Integrating research evidence into virtual healthcare service programming: a quality improvement analysis of healthcare utilization and series of rapid umbrella reviews

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Abstract

Background The integration of virtual solutions in healthcare has shown promise in improving access and reducing strain on hospital services. To maximize impact, healthcare authorities should understand what populations to prioritize in virtual healthcare service deployment as well as the research evidence for virtual care services for those populations. This study aims to support the Fraser Health (FH) Authority in prioritizing the implementation of virtual health, focusing on patient populations that would benefit most. "Patient profiles" were created by analyzing admission, readmission rates, and length of stay based on chronic conditions across FH sites. Using the Pabon Lasso Model for visualization, chronic conditions were categorized into zones to identify those with the greatest acute load. Rapid umbrella reviews were conducted for heart failure, COPD, and diabetes to identify evidence-based virtual care solutions for these high-utilization populations. The resulting knowledge products offered user-friendly, high-level overviews of the evidence for decision-making.

Results Heart failure, COPD, diabetes, schizophrenia, and anxiety disorders were identified as top chronic conditions with highest acute loads. Rapid umbrella reviews indicated potential benefits of the following virtual care interventions for heart failure, COPD, and diabetes: remote patient monitoring (RPM), eLearning, virtual support (via phone calls or video conferencing), tele-rehabilitation, and text messaging.

Conclusion Integration of virtual care services has the potential to revolutionize healthcare but requires careful planning and consideration of barriers. Patient profiles and rapid umbrella reviews offer a comprehensive approach to inform prioritization and implementation. RPM, eLearning, virtual support, tele-rehab, and text messaging showed promise for specific chronic conditions.

Keywords Telemedicine, Chronic disease, Telerehabilitation, Knowledge translation, Regional health planning, Umbrella review

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Introduction

In recent years, the integration of virtual care solutions into healthcare systems has demonstrated significant potential in enhancing access to high-quality healthcare while reducing the strain on traditional hospital

services [1]. Virtual healthcare refers to the use of technology to provide medical services remotely, allowing patients to receive care from the comfort of their homes. Randomized trials investigating virtual care for chronic diseases have reported high satisfaction rates among patients and healthcare professionals, with comparable clinical and service outcomes [2].

The emergence of various virtual care services on an international scale, such as remote patient monitoring [3, 4], and video visits [5, 6], has presented multiple implementation challenges [7, 8]. While numerous virtual care services have proven effective in improving health outcomes for diverse populations, it is essential for clinics and healthcare authorities or health systems to not only comprehend the research evidence regarding the effectiveness of different virtual care services, but also identify the populations that should be prioritized to maximize the impact of new virtual services. Understanding the specific patient populations that may benefit most from virtual care is crucial for optimizing resource allocation and improving overall healthcare outcomes.

The objective of this study is to support a regional health authority in British Columbia, Canada, in prioritizing the implementation of virtual healthcare services. By providing insights into the research evidence and identifying the populations that would benefit most from virtual care services, this work aims to facilitate the effective allocation of resources and improve healthcare outcomes in the region.

Context

This research is being done within Fraser Health (FH) Authority, one of the largest and most diverse regional health authorities within British Columbia, Canada. FH serves over 1.9 million Canadians residing in various communities, including cities such as Abbotsford, Surrey, Burnaby, New Westminster, and Langley [9]. In recent years, FH has prioritized the expansion of virtual care [10] and between January 2022-2023, more than 1.9 million virtual visits took place (roughly 27% of all visits). Considering the region's diverse population and geographical spread, implementing virtual health solutions within the FH holds great potential for enhancing healthcare accessibility, particularly for individuals who face barriers to in-person care. By prioritizing the implementation of virtual care services, FH aims to optimize resource allocation and improve overall healthcare outcomes for the communities it serves.

The current project

In this manuscript, we present a comprehensive analysis conducted by the FH Virtual Health team in partnership with the FH data analytics team. Specifically, our research aims to:

1. Create "patient profiles" to identify what patient populations within FH may benefit from virtual care interventions, with a particular focus on individuals with chronic diseases who exhibit increased hospital utilization. By identifying diagnoses with the highest acute load, we can tailor virtual care solutions to meet the specific needs of FH.
2. Conduct a series of rapid umbrella reviews to identify evidence-based virtual care solutions for those populations identified in aim 1.

