson already volunteers at a HSE contact tracing centre, providing hugely valuable contextual insight. They bring a team with highly relevant capabilities and expertise in UX (Dr Storni), data analysis (Dr Simpkin), data security and privacy (Dr Welsh) software evolution (Dr Razzaq), and medical systems (Dr Johnson).

Beyond this initial profiling though, the group brings a wealth of high-impact, project-specific expertise and resources to the table. For example, two of this group (Prof O Keeffe and Dr Buckley) recently advised the World Health Organisation (WHO) & national Covid-19 advisory group, the latter set up to advise the HSE on the best contact-tracing solutions to contain the virus. Likewise, Prof Glynn can utilize his ULEARN-GP [4] network to disseminate the survey proposed here. He can also use multiple online and social media platforms, such as his and Dr O'Callaghan's #COVIDWATCHIRL project on Twitter, which is generating nearly 50,000 impressions daily.

Project management will also feed into the successful delivery of this project. Core to that is a commitment by the group to fortnightly review sessions (see Figure 1). The purpose of those sessions will be to coordinate the work, monitor and ensure progress, allow all participants to feed into all streams of the proposal and allow the aggregation of all three streams into an integrated whole, in the second half of the project.

The proposal will, at all stages, apply best-practice adherence to GDPR Regulations and to the ethical regulations/guidelines of the relevant health service or university authority.

All personnel required to carry out the research work are either included in the team members listed above (and thus already available) or have already been identified and have given verbal assurances regarding their availability for this project.

Finally, this project can be completed through working-from-home, in the event of a prolonged campus closure, due to Covid-19.

4. O'Regan, A., Hayes, P., O'Connor, R. Glynn LG. The University of Limerick Education and Research Network for General Practice (ULEARN-GP): practice characteristics and general practitioner perspectives. BMC Fam Pract 21, 25 (2020). https://doi.org/10.1186/s12875-020-1100-y

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Section 4 – Resources and Plan

Project Plan

Provide a plan of work to be undertaken under this award, including clear timelines, milestones and deliverables.
Max. 500 words.

Stream 1: Public Survey (Prof Liam Glynn)
Work-package 1.1: Design of topic guide for focus groups and ethical approval/dissemination of survey.
Deliverable: Reviewed topic guide/Disseminated survey (on Qualtrics online platform).
Delivery Date: +1 month;

Work-package 1.2: Capture of survey data. Parallel focus groups with age-specific cohorts.
Deliverable: Survey and focus group data.
Delivery Date: +1.5 months;

Work-package 1.3: Analysis/Presentation of survey results. Transcription/Framework analysis of focus group data.
Deliverable: Report detailing initial findings.
Delivery Date: +3 months;

Work-package 1.4: Update of topic guide and survey design (to consider the existing HSE app), ethical approval and dissemination.
Deliverable: Revised topic guide and disseminated updated survey (again on Qualtrics).
Delivery Date: +4 months;

Work-package 1.5: Capture of survey data. Parallel focus groups with age-specific cohorts.
Deliverable: Survey and focus group data.
Delivery Date: +4.5 months;

Work-package 1.6: Analysis/Presentation of updated survey results. Transcription/Framework analysis of focus group data.
Deliverable: Report detailing updated findings, integrating with stream 2, 3 reports.
Delivery Date: +6 months.

Stream 2: Compare-and-Contrast of Existing Apps (Dr Jim Buckley)
Work-package 2.1: Critical reflection on the relevant criteria for evaluation of apps.
Deliverable: An initial evaluation framework for comparison, including societal characteristics like data security and regulations.
Delivery Date: +1.5 months;

Work-package 2.2: Application of the provisional framework against several existing tracing applications.
Deliverable: A refined evaluation framework.
Delivery Date: +2 months;

Work-package 2.3: Analysis of 4 existing contact tracing apps and their relative merits/limitations.
Deliverable: Report detailing findings across this set of apps, based on the refined framework.
Delivery Date: +3 months;

Work-package 2.4: Refinement of the framework/Identification of a fuller set of apps.
Deliverable: Refined framework and a fuller population of apps.
Delivery Date: +3.5 months;

Work-package 2.5: Analysis of these contact tracing apps with the refined framework, identifying their relative merits/limitations.
Deliverable: Technical report detailing findings across this set of apps.
Delivery Date: +5 months;

Work-package 2.6: Analysis and presentation of updated compare-and-contrast results.
Deliverable: Report detailing the stream's findings, integrated with reports from streams 1 and 3.
Delivery Date: +6 months;

Stream 3: Ideal Digital Contract Tracing Apps (IDCTA) (Prof Derek O Keeffe)
Work-package 3.1: Perspectives identification.
Deliverable: Report detailing the multiple aspects (Clinical, Technical, UX, and Societal) that need to be considered in an IDTCA.
Delivery Date: +1 month;

Work-package 3.2: Clinical considerations evaluation.
Deliverable: Report outlining the Clinical Issues.
Delivery Date: +1.5 months;

Work-package 3.3: Technical & UX considerations evaluation.
Deliverable: Report outlining the Technical & UX issues.
Delivery Date: +2 months;

Work-package 3.4: Societal considerations evaluation.
Deliverable: Report outlining the Societal (e.g. privacy, security and regulation) issues.
Delivery Date: +2.5 months;

Work-package 3.5: Presentation of results.
Deliverable: Summary report on IDCTA.
Delivery Date: +3 months;

Work-package 3.7: Reflection on, and refinement of, the individual considerations.
Deliverable: Updated reports on idealized clinical, technical and societal considerations, as issues from WPs 3.2-3.4 evolve.

