

# Cost Implications of Virtual Visits in Primary and Specialty Care



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# Rapid Evidence Review

## Cost implications of virtual visits on patients, physicians, and the healthcare system

### Review Questions

#### 1. Do virtual visits add to or replace in-person visits?

- a. What impact do virtual visits have on the total number of visits (regardless of in person or virtual)?
- b. Is the visit duration different between virtual and in-person visits?
- c. Is the visit attendance rate different between virtual and in-person visits?

#### 2. What impact do virtual visits have on practice patterns?

- a. Prescriptions
- b. Laboratory testing
- c. Diagnostic imaging
- d. Specialist referrals

#### 3. What impact do virtual visits have on subsequent healthcare utilization?

- a. Emergency department visits
- b. Hospitalizations

#### 4. What impact do virtual visits have on costs (direct, indirect, opportunity)?

- a. From the perspective of the patient
- b. From the perspective of the consulting physician
- c. From the perspective of the healthcare system

### Context

- Virtual care has evolved significantly over the last few years, most recently in response to the global COVID-19 pandemic. An initial rapid evidence report was published by the Alberta COVID-19 Scientific Advisory Group<sup>1</sup> that examined the impact of virtual visits compared with or in addition to face-to-face visits on process outcomes, patient and provider satisfaction, quality of care, and access to a provider. Subsequently, expanded reviews in the areas of primary care, diabetes management, cardiovascular disease, and addictions and mental health were undertaken through the associated Strategic Clinical Networks. The final reports are expected to be published in November, 2020. **The following rapid evidence review focuses on the cost implications of virtual care between a physician and patient within primary and specialty care.**

- There are several modalities of virtual care, which include real-time or synchronous visits, such as a telephone call or video visit, or asynchronous interactions, such as a text message or email. **For the purposes of this review, the focus remains on video and telephone visits** (herein referred to as a virtual visit) occurring between a physician and a patient, whereby patients are attending from their own homes using their own devices (phone or computer). In the context of Alberta, traditional Telehealth services have been available for years and remuneration policies allowing for telephone visits exist for primary and specialty care.
- Recently, in response to COVID-19, the adoption of virtual visits has increased and remuneration policies have changing to adapt to this increased need and desire for virtual visits. However, the cost implications associated with virtual visits are unclear. While evidence suggests that virtual visits may have cost savings to patients upfront with respect to avoiding travel, parking, and time off work, the implications to providers and payers as well as long-term cost implications from all perspectives are not well understood. **Understanding the cost implications of virtual visits is important to help inform the Alberta Health Services Virtual Care Strategy and develop policies, guidelines and planning for the expansion of virtual care services in the community setting with primary care.** Identifying where cost efficiencies can be gained is essential.
- Costs associated with virtual visits could be direct (actual visit fee, parking and transportation, equipment, room costs, clinic staff, etc.), indirect (pharmaceutical costs, referrals for diagnostic imaging or other healthcare providers, or subsequent healthcare utilization such as emergency department visits or hospitalizations), or opportunity (time off work for patients or resources used during appointments for clinic owners and/or the healthcare system). In addition to monitoring the broad cost implications, understanding whether virtual visits are as effective as in-person visits is also required. Cost-effectiveness, cost-benefit, and cost-utility analyses are needed to gain stronger insight about the implications of virtual visits.

## Executive Summary

The purpose of this rapid review was to identify and summarize the evidence pertaining to the cost implications of virtual visits on a variety of outcomes, including overall visit volume, practice patterns, follow-up care, and cost. Virtual visits were defined as real-time medical appointments between a physician and a patient over telephone or video modalities. Cost outcomes were either directly or indirectly related to the visit itself and were from the perspectives of the patient and family, physician, and the payer. Sources were limited to peer-reviewed publications or program evaluations published in or after 2010.

The review identified 29 studies involving a variety of settings. As virtual visits are an evolving, complex, and multifaceted intervention, the model of care itself is important to differentiate, as is the technology. Studies were separated into three main groups: primary care (5/29; 17%), Direct-to-Consumer (DTC) (11/29; 38%) and specialist care (13/29; 45%). The majority of studies (20/29; 69%) were in the United States. Six (21%) were randomized controlled trials (RCTs).

The certainty of evidence with respect to all forms of care (primary, DTC, specialist) across all outcomes was low. Most studies were at risk of bias either due to confounding, participant selection, reporting, missing data or brevity of follow-up. Many studies in the specialist setting had small sample sizes (an average of 161 patients, with 9/13 studies including less than 100 patients). Additionally, the

findings from most studies may not be generalizable to Alberta for a variety of reasons. Healthcare system characteristics (e.g., physician remuneration, fee structure, insurance for patients, etc.) are likely to influence both the use of virtual visits and their associated outcomes, which were not well described in most studies. Further, all studies were published prior to the COVID-19 outbreak, and the virtual visit landscape has changed significantly with respect to remuneration, technology, familiarity with technology, attitude, clinic workflow, and patient demand, among other issues.

Only 5 studies were identified in the primary care setting, of which the context, intervention, and outcomes varied considerably. Telephone-first models in the United Kingdom ultimately increased costs to the healthcare system through an increase in the overall visit frequency. When virtual visits were integrated in the primary care setting, the overall cost of primary care services decreased.