Methods
Patient profiles
Study design
We looked into admission, readmission rates, and length of stay (LOS) for patients, considering their chronic conditions as a proxy measure to identify patient groups who might have the greatest acute load across FH sites. Potential target patient groups for future virtual care services was informed by the patient groups with the highest acute load.

Data collection
The data for patient profile analysis includes FH acute admission and re-admissions, and LOS across all FH acute sites based on patients' chronic condition. Annual patient data was split by their most responsible diagnosis for a 5-year period, from 2017 to 2021.

Data analysis
For each of the chronic conditions, the following metrics were calculated to estimate annual average emergency and acute load of the patients for the period of study (2017-2021):

1. $30-day\ Annual\ Readmission\ Rate\ = \frac{Annual\ 30-day\ Readmission}{Annual\ Readmission}$
2. $Avg.\ Annual\ LOS\ = \frac{Annual\ LOS\ sum}{Annual\ Admissions}$

To better visualize and compare acute load of the patients, we adapted the Pabon Lasso Model, a technique used in healthcare literature to interpret hospital utilization [8]. Figure 1 shows an example where "average annual 30-day readmission rate" and "average annual admissions" metrics are shown on X & Y axes, respectively, and where the mean value of these 2 metrics divide the graph into four quadrants. The relative acute load of each chronic condition was interpreted and assessed depending on the zone to which their corresponding metric belongs to. Considering the example graph within Fig. 1, zone 1 includes chronic conditions with relative low admissions and low 30-day readmission rate, while zone 3 reflects chronic conditions with relative high admissions and high 30-day readmission rate.
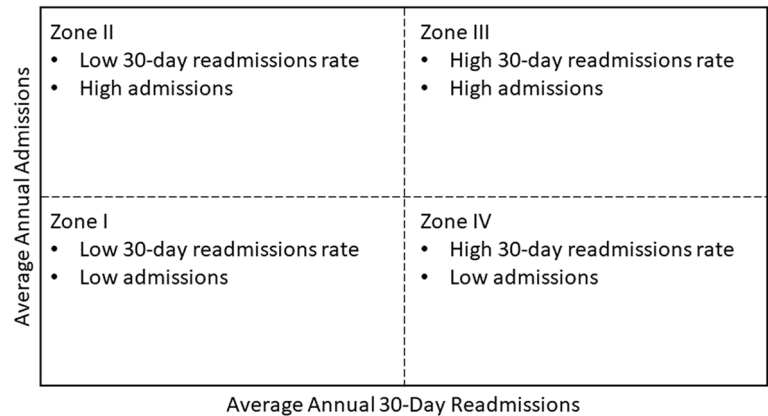
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Fig. 1 Quadrant analysis of hospital admission rates and 30-Day readmission rates. This diagram categorizes hospitals based on their average annual admissions and 30-day readmission rates, creating four zones: Zone I (low admissions, low 30-day readmissions rate), Zone II (high admissions, low 30-day readmissions rate), Zone III (high admissions, high 30-day readmissions rate), and Zone IV (low admissions, high 30-day readmissions rate)

In order to identify which chronic conditions had the greatest acute load, the following filters were applied: average annual LOS > 7 days; average annual readmission rate > 5%; average annual admissions > 500 (i.e., individuals outside of "zone 1" with an average length of stay greater than a week).

Rapid umbrella reviews

The purpose of the current series of rapid umbrella reviews was to summarize available research evidence for the patient populations which were identified as having increased burden on acute hospital resources within FH demonstrated by acute load. Rapid umbrella reviews were chosen as they allow for the timely dissemination of relevant information through streamlined systematic review methods. For more information on how systematic review methods can be streamlined to provide a timely synthesis, see MacPherson et al. [11], or guidelines offered by Cochrane [12]. A protocol for this series of rapid umbrella reviews has been deposited on *Open Science Framework* [13].

Identifying the research questions

A series of three rapid umbrella reviews were conducted to answer the question: what evidence-based virtual healthcare solutions exist for patients with heart failure, COPD, and diabetes.

Identifying relevant studies

To identify relevant studies, we searched Medline and CINAHL with search strategies developed in consultation with FH Library Services. To conduct this series of rapid umbrella reviews in a timely fashion, we limited our search strategy to Medline and CINAHL, two widely recognized and comprehensive databases in the fields of clinical medicine and nursing, respectively. Three separate searches were conducted using a combination of relevant keywords and Medical Subject Headings (MeSH) terms pertaining to each clinical population and virtual care. Searches were run in November 2022. See Appendix 1 for Medline search terms for each of the rapid umbrella reviews.