Delivery Date: +4.5 months;
Work-package 3.6: Updated results presentation.
Deliverable: Report outlining updated summary findings in the light of contributions from streams 1 and 3.
Delivery Date: +6 months;
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Budget (Academic Applicants)

Provide an overview of the resources required to complete this project (direct costs only). Eligible costs include staff costs, materials and consumables, and equipment (if appropriately justified and feasible to procure within the timeframe of the award).

Staff	€138,895
Equipment	N/A
Materials/Consumables	€3000
Travel	€6,000
TOTAL	**147,895**
	(excluding SFI overheads)

Budget (Non-Academic Applicants)

Provide an overview of the resources required to complete this project (direct costs only). Eligible costs include staff costs, materials and consumables, and equipment (if appropriately justified and feasible to procure within the timeframe of the award).

Staff	€N/A
Equipment	€N/A
Materials/Consumables	€N/A
Travel	€N/A
TOTAL	**€N/A**

Budget Justification

Provide high-level justification for the requested costs.

Max. 250 words

Stream 1 will be resourced in the form of one Research Fellow and one Research Assistant for the six months. They will work as a team with the Research Fellow focusing predominantly on the survey, while guiding the day-to-day work of the Research Assistant on the focus groups. Budget allowance here is made for transcription of the focus-group data preserving the efforts of the two researchers for design, analysis and reporting. An additional 2K is requested to raise awareness of/elicit participation in the survey.

Stream 2 will be resourced in the form of 2.5 Post Doctoral Researchers for the six months. One, with experience in systems security, will be charged with the compare-and-contrast work on societal concerns. One, with experience in software analysis, will be charged with technical considerations. Finally the stream will share a UX researcher with stream 3, and they will focus on the user experience when interacting with the existing apps.

That shared UX Post Doctoral Researcher, will contribute to the more user-experience aspects of stream 3. In addition, that stream (3) will have a research assistant for 6 months, to contribute to the clinical & societal aspects. 1K has been budgeted for Patient Public Involvement (PPI) through the NUI Galway PPI Ignite program, as we believe that it is crucial to get the input from our PPI community into the ideal considerations of an IDCTA system.

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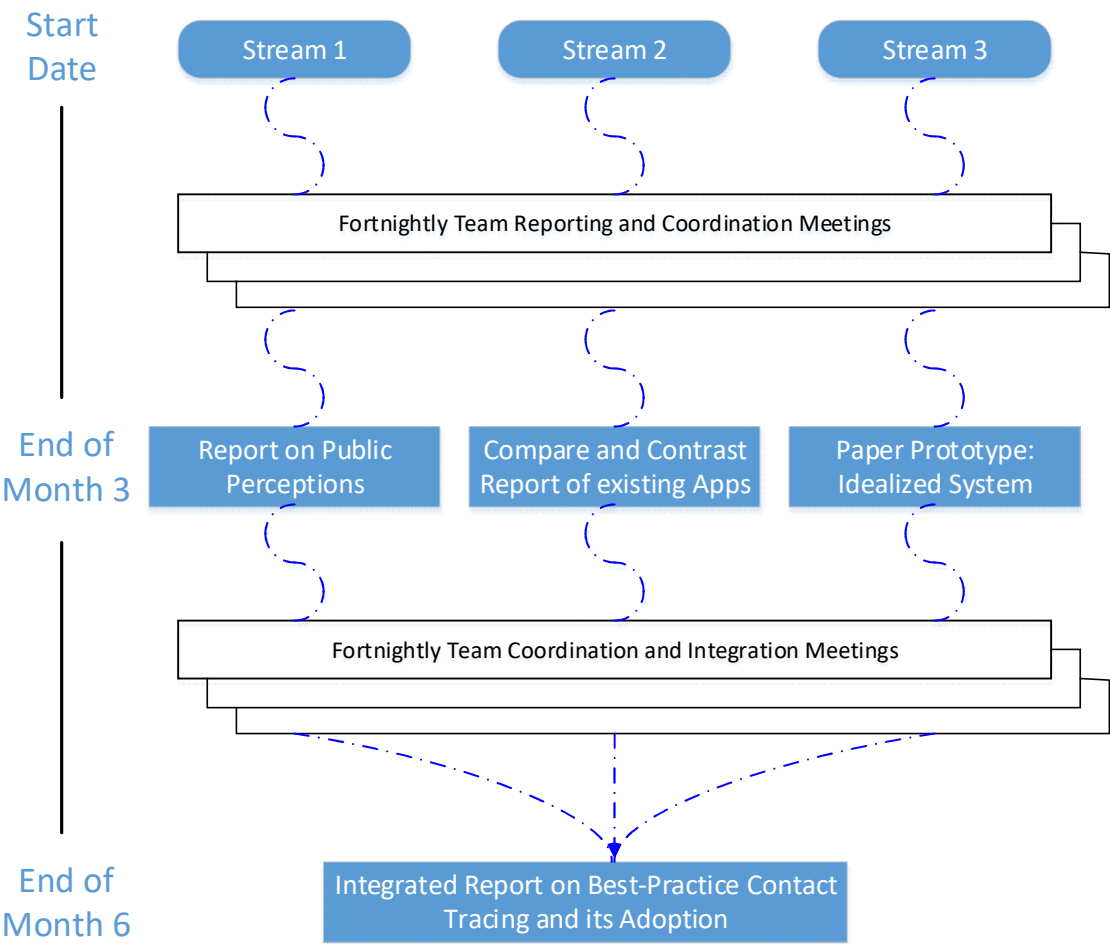**APPENDIX 1 – Diagrams/Graphics/Tables (max. 3 pages)**