Results of studies in the DTC setting were inconsistent. When DTC platforms were integrated into an existing health centre, virtual visits did not require more follow-up visits; resulted in fewer (or the same) antibiotic prescriptions or referrals for diagnostic imaging and laboratory tests; and overall were associated with cost savings, compared to in-person care. However, the impact of visits in a commercial DTC system was less clear. Virtual visits provided through commercial vendors appeared to increase follow-up healthcare utilization; however, studies showed conflicting results, and more studies with similar comparators and outcomes are needed to better understand this relationship. Provider type (primary care physician, emergency specialist) was often not specified for the commercial DTC studies and it is possible the comparator group involved different healthcare providers than those providing the virtual visits in other settings. In the DTC setting, it is possible that the model of care (integrated with the system vs. commercial) may have larger cost implications than the technology itself.

Virtual visits in specialist care overall reduced time and costs associated with travel. However, studies typically involved a small sample and most did not follow patients over time. Studies suggest that virtual visits in the specialist setting do not impact attendance rates and result in high patient satisfaction with care. The most commonly reported benefit among studies evaluating specialist virtual visits related to the time and cost savings, including travel avoided for patients. Virtual visits in the specialist setting similarly appeared to result in cost savings to the healthcare system, particularly where physicians or patients are reimbursed for travel costs.

Overall, results were inconsistent across studies, likely due to different contexts, comparators, economic evaluation methods, time periods, patient selection approaches, and outcomes. Physician payment models and fee structures of visits were poorly described in all studies. Evidence on the impact of virtual visits in primary care is unknown and inconsistent in DTC; however, it suggests that informational and relational continuity may influence outcomes. Of note, few studies in specialist care considered long-term implications. Further, of the studies investigating the longitudinal experience of virtual visits, many found that the initial effects of implementation did not last over time. Thus, there may be a novelty effect of virtual visits to consider as adoption progresses. Lastly, the generalizability of all studies to the current Alberta landscape is limited.

## Key Messages

<p>Primary Care</p>	<p>Studies in the UK suggest that a telephone-first model may result in an overall increase in costs related to total number of visits (i.e., increase in total phone visits but decrease in face-to-face visits). Subsequent utilization of secondary services, such as urgent care, emergency department (ED) and hospitalization, are mixed. Conflicting results may be the result of different patient, provider and health system contexts. Overall, too few studies in this setting were identified to be able to draw conclusions regarding the impact of virtual visits in primary care.</p>
<p>Direct-to-Consumer</p>	<p>Two main types of DTC models were studied: one where virtual services were integrated with the in-person services and one where virtual services were offered through a commercial platform, assumed external to the existing healthcare system (i.e., no access to electronic medical record).</p> <p>Results among the DTC settings varied and the cost implications of these models are unclear. However, findings suggest that when virtual services are not integrated with in-person services, the lack of continuity (information and/or relational) may increase costs through impacting physician practice patterns or follow-up healthcare utilization.</p>
<p>Specialist Care</p>	<p>The main benefit of virtual visits in specialty care was saving patients' costs and time associated with travel, likely because most specialists are concentrated in urban areas and patients typically need to travel longer distances for visits. In situations where physicians travel to visit with patients, virtual visits similarly reduced healthcare spending by eliminating travel costs.</p> <p>One study evaluated opportunity costs and suggested that virtual visits may reduce healthcare spending for resources needed for in-person visits or may free up resources for other uses. However, further research in this area is needed to fully understand costs associated with virtual visits.</p>

## Practical Considerations

This review explored the direct, indirect, and opportunity costs associated with virtual visits from the perspective of patients, physicians, and the payer. The cost implications of virtual visits will vary depending on context, specifically the fee structure of visits, physician remuneration models (for example, fee-for-service or salary), and other considerations. The review found limited evidence with respect to the cost implications of virtual care, particularly within the primary care setting. Further, few studies considered longer-term cost implications and as such, the considerations drawn from this review are limited; however, they are described below.

- More research in primary care is needed to understand the cost implications of virtual care. While only two studies evaluated a telephone-first model, both suggested that this model of virtual care may increase costs to the healthcare system through increasing the overall primary

care visit frequency (increase in virtual but decrease in face-to-face). Subsequent healthcare utilization such as ED and urgent care visits were mixed.

- There are several types of DTC models, with varying relational and informational continuity. The review identified two main types: one (integrated) that allows consulting physicians to access the patient's medical chart and another (commercial) model that, while not always described, is typically standalone and external to the system, similar to models such as Babylon in Alberta. Unfortunately, the physician specialty was not described in most DTC studies. Overall, integrated DTC models appear to reduce costs associated with subsequent healthcare utilization, whereas the cost implications of commercial DTC platforms are less clear and may result in subsequent healthcare utilization. Utilization of prescriptions, diagnostic imaging, and laboratory tests were inconsistent across studies. While the direct cost of a DTC visit may be less expensive than an in-person visit, the longer-term cost implications are unclear and may be impacted by the absence of relational continuity and, specific to commercial platforms, informational continuity.
- In specialty care, studies suggest that virtual visits result in direct cost savings to patients (by avoiding transportation costs) and payers (when physicians are required to travel). While these positive effects are encouraging, cost savings over the long term remain unknown.
- Few formal economic evaluations were identified in the review, and findings related to cost-effectiveness, cost-utility, or cost-minimization were identified. Overall, the impact of virtual visits on cost and efficiency remains unclear.
- Details on the physician payment model, remuneration policies for virtual visits, and fee structures were poorly described across all studies, all of which are important considerations when examining the cost implications of virtual care in either primary or specialty care.
- Ensuring virtual visits integrate with the existing healthcare system is important to realize any appreciable, consistent cost savings. Studies suggest that integrated virtual care models, allowing for informational or physician continuity, may result in higher cost savings than those external to the healthcare system.
- Future work aimed at the long-term cost implications, with larger sample sizes and efforts to reduce confounding are needed. Due to the importance of context, studies in Alberta evaluating the recent implementation of virtual visits across primary and specialty care may help provide useful guidance related to the direct and indirect cost implications of virtual visits.