Eligibility criteria

Given the wealth of existing literature on virtual care services for heart failure, COPD, and diabetes, rapid reviews were limited to review type articles (e.g., scoping, systematic, rapid, narrative; making them rapid umbrella reviews) discussing virtual care services for the given clinical population published in the last five years. This decision was made to allow for a comprehensive evaluation of the most current evidence, considering recent advancements and developments in technology, implementation strategies, and outcomes related to virtual care. All rapid umbrella reviews were limited to English only studies. No limits were placed on study location. For specific eligibility criteria reviews, see Table 1.

Study screening and selection

Search results collected from the electronic databases were exported into Covidence (Veritas Health Innovation Ltd., Melbourne, Australia), a software used to streamline the review process [14]. Study screening and selection was then completed in a two-step process. Firstly, all titles and abstracts were screened for inclusion by a single

Table 1 Eligibility criteria for rapid umbrella reviews

	Effectiveness of virtual care services for Heart Failure (review 1), COPD (review 2), or Diabetes (review 3)
Population	Individuals with: Heart Failure; COPD, or type 1 or type 2 diabetes (for the respective reviews)
Intervention or Comparison Group	Virtual care (except for implantable devices and mobile phone applications)
Outcomes	Effectiveness outcomes not limited to any specific outcome
Article type	Review articles only
Setting/Location	No limits
Language	English
Date	Published in the last 5 years (2017 – 2022)

reviewer (with ~ 20% double screened, time permitting) [11]. Following this, full text articles were screened again for inclusion by a single reviewer (with ~ 20% double screened, time permitting). The number of titles/ abstracts, and full text articles double screened was documented for each review, and the study selection process was documented via individual PRISMA flowcharts for each of the 3 rapid umbrella reviews (see Appendix 2).

Data extraction

To ensure the timely synthesis of results to be integrated into decision making, only information identified by FH knowledge users as being important in the decision-making process was extracted for each review. One reviewer independently extracted data from included articles. Specific data extracted includes definition of virtual health service; outcomes measured; and if the reported virtual health service was determined to be effective.

Collating, summarizing, and reporting the results

Following the approach of other rapid reviews [15], the collated results were synthesized and presented in a narrative or visual format, such as infographics, to the Virtual Health team members. The final knowledge products were designed to provide a user-friendly, high-level overview of the evidence, allowing the team members to grasp the extent and trends of available evidence in the field of virtual health.

Results

Patient profiles

Acute load by chronic conditions within FH were calculated and compared using the analysis methodology explained within the methods section. The summary of our analysis is presented in Fig. 2 and Table 2.

Based on our operationalization of "greatest acute load" (i.e., average annual LOS > 7 days; average annual readmission rate > 5%; average annual admissions > 500),

Heart Failure, COPD, Diabetes Mellitus, Schizophrenia and Delusional Disorder, and *Mood and Anxiety Disorder* are the top chronic conditions in terms of acute load.

Rapid umbrella reviews

Following completion of the "patient profiles" rapid umbrella reviews were conducted for the following patient populations: heart failure, COPD, and diabetes. We chose not to conduct reviews for schizophrenia and delusional disorders or mood and anxiety disorders at this time as FH already has a comprehensive virtual psychiatry unit in place and the purpose of the reviews was to help inform the development of new virtual healthcare services.

Heart failure

Out of the 5,477 references initially screened based on title and abstract, a total of 18 reviews were eligible for data extraction [16–33], collectively encompassing 172 unique studies. These reviews focused on various virtual care services for heart failure, including remote patient monitoring (RPM), eLearning, tele-rehab, virtual support (such as telephone or video conference), text messaging, and virtual support combined with RPM. For a list of all outcomes assessed across the reviews and virtual care types see Fig. 3. Notably, no virtual care service demonstrated improved outcomes in terms of emergency department visits or hospital costs. RPM, eLearning, and virtual support exhibited the most extensive body of evidence across the breadth of assessed outcomes.

