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Abbreviations

AF	atrial fibrillation
ECG	electrocardiogram
CASP	Critical Appraisal Skills Program
HTA	health technology assessment
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RAMESES	Realist And Meta-narrative Evidence Syntheses: Evolving Standards
RM	remote monitoring

This protocol for a realist review has been developed as an addendum to the main health technology assessment (HTA) protocol.[1] The protocol has been drafted ensuring attention to elements described in the Realist And Meta-narrative Evidence Syntheses: Evolving Standards (RAMESES II) publication standards, as appropriate.[2] The protocol is registered with PROSPERO (Submitted, registration number not yet received).

Realist Review

Background

Remote monitoring (RM) programs (also known as remote patient monitoring or remote patient management) offer a compelling alternative and supplement to traditional face-to-face health care for people in Canada with chronic cardiac conditions. The current base of trials evaluating RM programs continues to grow but the type of evidence that these trials generate to inform design decisions at the local level is often too general to be especially useful. This not only hampers local service design but also potentially harms patients and increases system-wide costs by failing to realize the potential of different RM techniques for different contexts.[3,4]

This situation should not, however, lead to the rejection of RM for the large population of people in Canada with chronic cardiac conditions. Trials over the last 20 years continue to indicate that RM programs for cardiac conditions generally work.[3,5,6] For example, programs for patients with a variety of chronic cardiac conditions have been shown to be effective by randomized trials and meta-analyses at reducing adverse events (notably hospitalization) and improving quality of life (for example: Clark et al., 2007; Neubeck et al., 2009; Jin et al., 2019)[7-9] and have, for over a decade, been found in systematic reviews to have comparable effects to site-based programs (e.g., Anderson et al., 2017; Clark et al., 2007).[9,10] That said, beyond these positive effects, the actual components of the RM programs remain poorly described in the vast majority of published trials[3,11] and meta-analyses.[12] Reviewing the body of RM programs for heart failure, this tendency has been termed to contribute to a policy-maker's "nightmare" due to the evidence being vast, fragmented, heterogeneous, of variable quality, and with no clear answers to the question of what technologies, supported by what service infrastructure, to provide for whom.

Details of which types of programs work best in different settings and why are not mere statistical irrelevancies but actually convey vital knowledge for health services design for patients with chronic cardiac conditions.[13] For example: a systematic review of programs for cardiac rehabilitation identified that on-site programs of up to 1,000 hours of patient contact had similar benefits for morbidity as compared to RM programs with only 10 hours of patient contact.[14] Further, the negative effect of vague intervention descriptions is compounded by the comparably high diversity of RM programs in terms of target populations and components — and the inadequacy of systematic reviews to acknowledge and explore these variations.[3,6,12,15,16] Those charged with designing or adapting RM programs for specific settings lack an evidence base that is sufficiently specific to inform their decisions.[3] More research is still needed to unpack which components of RM programs matter most in different contexts for different populations.

Study Design

To examine what works for whom, when, and why concerning RM programs for treatment and support of chronic cardiac conditions, a realist review will be conducted.[17] Realist reviews are appropriate for assessing how and why various aspects of complex

interventions work, for whom, in what contexts, and to what extent.[17] Knowledge from a realist review provides useful and nuanced guidance for decision-makers in different contexts to inform local service design decisions.[17] This can, for example, better ensure that interventions to promote health and self-management of chronic disease have more consistent benefits across different patients and settings.[13] Accordingly, findings from realist reviews supplement and complement evidence from other methods (notably randomized trials and meta-analyses) – which provide broad but less specific and useful evidence for decision-makers.[3,4] While such methods convey that a health services intervention may generally work,[5] the generic-nature of this evidence fails to convey the influence on intervention outcomes of where the program is provided (context), how it influences outcomes (mechanisms), and what about the intervention promotes effectiveness (components).[18]

As an approach, realist reviews are grounded in the realist evaluation method,[19] which has its roots in critical realist philosophy[20] and complexity-driven methods and theory.[21] These approaches share a rejection of research and theory that assume or imply that interventions (such as policies, programs, or strategies) involving behaviours influence outcomes in orderly, linear, law-like ways (e.g., intervention A leads to benefit B in population C).[22] Instead, causality between the intervention and its effects is seen to be contingent — resulting from the effects of multiple factors interacting, for example, related to patients, programs, and places, to generate changes in outcomes.[23] Under this contingent approach to causality, even small changes in one element of intervention design (such as a component or subcomponent; or a characteristic of context) could generate large changes in a primary outcome.[24]

Realist approaches to evaluation and review have profound implications for how health service interventions are conceptualized and researched.[25] Accordingly, realist reviews focus less on making a judgment of the truth of a linear causal relation between two single variables (i.e., does x cause y?), but more on the complex ways in which x can cause y under conditions a, b, and so on.[17] As such, realist review methods can be used to tease out the mechanisms and contextual factors that enable interventions to lead to desired outcomes and can identify key circumstances under which a complex intervention can fail or lead to unintended outcomes.[17] This generative approach accounts for why interventions that ostensibly have the same components of design can have markedly different outcomes in different contexts[19]—or, in randomized trials of disease management interventions, why the benefits of affirmative trials are often not replicated or scaled over time in different trials.[5] Realist approaches view such variations as inevitable consequences of complexity[26] rather than weaknesses in interventions or study design, related to intervention design, provision, implementation, or fidelity.[11]