## Overview of Review Process

An extensive literature search was performed on 23 June, 2020, with support from a librarian at Alberta Health Services Knowledge Resource Service. Key databases were searched: OVID (Medline + PubMed) and CINAHL and Google Scholar (Appendix B, Table 3). The TRIP medical database was additionally searched for grey literature.

The database search identified 5,461 citations and 89 additional sources that were considered (Appendix C, Figure 1). After duplicates were removed, 4,420 references were screened for eligibility

based on pre-specified criteria (Appendix B, Table 2). In brief, studies were eligible if they were published in 2010 onward, studied telephone or video visits between a physician and a patient, and occurred in an OECD country. Studies using traditional Telehealth or involving shared care models were excluded.

Twenty-nine unique studies were included in the final review: 5 in primary care,<sup>2-6</sup> 11 using a DTC model,<sup>7-17</sup> and 13 in specialist clinics.<sup>18-30</sup>

Data were extracted from included studies using a standard template. Information on the study setting, intervention design, comparator, and any other relevant details, and results were extracted (Appendix C, Table 4). Findings were summarized according to main setting (primary care, direct-to-consumer, specialist, other) and presented by overall question theme. ML also assessed study quality of randomized controlled trials using the Revised Cochrane risk-of-bias tool for randomized trials (RoB 2)<sup>31</sup> and of cohort studies using the Risk Of Bias In Non-randomized Studies – of Interventions (ROBINS-I) assessment tool.<sup>32</sup>

## Strength of Evidence

The evidence pertaining to the cost implications of virtual visits in any setting is limited and the overall cost implications of virtual visits are uncertain. Findings varied significantly across the different settings and appeared to be context specific. Among the 29 studies, 20 were in the United States, five were in the United Kingdom, 2 were in Canada, 1 was in Australia, and 1 in the Netherlands. Overall, study quality across all groups was low due to risks of confounding, selection, reporting, and missing data bias. In many studies, sample sizes were small and follow-up periods were short. Further, as context is important when considering the cost implications of virtual visits (for example, the fee structure and remuneration policies for visits), the generalizability of these studies and application to Alberta is unclear.

### Primary Care

The evidence pertaining to the cost implications of virtual visits in the primary care setting is limited and the overall impact of primary care virtual visits is uncertain. None of the studies were randomized controlled trials and therefore may be at risk of confounding and selection bias. Overall, the impact of virtual visits on overall visit frequency is unclear due to the limited studies reviewed; however, telephone-first strategies resulted in an overall increase in the number of total visits and mixed results pertaining to subsequent healthcare utilization in two studies.

### Direct-to-Consumer (DTC)

Evidence about the impact of DTC models on cost is similarly uncertain. Integrated models appeared to reduce healthcare system costs as the direct cost for a virtual appointment is often less than an in-person comparator. When DTC models were integrated in an existing hospital or health centre, there was no resulting increase in follow-up care and, overall, the upfront cost of a virtual visit was less than that of an in-person visit, which may imply a positive cost savings to payers. Commercial models had conflicting results and the overall evidence about the use of commercial DTC platforms is unclear. Further, the DTC studies reviewed did not include a long follow-up period and allocation was not randomized, risking potential selection bias. Physician specialties were often not described and potentially different between virtual and in-person visits. Similarly, none of the studies were randomized trials and at risk of confounding and selection bias. Commercial models were additionally at risk of reporting and sponsorship bias.

## Specialist Clinics

Overall, the evidence suggests virtual visits in specialist care may reduce costs for patients due to travel avoidance. Further, virtual visits may reduce healthcare spending in systems that reimburse patient or physician travel expenses. However, most of the studies in specialist care were smaller feasibility studies and only half were randomized controlled trials. Many had missing data and did not consider downstream effects or costs. Similarly with primary care, the generalizability of the studies in specialty care and the application to Alberta may be limited.

## Limitations of Review

The review has important limitations that should be considered. Only 6/29 (21%) studies were RCTs, all of which occurred in the specialist setting. Few studies, particularly in the primary and specialist care settings, monitored the immediate outcomes of virtual visits (for example, whether subsequent healthcare services were required). Studies varied substantially in context (patient population, country interventions, purpose of visit, clinic structure, follow-up period, outcomes measured) and therefore it was difficult to compare findings.

Of the 17 studies reporting cost outcomes, only one reported cost-effectiveness, one cost-utility, and one cost-minimization. The majority used a cost-consequence analysis that often did not include a comprehensive or longitudinal perspective on cost or outcomes.

Less than one third of studies (8/29; 28%) reviewed were published in 2015 or earlier and fewer than half (13/29) in the last two years. Due to the rapid evolution of technology over recent years, studies from previous years that focus on costs may be less relevant to the virtual care landscape today. The COVID-19 pandemic has had considerable influence on virtual care delivery, including remuneration policies, access to technology, experience with virtual care, and efficiency. The generalizability of findings from studies examining cost implications of virtual care prior to the COVID-19 pandemic may be limited due to changes in policy and adoption of virtual care in practice.