Remote Patient Monitoring (RPM) RPM services have demonstrated positive impacts on several outcomes, including reductions in all-cause mortality, heart failure-related mortality, heart failure-related hospitalization, length of stay in the hospital, improvements in self-care, and increased patient satisfaction. However, the evidence regarding the effects of RPM on ED visits, hospital costs,
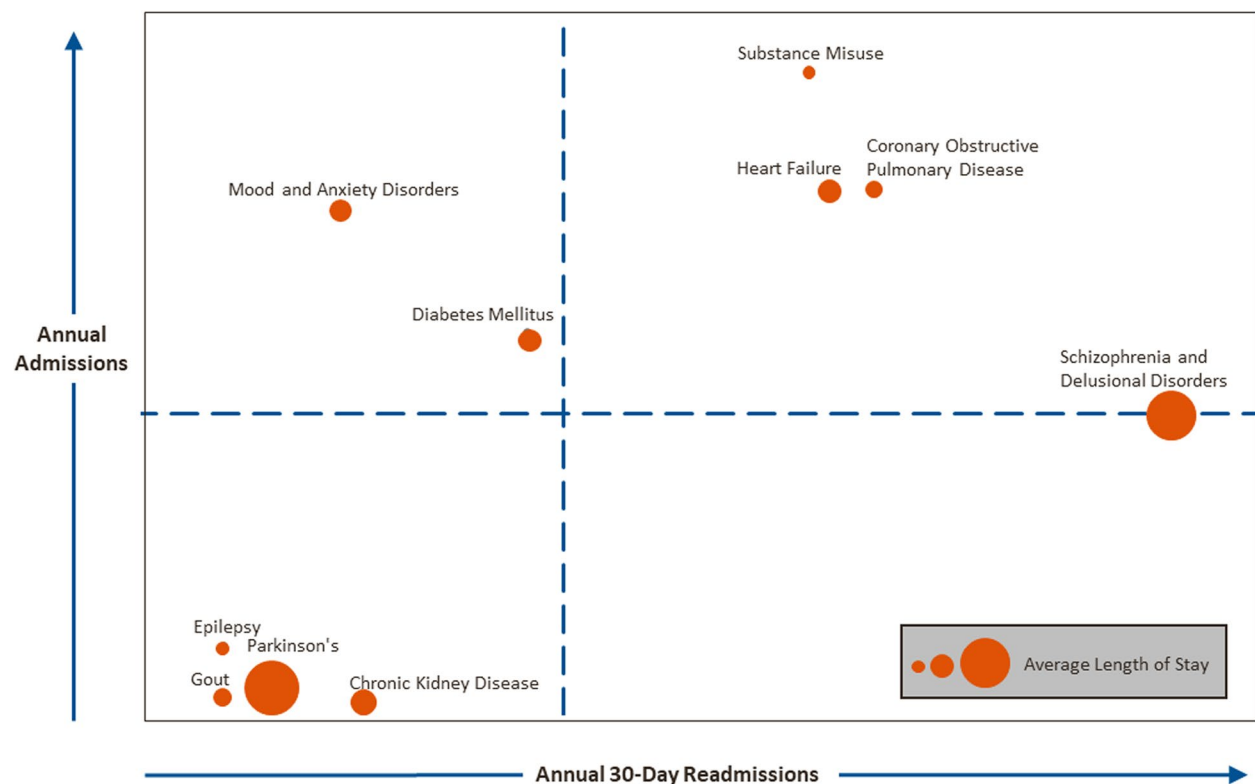
Fig. 2 Quadrant analysis of hospital admission rates and 30-Day readmission rates. This diagram shows the association of annual admissions and 30-day readmissions rates by chronic condition and average length of stay within Fraser Health

Table 2 Average annual readmission rate, admissions, length of stay, and associated "zone" by chronic disease condition within Fraser Health

Condition	Average annual readmission rates (%)	Average annual admissions (number of admissions)	Average annual length of stay (days)	Zone
Mood and Anxiety Disorder	7	2909	9	2
Diabetes Mellitus	8.8	2213	9.3	2
Substance Misuse	11.6	3713	5	3
Heart Failure	11.8	3054	9.5	3
Chronic Obstructive Pulmonary Disease	12.2	3043	7.1	3
Schizophrenia and Delusional Disorders	15.2	1736	20.6	4
Gout/Crystal Arthropathies	5.8	119	7.2	1
Chronic Kidney Disease	7.2	75	10.4	1
Parkinson's/ Parkinsonism	6.2	145	23	1
Epilepsy	5.8	397	5.2	1

readmission rates, and quality of life is inconsistent or inconclusive.

eLearning   eLearning services have demonstrated positive impact on all-cause mortality, all cause hospitalization, readmission rates, medication adherence, mental health, and self-care. However, evidence regarding the effects of eLearning on heart failure related hospitalization, quality of life, self-efficacy, and knowledge is inconsistent or inconclusive.