Realist review aligns well with RM programs for chronic cardiac conditions because these interventions can be termed *complex interventions* due to the number of and interactions between intervention components, including: monitoring program components, the context(s) in which programs are provided, the technology platform(s) used, the theory guiding design and content, and the frequency and intensity of monitoring.[26,27] Further, program components can be conceived to be multi-faceted and interactive rather than singular and isolated[24] — with intervention effects understood to be generated from interactions not only between these components but also between these components and aspects of patients and the context of the intervention.[25,26] As such, realist approaches are highly suited to examining and explaining the effects of RM programs for chronic cardiac conditions.[28]

Yet crucially, the existing evidence base has tended to leave the modifying influence of program components, context, and mechanisms unexplored and unacknowledged. See for example: in cardiac rehabilitation,[29,30] atrial fibrillation (AF),[31] and heart failure.[5,32-34] This neglects harms evidence quality,[11] reduces its usefulness to decision-makers[15,16,35] and, ultimately, fails to fully realize the benefits to cardiac patients in different settings of these promising RM programs.[13]

Specifically, therefore, this realist review will seek to explicate how context moderates the mechanisms of interventions to influence outcomes. Accordingly, the review will assess why RM programs for chronic cardiac conditions do or do not work in different contexts or circumstances, by different stakeholders, with different patient populations, and for different purposes. This will be done by exploring the influence on intervention effects and effectiveness of aspects and interactions of intervention mechanisms, with a particular focus on how mechanisms are influenced by aspects of intervention contexts, components, and recipients (including patient characteristics) in published accounts of interventions for the most common chronic cardiac conditions addressed by health services, these being: heart failure, cardiac rehabilitation, AF, and hypertension.

Research Question

To inform decisions about how RM programs can work most effectively, the research question underlying this review is:

> What aspects (e.g., duration and frequency of monitoring, what is monitored and how) of RM programs for chronic cardiac conditions or post-cardiac events influence patient and system-level outcomes, for whom, in what circumstances, to what extent, and why?

Research Methods

This realist review will primarily follow the realist review methods of Pawson (2005),[17] drawing on an interpretive approach to synthesis[36] which has been used successfully in a past realist review to identify the influence of mechanisms and context on remote and provider-based heart failure disease management interventions.[34,37] These approaches mirror those of systematic reviews of intervention effects (e.g., incorporating systematic and comprehensive search, quality appraisal, and synthesis of findings), with some modifications to ensure efficiency while accounting for scoping work that has already been conducted and a defined HTA timeline while reflecting the realist underpinning of the approach. While the steps are described sequentially, in practice they will be overlapping and iterative, responding to results as they emerge. The final results will be reported using the RAMESES II guidelines[2] for the reporting of realist evaluations and will form one part of the broader HTA report.

The primary goal of the realist review is to consider how the effects of RM programs are influenced by aspects of context and intervention components via the influence of these key factors on perceived or actual intervention mechanisms. The realist synthesis will identify studies using a comprehensive and detailed systematic search of published accounts of the mechanisms of RM programs for the most common programs offered for management, behavioural change, and self-care of cardiac conditions. Programs reviewed will be for patients with a primary diagnosis (and reason for program referral) for heart failure, cardiac rehabilitation, AF, and hypertension but may involve patients, family caregivers (e.g., partners or significant others), and health professionals. To explore the influence of program mechanisms with aspects of context, components, and patient characteristics on outcomes,

as with other approaches to theory-building from qualitative data, the approach will generate findings that move beyond description to present a new interpretation of published literature — which can offer additional insight into the phenomena of RM programs[17] (for example Clark et al., 2016).[37]

The findings of the review will be based on a literature search and responses to the CADTH Programs for RM Survey.[38] Reflecting the RAMESES II publication standards for realist synthesis,[2] the search approach will recognize that the quality of a search in a realist synthesis depends on the "relevance and robustness of particular data for the purposes of answering a specific question."[2] Relevance refers to the ability of data to contribute to the development of testing of theory around the research question,[2] while rigour refers to the credibility and trustworthiness of these data.[2] Accordingly, the search will seek data that could be of reasonable use to theory-building around program mechanisms — extending to those from qualitative and mixed-methods studies, quantitative-process data and grey literature, including program reports. All could conceivably contribute to "different ways of identifying and elucidating program theories."[2] As the number of documents anticipated to be identified in the search is expected to be large, selection and appraisal stages will be done in parallel with the synthesis stage.[2]

Literature Search Methods

The search for literature to support this realist review will be performed by a research information specialist using a peer-reviewed search strategy according to the Peer Review of Electronic Search Strategies checklist (PRESS).[39] The complete search strategy is presented in Appendix 1.