Start Date

Stream 1 Stream 2 Stream 3

Fortnightly Team Reporting and Coordination Meetings

End of Month 3

| Report on Public Perceptions | Compare and Contrast Report of existing Apps | Paper Prototype: Idealized System |

Fortnightly Team Coordination and Integration Meetings

End of Month 6

Integrated Report on Best-Practice Contact Tracing and its Adoption

Figure 1: Coordination and Integration of Covigilant Streams
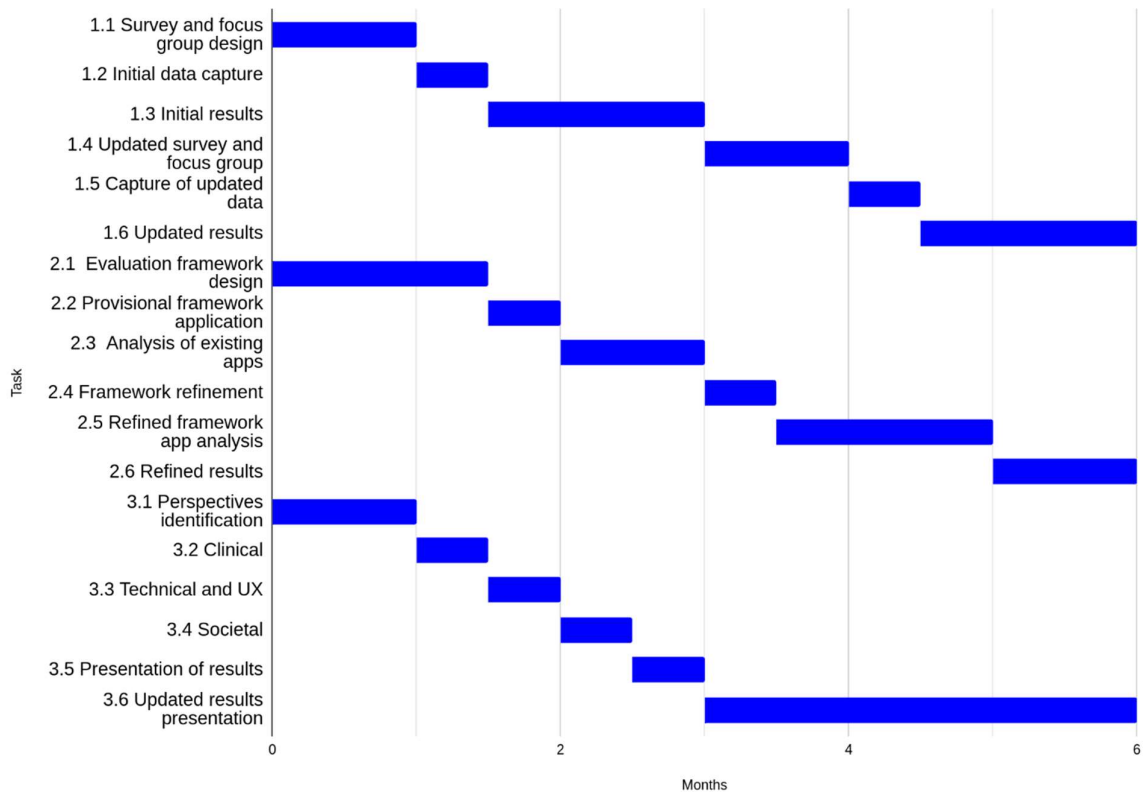
Figure 2: Proposed Gantt Chart for Covigilant

Risk Register

Risk	Probability	Impact	Mitigation
Temporary Loss of key staff	High	Medium	Overlapping responsibilities, agile approach
Permanent Loss of key staff	Low	High	Overlapping responsibilities
Project data loss or security breach	Medium	High	Heavy use of shared, secure, cloud-based storage, strong authentication employed, data risk assessment
Survey personal data exposure	Low	High	Anonymised data using known trusted survey software
Resource failure	Medium	Low	Minimal specialist technology is required