Virtual support   Virtual support services demonstrated positive impacts on all-cause mortality, heart failure related mortality, all-cause hospitalization, heart failure related

Heart Failure
Are virtual care services effective?

Outcomes	RPM	eLearning	Tele-Rehab	Virtual Support	Text Messaging	Virtual Support + RPM
All-cause mortality	✓	✓		✓	✓	✓
HF-related mortality	✓		✗	✓		
All cause hospitalization	?	✓		✓		
HF-related hospitalization	✓	✗		✓		✓
Length of stay	✓			✓	✓	
ED visits	✗			✗	✗	
Hospital costs	✗			✗		
Readmission rates	✗	✓	✗	✗	✗	✗
Medication adherence		✓		✗		
Quality of life	?	✗	✓	?	✗	✓
Mental Health		✓				
Functional capacity			✓			
Self-care	✓	✓	✓	✓		✓
Self-efficacy		✗				
Patient satisfaction	✓					
Knowledge		✗				

Fig. 3 Comparative effectiveness of virtual care services for heart failure

hospitalization, length of stay, and self-care. However, evidence regarding the effects of virtual support on ED visits, hospital costs, readmission rates, medication adherence, and quality of life is inconsistent or inconclusive.

COPD

Of the 348 reference imported for title and abstract screening, 17 reviews were included in data extraction [34–51]. These 17 reviews represent 184 unique studies. These reviews focused on various virtual care services for COPD, including RPM, eLearning, and tele-rehab. For a list of all outcomes assessed across the reviews and virtual care types see Fig. 4. Notably, no virtual care service demonstrated improved outcomes in terms of length of hospital stay.

Remote patient monitoring (RPM)　RPM services have demonstrated positive impacts on several outcomes, including reductions in all-cause hospitalization, COPD related hospitalization, ED visits, COPD exacerbations, and overall mental health. However, the evidence regarding the effects of RPM on all-cause mortality, length of stay, healthcare costs, dyspnea, and quality of life is inconsistent or inconclusive.

eLearning　eLearning services have demonstrated positive impacts on treatment adherence, quality of life, self-care, knowledge, and self-efficacy/symptom management. However, the evidence regarding the effects of eLearning on all-cause hospitalization, and exercise tolerance is inconsistent or inconclusive.

Tele-rehab　Tele-rehab services have demonstrated positive impacts on all-cause hospitalization, ED visits, healthcare costs, COPD exacerbations, dyspnea, treatment adherence, quality of life, mental health, exercise tolerance, self-efficacy/symptom management, and patient satisfaction.