Published literature will be identified by searching the following bibliographic databases: MEDLINE All (1946–) via Ovid, Embase (1974–) via Ovid, APA PsycINFO (1806–) via Ovid, the Cumulative Index to Nursing and Allied Health Literature (CINAHL) via EBSCO, and Scopus. The search strategy will be comprised of both controlled vocabularies, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. The main search concepts will include chronic cardiac conditions, cardiac rehabilitation, and RM.

Clinical trials registries will be searched: the US National Institutes of Health's clinicaltrials.gov, WHO's International Clinical Trials Registry Platform search portal, Health Canada's Clinical Trials Database, and the European Union Clinical Trials Register.

No filters will be applied to limit the retrieval by study type. The search will be limited to English and French language documents published after January 1, 2010. Conference abstracts will be excluded from the search results.

The initial search will be completed in autumn 2020. Regular alerts will update the search until the publication of the final report. The clinical trials registries search will be updated prior to the completion of the stakeholder feedback period. Studies meeting the selection criteria of the review and identified in the alerts prior to the completion of the stakeholder feedback period will be incorporated into the analysis of the final report. Any studies that were identified after the stakeholder feedback period will be described in the discussion, with a focus on comparing the results of these new studies with the results of the analysis conducted for this report.

Grey literature (literature that is not commercially published) will be identified by searching sources listed in relevant sections of the Grey Matters: A Practical Tool For Searching Health-Related Grey Literature checklist (https://www.cadth.ca/grey-matters),[40] which

includes the websites of regulatory agencies, HTA agencies, clinical guideline repositories, systematic review repositories, patient-related groups, and professional associations. Google will be used to search for additional Internet-based materials. See Appendix 1 for more information on the grey literature search strategy.

Selection and Eligibility Criteria

The study eligibility criteria can be found in Table1.

Table 1: Inclusion Criteria for Information Screening using SPIDER

Sample	Adults persons living with a chronic cardiac condition (as defined as physician-confirmed diagnosis of: heart failure, hypertension, and AF) or post-cardiac event (i.e., heart attack, cardiac surgery, heart transplant, or angioplasty in cardiac rehabilitation or similar secondary prevention disease management program); persons who care for those living with a chronic cardiac condition or post-cardiac event (e.g., partners, family, health care providers).
Phenomena of interest	Perceived or actual mechanisms of RM programs as defined as: formal RM offered by a health care organization, including programs of both no pre-specified duration and pre-specified duration set in primary, home, tertiary, community, or long-term care based intervention/service) in rural, remote, and urban areas.
Design	Studies containing data or themes, which could be reasonably interpreted as relating to program mechanisms.
Evaluation	Perspectives, experiences, or program-related data for people living with a chronic cardiac condition or post-cardiac event and who engaged with RM programs [a], and of those involved in their care.
Research type	Qualitative, mixed-method, or quantitative studies reporting primary data or dedicated themes extractable for chronic cardiac study populations reported in English.

[a] For the management of patients with relevant cardiovascular conditions, not diagnosis or detection of the cardiovascular conditions.

The review will not include studies published before January 1, 2010; and will extend to grey literature and program evaluations. Date restrictions may be imposed during the review should the volume of studies identified be judged to be excessively large.

Exclusion criteria:

- Studies not meeting the inclusion criteria outlined in Table 1
- Studies which do not contain data extractable specifically for chronic cardiac conditions or post-cardiac events
- Studies addressing single, one-off, or ad hoc RM techniques
- Studies addressing hypertension associated with pregnancy

The approach to mechanisms proposed is important because mechanisms are defined poorly, narrowly, or not at all in many past realist reviews,[41] but nevertheless, serve the vital explanatory function of accounting for why particular programs have the effects they do. In short, mechanisms "explain why the relationships come about…(and) establish what goes on in the system that connects its various inputs and outputs."[41] This definition reflects Pawson and Tilley's (1997)[19] original program-focused approach in which "Mechanisms describe what it is about programs and interventions that bring about any effects… as the workings of a clock (mechanisms) cannot be seen but drive the patterned movements of the hands."[19] As such, in this review, mechanisms will be defined as referring to the "...underlying entities, processes, or...structures which operate in particular contexts to generate outcomes of interest."[42]

This definition of mechanisms is inclusive, credible (reflecting past approaches to defining mechanisms),[42] and ultimately useful. In short, it provides a fruitful basis for identifying how RM programs could be adapted for different settings. It is not, however, straightforward in that mechanisms of programs may not be directly observable (though they can be inferred),[42] not readily measurable (though they can be captured via qualitative data), or objective (though they can be perceived).[18] Further, in health services interventions, research into mechanisms remains rudimentary and challenging — with mechanisms being defined, conceived, and researched in many different often vague ways — or lacking in any systematic definition at all.[18] That said, the presence and influence of mechanisms on outcomes can be inferred from both dedicated realist evaluations (i.e., studies collecting primary data using variations of realist evaluation) and studies using other methods that contain qualitative or quantitative data on mechanisms,[2] including studies of mechanisms and context in health services for cardiac conditions.[37]