## Detailed Summary of Findings

### Primary Care

Five observational studies evaluated the impact of virtual visits in the primary care setting. Two studies were in primary care clinics that studied integrated virtual visits<sup>2,3</sup> (for example, both in-person and virtual visits were available and selected as per physician discretion). Two studies adopted a telephone-first model<sup>4,5</sup> and 1 was exclusively in a continuing care facility.<sup>6</sup>

Among the two integrated studies, one was in British Columbia, Canada<sup>2</sup> and compared outcomes between patients receiving traditional in-person care and those receiving virtual visits, offered through an integrated electronic medical record platform. The other was in Scotland<sup>3</sup> involving 9 primary care practices belonging to the Scottish Primary Care Research Network, and compared outcomes between telephone and in-person visits. McGrail et al.<sup>2</sup> matched cohorts on patient age, sex, and location and used a time-series analysis to estimate spending trends<sup>2</sup>. McKinstry et al.<sup>3</sup> adjusted analyses by age, sex, consulting provider, duration of consultation, the number and type of problem, and whether the doctor or patient initiated the consultation.<sup>3</sup> However, the only outcome used in this review was consultation duration, which was not adjusted.

The 2 studies exploring a telephone-first strategy compared outcomes prior to and after implementation. One studied a single primary care practice in a socioeconomically deprived urban setting in Northern Ireland<sup>4</sup> and one studied 147 practices across the United Kingdom, both of which were supported by a company (Doctor First and GP Access).<sup>5</sup> Miller et al.<sup>4</sup> used an interrupted time series model and Newbould et al.<sup>5</sup> adjusted encounter outcomes (consultation time, duration, continuity of care, etc.) by the month and day of the week, and adjusted secondary care use outcomes by patient demographics, as well as national, seasonal, and long-term trend effects, clustering by practice.

The study of a continuing care facility in New York State, USA, evaluated the use of a virtual care service to connect primary care physicians with residents of senior living communities across the State.<sup>6</sup> The authors controlled analysis for study variables found to be imbalanced, which were not described. Findings of the study suggest that integrated virtual visits in the primary care setting do not impact the overall visit frequency. McGrail et al.<sup>2</sup> found no difference in the number of subsequent follow-up primary care visits required between virtual or in-person care.<sup>2</sup> McKinstry et al.<sup>3</sup> compared visit duration between telephone and in-person consults and reported that, on average, virtual visits were shorter compared to in-person visits (4.6 minutes vs. 9.7 minutes, respectively;  $p < 0.001$ ).<sup>3</sup> The impact of virtual visits on overall visit frequency was not reported in this study.

#### *Virtual vs. In-Person Visits*

Studies using a telephone-first strategy in primary care clinics suggest that this model of care may increase overall visit frequency. Miller et al.<sup>4</sup> and Newbould et al.<sup>5</sup> found an increase in the overall total number of visits after implementing the strategy, through a substantial increase in virtual visits accompanied with a small decrease in in-person visits. Miller et al.<sup>4</sup> studied a practice in a socioeconomically deprived urban setting in Northern Ireland with a patient list size of 11,500 and 6.75 full-time equivalent primary care physicians. Prior to implementing a telephone-first strategy, there was a monthly mean of 3,384 visits, which increased to 4,412 with the intervention ( $p < 0.001$ ). Newbould et al.<sup>5</sup> studied practices in the United Kingdom that employed two companies to support the implementation and reported an increase of 5.3 visits/day/1000 patients ( $p < 0.001$ ). Both studies found an increase in the number of telephone consultations (133%<sup>4</sup> and 1204%<sup>5</sup>) and a decrease in the number of in-person visits (39%<sup>4</sup> and 38%<sup>5</sup>) ( $p < 0.001$ ). The impact that virtual visits have on overall visit frequency in the continuing care setting was not reported.

#### *Practice Patterns*

The effect that virtual visits have on physician practice patterns was studied in two studies: one using an integrated model<sup>2</sup> and one using a telephone-first model.<sup>4</sup> Among the integrated model, McGrail et al.<sup>2</sup> reported that virtual visits more often resulted in a prescription than in-person visits and less often resulted in a referral for laboratory testing or diagnostic imaging ( $p < 0.001$ ).<sup>2</sup> McGrail et al.<sup>2</sup> also found that surgical specialist referrals were more common among in-person visits compared to virtual visits ( $p < 0.001$ ). No difference was reported in medical specialty referrals. In the telephone-first model, Miller et al.<sup>4</sup> reported no impact of virtual visits on practice patterns,<sup>4</sup> but studied only laboratory testing.

#### *Healthcare Utilization*

Three studies evaluated the impact of virtual visits on subsequent healthcare utilization, two using a telephone-first strategy<sup>4,5</sup> and one using video visits in a primary geriatric clinic.<sup>6</sup> Among the telephone-first studies, Miller et al.<sup>4</sup> found no change to the number of hospital referrals, primary clinic out-of-hours, or ED attendances<sup>4</sup>. Newbould et al.<sup>5</sup> found that within the first year of implementation, the telephone-first approach led to an increase (2%) in total hospital admissions ( $p < 0.01$ ), specifically

related to an increase in admissions for ambulatory care-sensitive conditions (ACSCs) ( $p < 0.01$ ), and ED admissions ( $p < 0.01$ ).<sup>5</sup> One year following the implementation, the increase in total hospital admissions or ED visits was not sustained; however, the increase in admissions for ACSCs continued ( $p < 0.01$ ) and an increase in elective admissions was now observed ( $p < 0.01$ ).<sup>5</sup> In the continuing care model, Shah MN et al.<sup>6</sup> found that, after adjusting for participant and facility characteristics, a reduction of subsequent ED visits (for ACSCs) was reported among virtual visits at an annual rate of 34% (RR: 0.661, 95% CI (Confidence Indicator): 0.444 to 0.982). In the control group, a non-significant increase in emergency department visits was observed at a rate of 1.2 (95% CI: -10.5 to 14.3). However, the difference in ED visits between groups (in-person and virtual) was not statistically significant ( $p = 0.0622$ ).<sup>6</sup>