Diabetes

Of the 2338 reference imported for title and abstract screening, 17 reviews were included in data extraction [52–68]. These 17 reviews represent 222 unique studies. These reviews focused on various virtual care services for diabetes, including RPM, eLearning, virtual support, text messaging, and virtual support plus RPM. For a list of all outcomes assessed across the reviews and virtual care types see Fig. 5. RPM, virtual support, and text messaging exhibited the most extensive body of evidence across the breadth of assessed outcomes.
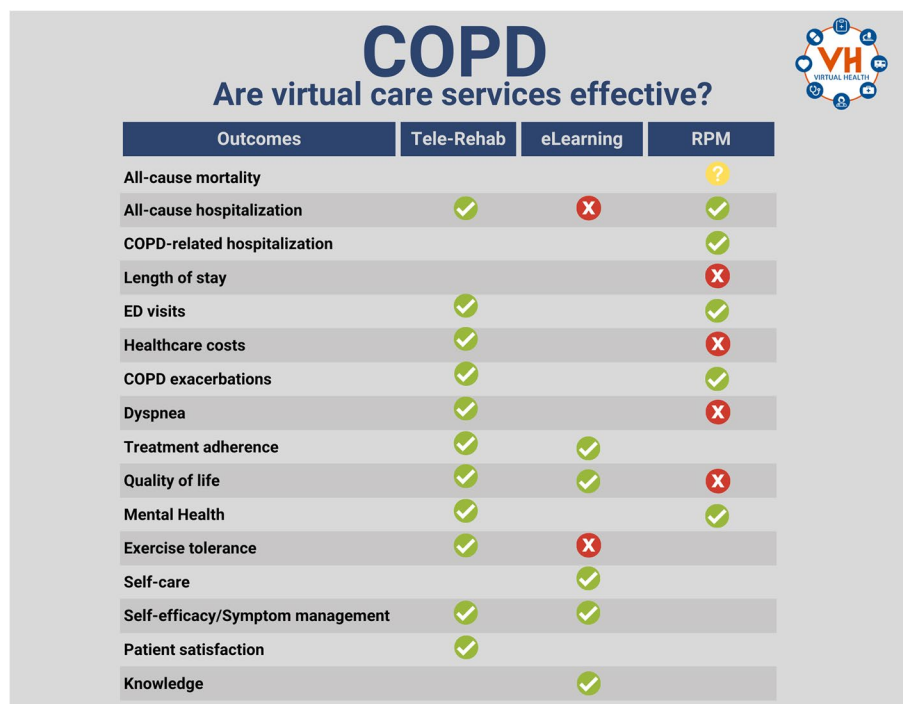
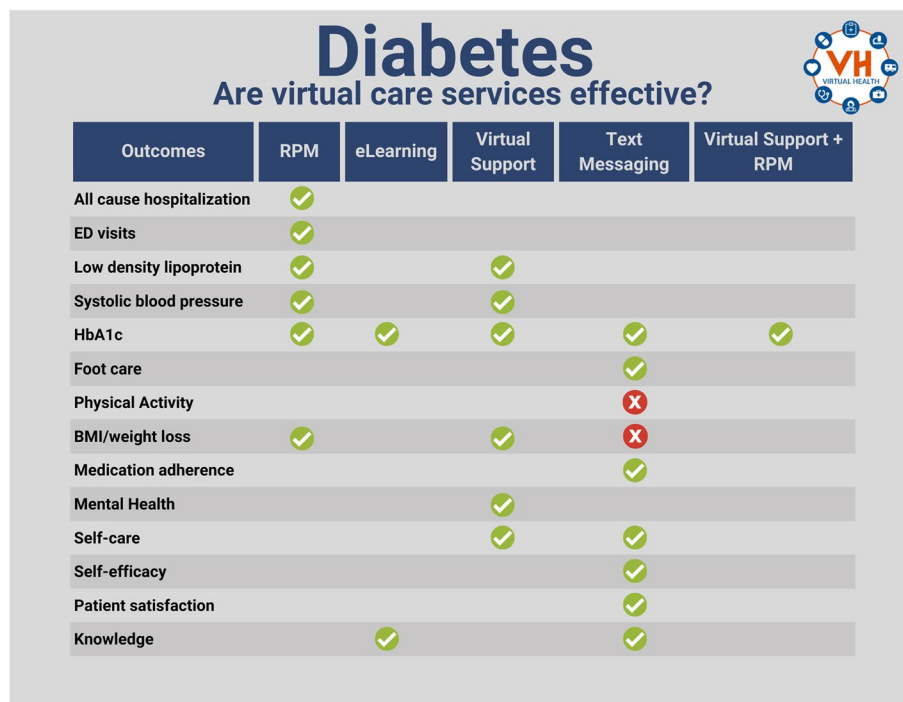**Fig. 4** Comparative effectiveness of virtual care services for COPD

Fig. 5 Comparative effectiveness of virtual care services for diabetes

RPM RPM services have demonstrated positive impacts on several outcomes, including reductions in all-cause hospitalization, ED visits, low density lipoprotein, systolic blood pressure, HbA1c, and BMI/weight loss.

Virtual support Virtual support services have demonstrated positive impact on low density lipoprotein, systolic blood pressure, HbA1c, BMI/weight loss, mental health, and self-care.

Text messaging Text messaging services have demonstrated positive impact on HbA1c, foot care, medication adherence, self-care, self-efficacy, patient satisfaction, and knowledge. However, the evidence regarding the effects of text messaging on physical activity and BMI/weight loss is inconsistent or inconclusive.

Discussion

The integration of virtual care services into healthcare systems has the potential to revolutionize healthcare delivery, improving access, efficiency, and patient outcomes. However, to effectively allocate resources and prioritize the implementation of virtual care interventions, it is crucial to not only comprehend the research evidence regarding the effectiveness of different virtual care services but also identify the specific patient populations that would benefit most from these interventions. This study aimed to address this need by conducting patient profiles based on hospital utilization data for chronic disease populations in FH, British Columbia, Canada, and performing rapid umbrella reviews for heart failure, COPD, and diabetes.