For many years, systematic reviews demonstrated that context was comparatively neglected in published accounts of realist evaluations.[42] This is a major weakness because the moderating effects of context on mechanisms is a core tenet of realist evaluation[19] and do appear to influence outcomes and mechanisms in health service programs for cardiac conditions.[34] Given the relatively small number of existing published realist evaluations, it is unrealistic to identify clearly delineated, almost mathematical context-mechanism-outcome synergies as envisaged by some theorists[41] working in realist evaluation. However, as with mechanisms, the influence of context on mechanisms can be inferred for complex interventions for cardiac conditions from realist evaluations, qualitative, quantitative, and mixed-method studies,[2] (Strachan et al., 2014).[34] As such the review search will focus on published accounts of mechanisms but in the identified studies explore instances in which context has been found to moderate these mechanisms.

Screening and Selecting Studies for Inclusion

Due to the high number of articles the search is anticipated to identify during the preliminary search stage (level 1), four reviewers working in two dyads will independently screen titles and abstracts in DistillerSR[43] against the pre-determined inclusion criteria (Table 1). The DistillerAI tool will also be used during level 1 screening to identify studies earlier in the screening process which are most likely to meet the inclusion criteria[44] and act as an additional screener to review references and check for errors. In testing in 10 systematic reviews (including non-pharmacological therapies), this tool was found to be sufficiently accurate and sensitive in screening procedures.[44] If the reviewers cannot judge relevancy from the titles and abstracts alone, full-text copies of articles will be obtained for more detailed screening (level 2). The reviewers in each dyad will then compare their chosen included and excluded studies; disagreements will be recorded and discussed with a fifth reviewer (a project leader) until a consensus is reached on selection. The study selection process will be presented in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[45] flowchart which will be generated in DistillerSR.[43] A list of included studies and those excluded after full-text screening with reasons will be provided.

A pilot exercise will be undertaken between the four reviewers to test the screening procedures and inclusion criteria with a cohort of five papers randomly selected from the Perspectives and Experiences Review of the larger HTA. A project leader will check the accuracy and consistency of the reviewers' screening and selection decisions. Feedback will be provided to reviewers and criteria and procedures will be amended as necessary. If necessary, additional pilot exercises utilizing five randomly selected papers will be

conducted and the process described above will be repeated until consistency among reviewers is achieved.

Data Extraction

Data extraction will be performed by the project leaders. For each study included in the review (from levels 1 and 2), one project leader will perform data extraction using standardized data extraction templates within DistillerSR.[43] For each included study, the second project leader will check the data extraction for completeness and accuracy. Omissions or disagreements will be recorded and discussed by the two project leaders and resolved by consensus. A panel of study experts across the cardiac conditions will be consulted in instances in which disagreements in data extraction cannot be resolved.

A data extraction template will be developed by one project leader within DistillerSR,[43] using a form developed for a previously funded realist review of disease management interventions for heart failure[18] as a guide. Where possible categorical fields will be used. The extraction template will be pilot tested using three randomly selected articles initially by the second project leader. Amendments from the pilot extraction stage will be made before commencing extraction for the full review.

For each included study, the following details will be extracted. Missing data will be noted.

- Publication title
- First author
- Full citation
- Main focus (heart failure, AF, hypertension, cardiac rehabilitation)
- Program recipient(s) (patient, caregiver, health professional, other)
- Method category (qualitative, quantitative, mixed, unclear)
- Qualitative (general, grounded theory, ethnography, critical, experiential, other)
- Quantitative (survey, trial, case control, cohort, other)
- Country of setting
- Inclusion criteria
- Population studied (inpatient, outpatient, community)
- Sex of sample (m/f)
- Mean age
- Recruitment method (volunteer, snowball, purposive, random, other)
- Data collection method (face-to-face interview, telephone interview, online interview, focus group, measurement, other)
- RM components (telemonitoring, home telehealth, data transfer, other)
- RM adjuncts (home-visit, clinical-visit, none)
- Data transfer (ECG, blood pressure, heart rate, body weight).

Concerning mechanisms, verbatim data, and themes will be cut and pasted from published studies into a primary data extraction matrix (DistillerSR)[43] with main identified contextual effects. For qualitative studies, data will be derived from themes or data relating to

mechanisms, while for quantitative or mixed-method studies, primary numerical data will be extracted from each study that is interpreted as giving insight into underlying mechanisms. In deciding whether data or themes are pertinent to the synthesis, project leaders will consider if the identified data offer an explanatory account of what is going on between the intervention(s) and its outcomes (stage I synthesis below). As such, data or themes will not necessarily be specifically labelled as pertaining to mechanisms in study reports but must be reasonably interpreted as pertaining to mechanisms of RM aspects of interventions for cardiac conditions to be included. Authors will be contacted (via emails in included and/or recent publications) to attain any missing data from study reports and the existence of any additional data or themes on mechanisms.