### Cost

The impact of virtual visits on monetary outcomes was evaluated in two studies in the primary care setting: one in an integrated model<sup>2</sup> and one using a telephone-first strategy.<sup>5</sup> McGrail et al.<sup>2</sup> reported that virtual visits, when integrated into the in-person model, reduced primary care costs by approximately CA\$4 per quarter (CA-\$3.79,  $p = 0.01$ ), when compared to matched (patient age, sex, diagnosis) in-person controls.<sup>2</sup> Newbould et al.<sup>5</sup> found that the telephone-first strategy led to an estimated overall increase in secondary care costs related to ED admissions (GB £11,766 per 1,000 patients) during the first year of telephone-first implementation.<sup>5</sup>

The overall quality of studies in the primary care setting was low. As no studies were randomized, they were at risk of confounding bias. The certainty of evidence on primary virtual visits was similarly low. Studies were heterogeneous in setting, intervention, and outcomes and, overall, too few studies were identified to draw any definitive conclusion.

In conclusion, the impact of virtual visits in the primary care setting on overall visit numbers, practice patterns, or cost is unclear. Virtual visits in an integrated model did not lead to an increase in subsequent follow-up visits with a primary care provider, compared to in-person visits. Physician practice patterns may change slightly when visits are offered virtually, as virtual visits more often resulted in prescriptions and referrals to surgical specialists compared to in-person visits, and less often resulted in laboratory testing or diagnostic imaging. Telephone visits may be generally shorter than in-person visits, but thus may be at risk of missing important information needed for accurate diagnosing in some situations.

Telephone-first strategies appear to reduce the number of in-person visits but many, however, increase the overall visit rate. Cost implications of the telephone-first strategy over time are unclear, but an increase in hospital admission rates for ACSCs was identified in one study. Further, while telephone-first strategies may reduce the wait time for an appointment, some patients expressed frustration with the callback system and found communication by telephone more difficult. The impact of telephone-first strategies with respect to continuity of care and workload varied substantially across clinics. Lastly, the impact of virtual primary care services for senior living communities on emergency department use was unclear over time.

### Direct-to-Consumer

Eleven studies evaluated a DTC service, with varying models of care. Three studies (27%) were among healthcare institutions that offered a virtual walk-in clinic through an integrated DTC platform<sup>8,10,12</sup> and 8 (73%) used a commercial DTC platform, most often Teladoc.<sup>7,9,11,13-17</sup> The type of physician providing care in these models was often not described. Among the integrated models, physicians providing

virtual care were board-certified or board-eligible emergency physicians based in an academic practice,<sup>8</sup> or were emergency physicians at the Jefferson Health hospital network.<sup>12</sup> Lovell et al.<sup>10</sup> studied virtual DTC visits offered through the Intermountain Virtual Care program, but did not describe the specialty of the physicians providing virtual or in-person visits.<sup>10</sup> The comparator physician varied across studies. Davis et al.<sup>8</sup> selected in-person visits as a comparator, which were provided by community-based nurse practitioners, physician assistants, or primary care physicians.<sup>8</sup> Lovell et al.<sup>10</sup> selected visits from urgent care centres, primary care offices, and emergency departments as an in-person comparator. The consulting physician's specialty was not described for these visits.<sup>10</sup> Nord et al.<sup>12</sup> selected only virtual visits, and asked respondents to state where they would have sought care if the DTC service had not been available, to estimate potential cost implications.<sup>12</sup>

Among the 3 integrated models, the patients' electronic medical records were available to consulting physicians. Davis et al.<sup>8</sup> evaluated visits among adults with sinusitis, Lovell et al.<sup>10</sup> studied visits for low-acuity urgent conditions,<sup>10</sup> and Nord et al.<sup>12</sup> included all visits through the service and did not select based on a specific diagnosis.<sup>12</sup> Davis et al.<sup>8</sup> and Lovell et al.<sup>10</sup> matched virtual and in-person visits based on condition (acute sinusitis<sup>8</sup> and low-acuity urgent conditions,<sup>10</sup> respectively) and selected patients from the same timeframe. Additionally, Davis et al.<sup>8</sup> matched the in-person and virtual cohorts; however, the specific variables were not described. Lovell et al.<sup>10</sup> matched cohorts by age and comorbidities. Nord et al.<sup>12</sup> did not use a comparator group.<sup>12</sup>

Among the commercial DTC studies, Gordon et al.<sup>9</sup> indicated that physicians providing the virtual visits were either primary care, internal medicine, general medicine, or pediatric.<sup>9</sup> Martinez et al.<sup>11</sup> also reported that the virtually visiting physician's specialty was either primary care, internal medicine, emergency medicine, or other.<sup>11</sup> None of the remaining commercial DTC studies<sup>7,13-17</sup> clarified the specialty of the physician providing either the virtual or in-person visits. The platform type also varied among the studies: 4 used Teladoc,<sup>7,15-17</sup> 1 used the Amwell platform (Online Care Group)<sup>11</sup>, 1 used the Live Health Online platform (Anthem, Inc.),<sup>9</sup> and 2 used an unspecified DTC platform.<sup>13,14</sup> Three of the Teladoc studies were published by the same author using a similar claims dataset;<sup>15-17</sup> however, each study addressed different outcomes. Gordon et al.<sup>9</sup> disclosed that the company owning the DTC platform being investigated funded the study.<sup>9</sup> All 11 studies took place in the United States and were cohort studies.