The findings from the rapid umbrella reviews offer valuable insights that can be generalized to other health systems aiming to implement virtual care services for similar chronic conditions. Specifically, the positive impacts demonstrated by virtual care interventions such as RPM, eLearning, virtual support, tele-rehab, and text messaging for patients with heart failure, COPD, and diabetes suggest that these interventions hold promise across different healthcare contexts. While specific implementation strategies may vary based on factors such as infrastructure, resource availability, and patient demographics, the evidence of effectiveness provided by these reviews serves as a strong foundation for informing the design and implementation of virtual care programs in diverse health systems.

By combining the patient profiles and rapid umbrella reviews, this study offers an approach to inform the prioritization and implementation of virtual care services. The data derived from the patient profiles analysis can shed light on opportunities within our healthcare system. Specifically, this analysis provided valuable insights into the populations with the highest hospital utilization rates, identifying heart failure, COPD, and diabetes as the chronic conditions associated with increased healthcare utilization in FH. These findings highlight the importance of focusing on these specific populations for the implementation of virtual care interventions to optimize resource allocation and improve healthcare outcomes. Use of patient profiles has potential implications for the implementation of virtual care interventions into practice. By identifying the patient populations that would benefit most from virtual care, healthcare authorities can tailor their implementation strategies to focusing on these specific populations. This targeted approach enhances the likelihood of successful implementation, as it focuses resources and efforts on the areas where they are most needed and where the potential impact is expected to be highest.

The rapid umbrella reviews further enriched our understanding of the research evidence regarding the effectiveness of virtual care services for the identified chronic disease populations. By systematically reviewing and synthesizing the available evidence, the reviews provided insights into the potential benefits and limitations of virtual care interventions, such as RPM, eLearning, virtual support, tele-rehab, and text messaging, for heart failure, COPD, and diabetes. These findings can guide healthcare authorities in selecting and implementing virtual care services that have demonstrated positive impacts on relevant outcomes, ensuring that the resources are allocated to interventions with the highest likelihood of success.

Specifically, across the three chronic conditions, remote patient monitoring (RPM) emerged as a virtual care service that demonstrated positive impacts on several outcomes. RPM services were associated with reductions in hospitalizations, improvements in self-care, and increased patient satisfaction for heart failure, COPD, and diabetes populations. These findings align with previous research that has highlighted the benefits of RPM in managing chronic diseases [4, 69, 70]. Additionally, eLearning was identified as a virtual care service that showed promising results for heart failure, COPD, and diabetes populations. eLearning interventions demonstrated positive impacts on treatment adherence, quality of life, self-care, and knowledge for patients with these chronic conditions. The potential of eLearning to improve self-management and patient education aligns with previous studies on its effectiveness in chronic disease management [71, 72]. Virtual support services were another virtual care modality that exhibited potential benefits for heart

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failure, COPD, and diabetes populations. Virtual support interventions showed positive impacts on various outcomes, including mortality, hospitalizations, length of stay, and self-care. The provision of virtual support through telephone, video conference, or other communication platforms has the potential to enhance patient access to care, facilitate disease management, and provide support for self-management [73]. Furthermore, tele-rehab emerged as a virtual care service that demonstrated positive impacts on multiple outcomes for patients with COPD. Tele-rehab interventions were associated with reductions in hospitalizations, emergency department visits, COPD exacerbations, and improvements in exercise tolerance, quality of life, and patient satisfaction. These findings support the potential of tele-rehabilitation programs to deliver effective care remotely and promote physical activity and functional improvement in patients with COPD [74]. Finally, text messaging was another virtual care service that showed promise for patients with diabetes. Text messaging interventions demonstrated positive impacts on outcomes such as glycemic control, medication adherence, self-care, patient satisfaction, and knowledge. The use of text messaging as a tool for remote communication and support has been shown to be effective in promoting behavior change and enhancing self-management in diabetes [66].