Fields may be modified, added, or deleted during data extraction to aid with the data analysis and assessment of transferability. Study and participant characteristics will be reported in tables and summarized narratively.

Critical Appraisal

Realist reviews should report the overall strengths of evidence supporting the explanatory insights that emerged.[2] Consequently, for each included study, to assess the merits of the research, the project leaders will appraise the quality of included studies using the appropriate quality appraisal tools from the Centre for Evidence-Based Medicine (University of Oxford) for qualitative and quantitative studies (Critical Appraisal Skills Program [CASP])[46] and the Mixed Method Appraisal Tool (MMAT) for mixed-method studies.[47] These tools are narrative-based (i.e., they do not compute a quality score). The quality of each study will be categorized independently as low, moderate, or high by the primary and secondary project leaders using the appropriate CASP tool of quality appraisal with project leaders resolving disagreements until a consensus is reached. Justification(s) for the critical appraisal will be noted in narrative form. The papers will be screened against quality criteria but not excluded based on quality, given long and ongoing disagreement over the use of quality criteria to appraise research.[48] Each project leader will act as a primary quality appraiser for half of the finalized cohort of included studies, acting as the second check for the other project leader. Disagreements in critical appraisal will be recorded, discussed, and resolved by consensus.

The results of the critical appraisal will be reported as a narrative summary and in a Table of Critical Appraisal documenting key study strengths and weaknesses for each of the included studies.

Data Analysis and Synthesis

Data synthesis will be carried out by the two project leaders, who will each undertake the synthesis of findings from half of the final cohort of included papers. The approach to analysis and synthesis to be used has been employed in a previously funded realist review into the mechanisms of disease management interventions for heart failure.[37] As was the case with this past review, qualitative and quantitative data are useful in understanding mechanisms of RM interventions. Consequently, both types of data will be synthesized. Though necessary, this is challenging because the synthesis of qualitative and quantitative research together remains relatively new; also mechanisms usually have to be inferred or interpreted from these data as opposed to being clearly labelled in studies.[42] To address these challenges, a combination of established approaches to identify main mechanisms will be used: the realist-synthesis approach[17] and meta-ethnography.[36]

Stage one

Each project leader will read each study in the final cohort to identify or infer the main mechanisms in the studies and extract data as described above. Two types of data will be extracted: qualitative data relating to mechanisms and quantitative data that yield clues of underlying mechanisms.[49] *For qualitative studies*, data will be derived from themes or data relating to mechanisms. As per guidance for the systematic review of mechanisms, in a manner similar to meta-synthesis,[36] the project leader will extract the same words and terms as the original studies as much as is possible when extracting these subjective data around mechanisms.[17] *For quantitative studies*, primary numerical data will be extracted from each study that is interpreted as giving insights into underlying mechanisms with a narrative account of what these data refer to. In qualitative and quantitative studies, data and themes will be extracted related to mechanisms irrespective of whether these data are self-identified by authors to constitute mechanisms. This is normal in realist evaluation when mechanisms are theorized or inferred from data.[50]

Stage two (second-order coding)

Each project leader will examine the initial mechanisms and study descriptions identified during stage one, and using the meta-ethnography method, will meet to discuss emerging mechanisms from the stage one synthesis, then using conceptual mindmaps[51] translate and synthesize both the qualitative and quantitative data into a core set of qualitative data about the nature of the main mechanisms and how aspects of context and study design influence these mechanisms (recorded in Matrix 1). Hence, as per meta-ethnography,[36] data from different types of studies are triangulated and interpretations will be applied to the extracted data. Higher-order concepts will be identified as codes through comparison of mechanisms found in original studies that will be reinterpreted in the context of the other studies. The approach to theory development will be discursive with emerging themes and theorizations discussed extensively and resolved by consensus.

A matrix (Matrix 2) will be used to organize data on mechanisms and study details for this stage; separate sections will record mechanisms linked to key factors, such as, but not restricted to sex, age, and disease type or severity. The project leaders will analyze Matrix 2 independently and then discuss the analyses in consultation with the panel of experts. This will support the discussion of emerging results with knowledge users, and garner additional and possible alternative interpretations of the data.

Stage three (synthesis)

As with Noblit and Hare (1988),[36] the project leaders will generate the final synthesis account with an interpretive analysis[52] of Matrix 2 to generate an account of the main mechanisms acting in each type of self-care intervention and a description of how each is affected by context and populations. These interpretations will be collated in the final report.