Of the 8 commercial DTC studies, 5 evaluated encounters for acute respiratory infections only,<sup>7,11,13,14,16</sup> Gordon et al.<sup>9</sup> studied all acute, non-urgent conditions,<sup>9</sup> Uscher-Pines et al.<sup>16</sup> did not limit virtual encounter type, but mentioned the most common were acute respiratory and urinary tract infections and skin problems, and were matched with in-person visits for a similar condition.<sup>15</sup> Uscher-Pines et al.<sup>17</sup> were primarily interested in patient characteristics associated with virtual visit use; however, limited virtual and in-person visit type when studying the impact of modality on practice patterns.<sup>17</sup> For example, laboratory testing outcomes were limited to encounters for pharyngitis; imaging referral outcomes were limited to encounters for back pain; and antibiotic prescribing patterns were limited to encounters for acute bronchitis. All 8 studies selected the virtual and in-person visits from the same study period to reduce the risk of confounding. Six studies<sup>7,9,13-16</sup> further attempted to control for confounding through matching virtual and in-person cohorts, or adjusting analyses, by patient characteristics (most often age, sex, and comorbidities). Martinez et al.<sup>11</sup> studied virtual visits only and examined the association between patient satisfaction with a visit and prescription outcome, adjusting for patient, physician, and encounter characteristics.<sup>11</sup> Uscher-Pines et al.<sup>17</sup> adjusted analyses when examining factors related to Teladoc use; however, when comparing in-person and virtual visits, did not adjust or match cohorts other than the time period of the visits and condition.<sup>17</sup>

### *Virtual vs. In-Person Visits*

Six studies examined whether virtual visits offered through a DTC model add to or replace in-person care: one in an integrated model<sup>12</sup> and five using a commercial model.<sup>7,9,12-15</sup> Nord et al.<sup>12</sup> tested a platform that was integrated into an existing health centre, and physicians had access to patients' medical records during the visit. Patients were surveyed after a virtual visit to inquire about additional care needed within 2-3 days of their initial visit. Of 172 patients, 15% followed up with their doctor and 1% went to a retail health clinic. Seventy-four per cent of patients did not need to seek additional follow-up care, implying the virtual visit was able to resolve the initial complaint.<sup>12</sup>

Five studies evaluated commercial DTC platforms. Ashwood et al.<sup>7</sup> found that, of the 981 virtual visits (Teladoc), 12% replaced visits to other providers and 88% represented new utilization.<sup>7</sup> When comparing an initial visit through a commercial DTC platform to an in-person visit at an urgent care centre, 3 studies found that visits via the commercial DTC model resulted in more follow-up visits compared to the in-person visits at the urgent care centre.<sup>9,13,14</sup> Two of these 3 studies also compared follow-up visit use after commercial DTC visits with in-person primary care clinic visits<sup>13,14</sup> and similarly found a higher frequency of follow-up visits after commercial DTC visits. Conversely, Uscher-Pines and Mehrotra<sup>15</sup> found that virtual visits resulted in fewer follow-up visits than those initially conducted at a primary care clinic.<sup>15</sup> Gordon et al.<sup>9</sup> and Uscher-Pines and Mehrotra<sup>15</sup> found that commercial DTC visits had lower follow-up rates than those initially occurring at an emergency department, when adjusted for age comorbidities.<sup>9,15</sup> Follow-up visit rates were the same between virtual visits and those at retail health clinics.<sup>9</sup>

### *Practice Patterns*

Eight studies evaluated the impact of virtual DTC models on practice patterns related to prescribing or referrals, 2 in an integrated model<sup>8,10</sup> and 6 using commercial models.<sup>9-11,13,14,16,17</sup>

Among the integrated models, Davis et al.<sup>8</sup> studied visits for acute sinusitis and Lovell et al.<sup>10</sup> studied visits for low-acuity, urgent conditions. Davis et al.<sup>8</sup> found that virtual visits resulted in a lower rate of antibiotic prescribing compared to in-person visits ( $p < 0.001$ ).<sup>8</sup> Lovell et al.<sup>10</sup> found no difference in antibiotic use between virtual visits and all three forms of in-person care (urgent care centre, primary care office, emergency department), when matched by age and comorbidity status and within the same time period (April 2016 to March 2017).<sup>10</sup> Lovell et al.<sup>10</sup> also found that virtual visits resulted in fewer referrals for laboratory testing and diagnostic imaging compared to visits in primary care physician offices, urgent care centres, or emergency department visits,<sup>10</sup> when matched as described above.