Overall, the results of the rapid umbrella reviews indicate that virtual care interventions, particularly RPM, eLearning, virtual support, tele-rehab, and text messaging, have the potential to improve outcomes for patients with heart failure, COPD, and diabetes. These interventions can enhance self-management, promote treatment adherence, and provide support for patients in managing their chronic conditions. Findings from this work can provide valuable insights for FH in prioritizing the implementation of virtual care services, focusing on the populations with the highest hospital utilization rates. However, it is important to acknowledge that the evidence for some outcomes was inconsistent or inconclusive, highlighting the need for further research and evaluation. Further, it is essential to recognize that the successful implementation of virtual care interventions requires careful planning, infrastructure support, and consideration of potential barriers. Factors such as patient acceptance, technological literacy, access to reliable internet connections, and privacy and security concerns need to be addressed to ensure equitable access and successful adoption of virtual care services. Moreover, ongoing evaluation and monitoring of the implemented virtual care interventions are crucial to assess their long-term

impact on healthcare outcomes, patient experiences, and resource allocation.

Limitations
Patient profiles
Current analysis of patient profile mainly focuses on admission, ED visit, and LOS metrics, stratified only by chronic conditions (i.e., most responsible diagnosis). To better determine the populations of focus for delivering virtual care services, patient demographic features (e.g., age, gender and geographical location, etc.), patient acuity and complexity features (e.g., CTAS, comorbidity, resource intensity) and more in-depth hospital utilization metrics (e.g., acute LOS and bed occupancy) must be looked into and analyzed. Further, it is important to acknowledge that this study does not incorporate qualitative data or perspectives from patients and healthcare professionals. Patient experiences, clinician insights, and patient preferences may offer valuable context and nuances that quantitative data alone cannot capture. Future research should consider integrating qualitative methodologies to better understand the appropriateness and acceptability of virtual care solutions from the perspectives of those directly involved in care.

Rapid umbrella reviews
While rapid umbrella reviews offer a time-efficient manner of synthesizing evidence, they are not without limitations. Rapid umbrella review methods tend to sacrifice rigour for efficiency, and therefore may be subject to a greater degree of error. For example, these reviews only pulled from two databases, and studies were screened by a single reviewer with only ~20% double coded; this may have resulted in some relevant studies being missed. Additionally, rapid umbrella reviews typically do not have the same level of detail within the analysis and interpretation of evidence when compared to systematic reviews. While there is limited research comparing rapid umbrella reviews to systematic reviews, a study by Watt et al. [75] found that despite their differences, the conclusions drawn between the two types of reviews were not extensively different from one another; this suggests that results from the current rapid umbrella reviews may offer valid and reliable results to be used within evidence-informed healthcare decision making.

Another important limitation of this study is the absence of an equity lens in the review process. Equity considerations, including disparities in healthcare access and outcomes among different populations, were not systematically addressed in the rapid umbrella

reviews. This omission is significant as it may overlook potential disparities in the effectiveness and accessibility of virtual care solutions among diverse patient groups. Future research should prioritize incorporating equity assessments to better understand the impact of virtual care on underserved populations and ensure healthcare interventions are equitable.

Conclusion

The combination of patient profiles and rapid umbrella reviews offers a synergistic approach that enhances the value and relevance of the study findings. The patient profiles provide real-world data on the populations with the greatest healthcare utilization, offering a practical lens through which virtual care interventions can be targeted to maximize impact. On the other hand, the rapid umbrella reviews provide a comprehensive assessment of the research evidence, offering insights into the effectiveness and potential benefits of various virtual care services. By integrating these two approaches, the study bridges the gap between research evidence and real-world healthcare utilization, facilitating the translation of evidence-based interventions into practice.

The findings highlight the potential benefits of RPM, eLearning, virtual support, tele-rehab, and text messaging for patients with heart failure, COPD, and diabetes. By identifying the chronic disease populations with the highest hospital utilization rates, this research provides valuable guidance for Fraser Health in prioritizing the allocation of resources towards virtual care implementation. The successful integration of virtual care services has the potential to improve healthcare outcomes, enhance patient experiences, and optimize resource allocation, ultimately leading to a more efficient and effective healthcare system. Future research should continue to explore and evaluate virtual care interventions in different populations and healthcare settings to further advance the evidence base and inform decision-making in healthcare delivery.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s44247-024-00119-3.

> Supplementary Material 1.
>
> Supplementary Material 2.

Declarations

Ethics approval and consent to participate
Not applicable. This work consists of a quality improvement initiative and reviews, as such, ethics approval was not necessary.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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