Results and conclusions will take the form of caveats and considerations for those involved in the delivery of RM programs, such as "'remember A', 'beware of B', 'take care of C', 'D can result in both E and F', 'Gs and Hs are likely to interpret I quite differently', 'if you try J make sure that K, L, and M have also been considered.'"[17]

Rigour and Methodological Uniformity

While the data on mechanisms are heterogeneous and potentially difficult to identify, meta-ethnography has also been used to identify mechanisms using primary qualitative and quantitative data[53] and is well suited to examining the mechanisms of interventions for cardiac conditions — an effort for which literature is not primarily grounded in the social science.[18]

Panel of Experts

To support the project team, a panel of international experts on cardiac conditions will provide expert input to the review — notably providing consultation in regard to RM for different kinds of cardiac conditions. The panel will include:

- Associate Professor Julie Redfern (University of Western Sydney; RM in cardiac rehabilitation/secondary prevention/hypotension)
- Dr. Liz Sturgiss (Monash University; RM in primary care)
- Professor Lis Neubeck (Napier University; RM in AF)
- Professor David R. Thompson (Queens University, Belfast; RM in heart failure, cardiac rehabilitation, secondary prevention)
- Dr. Chantal F. Ski (Queens University, Belfast; RM in heart failure, hypotension)
- Professor Kay Currie (Glasgow Caledonian University; RM in cardiac rehabilitation, secondary prevention).

Input from these experts will be sought for the design of data extraction forms, key papers for screening, disagreements over inclusion, and recommendations from the review for RM in clinical practice for discrete cardiac disease populations and settings.

Final Reporting

The final report will be written using the appropriate RAMESES II reporting standards for realist review,[2] with study inclusion documented using PRISMA recommendations.[45]

Protocol Amendments

If amendments are required at any time during the study, reasons for changes will be recorded in a study file and subsequently reported within the final study report. If necessary, a rescreening of the previous literature search or an updated literature search will be performed to capture additional data, according to the amendments.

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Appendix 1: Literature Search Strategy

Realist Literature Search

OVERVIEW	
Interface:	Ovid
Databases:	MEDLINE All (1946-present) Embase (1974-present) APA PsycINFO (1806-present) **Note:** Subject headings have been customized for each database. Duplicates between databases were removed in Ovid.
Date of Search:	Autumn 2020
Alerts:	Monthly search updates until project completion
Study Types:	Realist reviews
Limits:	Publication date limit: January 01, 2010 to present Humans Language limit: English or French Conference abstracts: excluded

SYNTAX GUIDE	
/	At the end of a phrase, searches the phrase as a subject heading
MeSH	Medical Subject Heading
exp	Explode a subject heading
*	Before a word, indicates that the marked subject heading is a primary topic; or, after a word, a truncation symbol (wildcard) to retrieve plurals or varying endings
adj#	Requires terms to be adjacent to each other within # number of words (in any order)
.ti	Title
.ab	Abstract
.kf	Author keyword heading word (MEDLINE)
.kw	Author keyword (Embase)
.id	Key concepts (PyscINFO)
.yr	Publication year
.jw	Journal word title (MEDLINE)
.jx	Journal word (Embase, PsycINFO)
medall	Ovid database code: MEDLINE All, 1946 to present, updated daily
oemezd	Ovid database code; Embase, 1974 to present, updated daily
pysh	Ovid database code: APA PsycINFO 1806 to present, updated weekly

OVID MULTI-DATABASE STRATEGY	
Line #	**Search Strategy**
1	exp heart failure/
2	((heart or cardiac* or cardio* or myocardi* or diastolic* or systolic* or paroxysmal*) adj5 (failure* or edema* or oedema* or decompensation* or dyspnea* or asthma* or chronic* or insufficien*)).ti,ab,kf.
3	((preserved ejection* or reduced ejection*) adj5 fraction*).ti,ab,kf.
4	(congestive heart* adj5 disease*).ti,ab,kf.
5	((cardio renal* or cardiorenal* or reno cardiac* or renocardiac*) adj5 syndrome*).ti,ab,kf.