Among the studies of commercial DTC visits, the impact on practice patterns varied. Shi et al.<sup>14</sup> evaluated outcomes of visits for acute respiratory infections and found that virtual visits resulted in fewer antibiotic prescriptions compared to in-person visits (any type as well as broad spectrum specifically) and better concordance with antibiotic management guidelines, compared to in-person care ( $p < 0.001$ ).<sup>14</sup> Conversely, Gordon et al.<sup>9</sup> and Ray et al.<sup>13</sup> found that virtual visits were more likely to result in an antibiotic prescription than in-person visits ( $p < 0.001$ ).<sup>9,13</sup> Further, among visits for acute respiratory infections, Uscher-Pines et al.<sup>16</sup> found that virtual visits were more likely to result in a prescription for a broad-spectrum antibiotic compared to an in-person visit ( $p < 0.01$ ).<sup>16</sup> Similarly, Gordon et al.<sup>9</sup> found that, when adjusted for acute condition, patient age, sex, and location, and quarter and year of visit, virtual visits were more likely to result in a prescription for a broad-spectrum antibiotic compared to in-person visits at a retail health clinic, an urgent care centre, or an emergency department visit ( $p < 0.01$ ), but the same as in-person visits at a primary care clinic.<sup>9</sup> Uscher-Pines et

al.<sup>17</sup> and Ray et al.<sup>13</sup> compared physician accordance with antibiotic guidelines and found that virtual visits were less likely to accord with guidelines.<sup>13,17</sup> For example, Uscher-Pines et al.<sup>17</sup> reported that among uncomplicated acute bronchitis cases, in-person visits were more likely to correctly avoid antibiotic prescribing as advised, compared to virtual visits.<sup>17</sup> Ray et al.,<sup>13</sup> examining pediatric visits for acute respiratory infections, found that virtual visits were less likely to result in guideline-concordant antibiotic management compared to in-person visits, when matched on age, sex, chronic medical complexity, and respiratory infection diagnosis, among others ( $p < 0.001$ ).<sup>13</sup> Martinez et al.<sup>11</sup> explored the impact of receiving a prescription on patient satisfaction with care and found that, compared with receiving no prescription, receipt of a prescription for an antibiotic was strongly associated with a high patient satisfaction rating (adjusted odds ratio, 3.23; 95%CI, 2.67-3.91), as was receiving a prescription for a non-antibiotic medication (adjusted odds ratio, 2.21; 95% CI, 1.80-2.71).<sup>11</sup>

Among commercial DTC models, virtual visit providers were less likely to order laboratory testing or diagnostic imaging, compared to in-person visits. Three studies specifically compared streptococcal testing among visits with a diagnosis of streptococcal pharyngitis, and found virtual visits were less likely to appropriately order the test compared to in-person settings ( $p < 0.001$ )<sup>13,14</sup> ( $p < 0.01$ ).<sup>17</sup> Gordon et al.<sup>9</sup> also found lower laboratory testing or diagnostic imaging among virtual visits compared to those at primary care physician offices, urgent care centres, or ED visits, but the same rate as in retail health clinic visits.<sup>9</sup> Uscher-Pines et al.<sup>17</sup> evaluated imaging studies (x-ray, magnetic resonance imaging, computed tomography scan) among low back pain encounters and found equal rates between virtual and in-person visits.<sup>17</sup>

### *Healthcare Utilization*

Five studies evaluated the impact of DTC virtual visits on healthcare utilization. Lovell et al.<sup>10</sup> studied an integrated model within an existing health centre<sup>10</sup> and 4 studied a commercial DTC platform.<sup>9,13-15</sup>

Lovell et al.<sup>10</sup> examined an integrated DTC model in an existing health centre, evaluating the impact of virtual visits on subsequent emergency or urgent healthcare utilization 21 days following the initial visit. There were no differences in subsequent healthcare utilization (evaluation and management, ED visit, hospitalization, or any follow-up visit) between care received virtually, at an urgent care centre, or at a primary care clinic. Patients that received their initial visit at an emergency department reported higher rates of all follow-up visit types. However, a greater proportion of patients seeking initial care at an emergency department had a history of a myocardial infarction, were older, more likely to receive a diagnosis for an upper respiratory or urinary tract infection, and less likely to receive a diagnosis for sinusitis, compared to those seeking virtual care ( $p < 0.001$ ).<sup>10</sup>

Healthcare utilization following commercial DTC visits was unclear. Gordon et al.<sup>9</sup> monitored ED visits or hospitalizations within 21 days of the initial visit and found that virtual visits reported significantly fewer follow-up ED visits and hospitalizations than those occurring at a primary care provider office, urgent care centre, or emergency department, but the same as those at a retail health clinic.<sup>9</sup> Three studies also monitored subsequent visits, but did not specify the site of the follow-up encounter. Uscher-Pines and Mehrotra<sup>15</sup> monitored follow-up visits within 21 days for either a condition similar to the index visit or for any reason. Follow-up visits for similar conditions or any reason were less among virtual visits compared to initial visits at either primary care physician offices or Eds.<sup>15</sup> Conversely, Ray et al.<sup>13</sup> and Shi et al.<sup>14</sup> found that initial virtual visits resulted in a higher rate of follow-up visits (return acute respiratory infection visit<sup>13</sup> and not specified<sup>14</sup>) compared to visits initially at urgent care centres or primary care provider offices ( $p < 0.001$ ).<sup>13,14</sup>

### Cost

Four studies evaluated the impact of virtual visits on cost. Lovell et al.<sup>10</sup> and Nord et al.<sup>12</sup> studied a DTC model within an existing health centre and Ashwood et al.<sup>7</sup> and Gordon et al.<sup>9</sup> studied a commercial DTC platform.