OVID MULTI-DATABASE STRATEGY	
Line #	**Search Strategy**
6	exp Hypertension/
7	(hypertension* or ((high* or elevat*) adj5 (blood pressure* or bloodpressure* or diastolic pressure* or systolic pressure*))).ti,ab,kf.
8	exp Arrhythmias, Cardiac/
9	(arrhythmia* or dysrhythmia* or bradycardia* or bradyarrhythmia* or tachycardia* or tachyarrhythmia*).ti,ab,kf.
10	((irregular* or slow* or rapid* or fast or junctional*) adj3 (heartbeat* or heart beat* or rhythm*)).ti,ab,kf.
11	((atrial or auricular or ventricular) adj5 (fibrillation* or flutter*)).ti,ab,kf.
12	((heart rhythm* or cardiac rhythm*) adj5 disorder*).ti,ab,kf.
13	(premature adj3 (atrial or ventricular or junctional or cardiac) adj3 (contraction* or complex*)).ti,ab,kf.
14	((accelerat* or junctional*) adj5 rhythm*).ti,ab,kf.
15	(extra beats or heart block or heart blocks or AV block or AV blocks).ti,ab,kf.
16	Coronary Artery Disease/
17	(atherosclerosis or atheroscleroses or arteriosclerosis or arterioscleroses or (coronary adj5 disease*)).ti,ab,kf.
18	(hard* adj3 arter*).ti,ab,kf.
19	(plaque adj4 build*).ti,ab,kf.
20	Cardiac Rehabilitation/
21	((cardiac* or cardio* or heart*) adj5 (rehab* or conditioning*)).ti,ab,kf.
22	or/1-21
23	exp telemedicine/ or exp Telemetry/ or exp Videoconferencing/ or exp computer communication networks/ or Mobile Applications/
24	(teleconsult* or telemonitor* or RPC or RPM or telemetry or telemetric* or telepatholog* or teleradialog* or videoconference* or video conference* or asynchron* or ((remote or tele or virtual or rural or urban) adj5 (consult* or monitor* or checkin or check in or pathol* or radialog*))).ti,ab,kf.
25	(telehealth* or telemed* or telecommunicat* or tele communicat* or e health* or ehealth* or m health* or mhealth* or e consult* or econsult* or telecar* or HBPMTM or ((tele or mobile or virtual) adj5 (health* or med* or care or caring or visit or visits or appointment*))).ti,ab,kf.
26	(telerehab* or ((remote* or tele* or virtual*) adj5 rehab*)).ti,ab,kf.
27	(telemed* or tele med* or telehealth* or tele health* or telerehab* or tele rehab* or telecar* or tele car* or e health* or ehealth or m Health* or mHealth* or e consult* or econsult*).jw.
28	or/23-27
29	22 and 28
30	29 use medall
31	exp heart failure/
32	((heart or cardiac* or cardio* or myocardi* or diastolic* or systolic* or paroxysmal*) adj5 (failure* or edema* or oedema* or decompensation* or dyspnea* or asthma* or chronic* or insufficien*)).ti,ab,kw,dq.
33	((preserved ejection* or reduced ejection*) adj5 fraction*).ti,ab,kw,dq.
34	(congestive heart* adj5 disease*).ti,ab,kw,dq.
35	((cardio renal* or cardiorenal* or reno cardiac* or renocardiac*) adj5 syndrome*).ti,ab,kw,dq.
36	exp hypertension/
37	(hypertension* or ((high* or elevat*) adj5 (blood pressure* or bloodpressure* or diastolic pressure* or systolic pressure*))).ti,ab,kw,dq.
38	exp heart arrhythmia/
39	(arrhythmia* or dysrhythmia* or bradycardia* or bradyarrhythmia* or tachycardia* or tachyarrhythmia*).ti,ab,kw,dq.

OVID MULTI-DATABASE STRATEGY	
Line #	**Search Strategy**
40	((irregular* or slow* or rapid* or fast or junctional*) adj3 (heartbeat* or heart beat* or rhythm*)).ti,ab,kw,dq.
41	((atrial or auricular or ventricular) adj5 (fibrillation* or flutter*)).ti,ab,kw,dq.
42	((heart rhythm* or cardiac rhythm*) adj5 disorder*).ti,ab,kw,dq.
43	(premature adj3 (atrial or ventricular or junctional or cardiac) adj3 (contraction* or complex*)).ti,ab,kw,dq.
44	((accelerat* or junctional*) adj5 rhythm*).ti,ab,kw,dq.
45	(extra beats or heart block or heart blocks or AV block or AV blocks).ti,ab,kw,dq.
46	exp coronary artery disease/
47	(atherosclerosis or atherosclerоses or arteriosclerosis or arteriosclerоses or (coronary adj5 disease*)).ti,ab,kw,dq.
48	(hard* adj3 arter*).ti,ab,kw,dq.
49	(plaque adj4 build*).ti,ab,kw,dq.
50	heart rehabilitation/
51	((cardiac* or cardio* or heart*) adj5 (rehab* or conditioning*)).ti,ab,kw,dq.
52	or/31-51
53	telehealth/ or telemedicine/ or telecardiology/ or telenursing/ or teleconsultation/ or telediagnosis/ or telemonitoring/ or telepathology/ or teleradiology/ or telerehabilitation/ or teletherapy/ or telemetry/ or remote sensing/ or telephone telemetry/ or videoconferencing/ or exp computer network/ or exp internet/ or social media/ or mobile application/
54	(teleconsult* or telemonitor* or RPC or RPM or telemetry or telemetric* or telepatholog* or teleradialog* or videoconference* or video conference* or asynchron* or ((remote or tele or virtual or rural or urban) adj5 (consult* or monitor* or checkin or check in or pathol* or radialog*))).ti,ab,kw,dq.
55	(telehealth* or telemed* or telecommunicat* or tele communicat* or e health* or ehealth* or m health* or mhealth* or e consult* or econsult* or telecar* or HBPMTM or ((tele or mobile or virtual) adj5 (health* or med* or care or caring or visit or visits or appointment*))).ti,ab,kw,dq.
56	(telerehab* or ((remote* or tele* or virtual*) adj5 rehab*)).ti,ab,kw,dq.
57	(telemed* or tele med* or telehealth* or tele health* or telerehab* or tele rehab* or telecar* or tele car* or e health* or ehealth or m Health* or mHealth* or e consult* or econsult*).jx.
58	or/53-57
59	52 and 58
60	59 use oemezd
61	60 not conference abstract.pt.
62	exp heart/ and failure/
63	((heart or cardiac* or cardio* or myocardi* or diastolic* or systolic* or paroxysmal*) adj5 (failure* or edema* or oedema* or decompensation* or dyspnea* or asthma* or chronic* or insufficien*)).ti,ab,id.
64	((preserved ejection* or reduced ejection*) adj5 fraction*).ti,ab,id.
65	(congestive heart* adj5 disease*).ti,ab,id.
66	((cardio renal* or cardiorenal* or reno cardiac* or renocardiac*) adj5 syndrome*).ti,ab,id.
67	exp Hypertension/ or exp Blood Pressure/
68	(hypertension* or ((high* or elevat*) adj5 (blood pressure* or bloodpressure* or diastolic pressure* or systolic pressure*))).ti,ab,id.
69	exp "Arrhythmias (Heart)"/
70	(arrhythmia* or dysrhythmia* or bradycardia* or bradyarrhythmia* or tachycardia* or tachyarrhythmia*).ti,ab,id.
71	((irregular* or slow* or rapid* or fast or junctional*) adj3 (heartbeat* or heart beat* or rhythm*)).ti,ab,id.
72	((atrial or auricular or ventricular) adj5 (fibrillation* or flutter*)).ti,ab,id.
73	((heart rhythm* or cardiac rhythm*) adj5 disorder*).ti,ab,id.

OVID MULTI-DATABASE STRATEGY	
Line #	**Search Strategy**
74	(premature adj3 (atrial or ventricular or junctional or cardiac) adj3 (contraction* or complex*)).ti,ab,id.
75	((accelerat* or junctional*) adj5 rhythm*).ti,ab,id.
76	(extra beats or heart block or heart blocks or AV block or AV blocks).ti,ab,id.
77	Heart Disorders/
78	(atherosclerosis or atherosclerоses or arteriosclerosis or arterioscleroses or (coronary adj5 disease*)).ti,ab,id.
79	(hard* adj3 arter*).ti,ab,id.
80	(plaque adj4 build*).ti,ab,id.
81	exp heart/ and (rehabilitation/ or physical therapy/)
82	((cardiac* or cardio* or heart*) adj5 (rehab* or conditioning*)).ti,ab,id.
83	or/62-82
84	telemedicine/ or online therapy/ or exp teleconferencing/ or teleconsultation/ or telerehabilitation/ or Telemetry/ or computer mediated communication/ or internet/ or internet usage/ or online social networks/ or "smartphone use"/ or mobile applications/ or digital interventions/
85	(teleconsult* or telemonitor* or RPC or RPM or telemetry or telemetric* or telepatholog* or teleradialog* or videoconference* or video conference* or asynchron* or ((remote or tele or virtual or rural or urban) adj5 (consult* or monitor* or checkin or check in or pathol* or radialog*))).ti,ab,id.
86	(telehealth* or telemed* or telecommunicat* or tele communicat* or e health* or ehealth* or m health* or mhealth* or e consult* or econsult* or telecar* or HBPMTM or ((tele or mobile or virtual) adj5 (health* or med* or care or caring or visit or visits or appointment*))).ti,ab,id.
87	(telerehab* or ((remote* or tele* or virtual*) adj5 rehab*)).ti,ab,id.
88	(telemed* or tele med* or telehealth* or tele health* or telerehab* or tele rehab* or telecar* or tele car* or e health* or ehealth or m Health* or mHealth* or e consult* or econsult*).jx.
89	or/84-88
90	83 and 89
91	90 use psyh
92	30 or 61 or 91
93	limit 92 to yr=2010-current
94	limit 93 to (English or French)

OTHER DATABASES	
Scopus	Searched to capture records not found in MEDLINE. Same MeSH, keywords, limits, and study types used as per MEDLINE search, with appropriate syntax used.
CINAHL	Same MeSH, keywords, and limits used as per MEDLINE search, excluding study types and human restrictions. Syntax adjusted for EBSCO platform, including the addition of CINAHL headings.

Grey Literature

Search dates:	Autumn 2020
Keywords:	[(remote monitoring OR remote consultation OR remote check-in) AND (heart failure OR atrial fibrillation OR hypertension OR cardiac rehabilitation)]
Limits:	Publication date limit: January 01, 2010 to present Language limit: English or French
Updated:	Search will be updated prior to the completion of stakeholder feedback period

Relevant websites from the following sections of the CADTH grey literature checklist *Grey Matters: A Practical Tool For Searching Health-Related Grey Literature* (https://www.cadth.ca/grey-matters) will be searched:

- Health Technology Assessment Agencies
- Health Economics
- Clinical Practice Guidelines
- Clinical Trials Registries
- Databases (free)
- Internet Search
- Open Access Journals.