Three studies reported the cost (all in USD) of the visit itself and found that the fee of a virtual visit was lower than for an in-person visit.<sup>7,9,10</sup> Intermountain virtual care visits cost \$45 compared to \$136 for an urgent care centre visit, \$114 for a primary care clinic visit, and \$1,384 for an ED visit ( $p < 0.001$ ).<sup>10</sup> Teladoc visits were about 50% of the cost of physician office visits and less than 5% of the cost of an ED visit, predicted to result in a \$20 reduction in cost to the patient.<sup>7</sup> The LiveHealth Online platform offered virtual visits at a lower cost (\$49) to those at retail health clinics (\$74), primary care physician offices (\$109), urgent care centres (\$134), or emergency departments (\$1,404). One study reported that, when patients seek care at an ED visit rather than a virtual visit, adjusting for condition and patient age, costs could be nearly 30-fold higher (relative cost ratio of 28.75; 95% confidence interval [CI]: 28.39-29.36).<sup>9</sup>

Nord et al.<sup>9</sup> did not directly compare the encounter rate across DTC virtual and in-person visits; however, estimated diversion savings that virtual care may provide through avoidance of more expensive in-person visit options.<sup>12</sup> Patients attending virtual visits through the JeffConnect app (offered through the Jefferson Health academic medical centre) were asked where they would have sought treatment had the virtual service not been available. Of the 650 patients, 12% would have gone to the emergency department, 33% would have done so to urgent care, 5% would have gone to a retail health clinic, 34% would have gone to see their doctor, and 16% would have done nothing. This resulted in an estimated 'savings from diversion' of US\$57 to \$238.<sup>12</sup>

Costs associated with follow-up medical care were evaluated in 4 studies: Lovell et al.<sup>10</sup> and Nord et al.<sup>12</sup> studied an integrated model where DTC visits were offered through an existing health centre, and Ashwood et al.<sup>7</sup> and Gordon et al.<sup>9</sup> through a commercial platform. Lovell et al.<sup>10</sup> and Nord et al.<sup>12</sup> both showed positive cost savings through virtual visits. Lovell et al.<sup>10</sup> found that follow-up medical costs after virtual visits were lower compared to costs after primary care clinic visits ( $p = 0.038$ ) and ED visits ( $p < 0.001$ ), but not different than visits initially seen at an urgent care centre, when adjusted for age, comorbidity, and time period of visit.<sup>10</sup> Nord et al.<sup>12</sup> surveyed patients about subsequent care within 2-3 days of their virtual visit. Five per cent of patients reported they sought additional care at the emergency department, 4% went to urgent care, 1% went to a retail health clinic, 15% saw their doctor and 74% did not seek additional care. This resulted in an estimated 'costs reported post-visit' of US\$38 to \$118 per visit. The virtual care service used in this study was the JeffConnect app, available at the Jefferson Health academic medical centre.<sup>12</sup>

Gordon et al.<sup>9</sup> and Ashwood et al.<sup>7</sup> evaluated commercial DTC platforms and compared the costs for follow-up care within 21 days of the initial visits between virtual and in-person care. Gordon et al.<sup>9</sup> found that follow-up medical costs after virtual visits were lower compared to costs after primary care clinic or urgent care centre visits and emergency department visits but not different to those following visits at retail health clinics.<sup>9</sup> Ashwood et al.<sup>7</sup> found an increase in follow-up costs (for evaluation and care management) among virtual visits compared to in-person visits ( $p = 0.01$ ).<sup>7</sup>

The overall quality of studies in both the integrated and commercial DTC setting was low. No studies randomized intervention groups and all were at risk of confounding bias. Even among studies that adjusted models for patient demographic variables, confounders related to healthcare utilization are often complex and beyond standard demographic characteristics. Further, many studies in the DTC

setting are at risk of reporting bias, as few published a pre-specified analysis plan prior to publishing the primary results and many included multiple eligible outcome measurements and analyses. The certainty of evidence on DTC virtual visits was similarly low. Studies were heterogeneous in setting, intervention, and outcomes, and overall findings were inconsistent.

In conclusion, the impact of DTC virtual visits varied. In integrated models, virtual visits did not require more follow-up care, compared to in-person visits. Virtual visits resulted in fewer (or the same) antibiotic prescriptions and fewer referrals for diagnostic imaging and laboratory tests compared to in-person care. Overall, virtual visits using integrated DTC services were shown to decrease overall costs. Comparing virtual visits with those occurring at a primary care clinic, an urgent care centre, or an ED, costs were lower or the same across the different in-person options. Total estimated net savings varied across settings but demonstrated an overall cost savings with an integrated DTC model.

Among commercial DTC models, the impact of virtual visits on subsequent follow-up care was less clear. The majority of studies showed an increase in subsequent follow-up care after a virtual visit, compared to in-person visits. One study estimated that 88% of Teladoc visits represent new utilization and are therefore not replacing in-person visits. Concordance with antibiotic management among commercial DTC services was inconsistent. Some studies found that virtual visits were more likely to result in an antibiotic prescription where others found no difference or a reduced rate. Referrals for laboratory testing and diagnostic imaging appeared to be lower among virtual visits. Among patients with a streptococcal pharyngitis diagnosis, those attending virtual visits were less likely to receive streptococcal testing than those at in-person visits.

The cost implications of virtual visits through commercial DTC platforms are similarly unclear. The visit cost of virtual encounters appeared to be less expensive (particularly when compared to an ED visit); however, the impact on downstream costs was inconsistent. Costs for prescriptions and diagnostic imaging associated with visits were conflicting (some showing virtual visits increase these costs, others showing a decrease). Two studies compared costs of follow-up medical care between initial virtual and in-person visits and reported opposing findings: one finding that virtual visits increased subsequent evaluation and management costs, compared to an initial in-person visit at a physician's office; and the other that virtual visits decreased follow-up medical costs, compared to in-person visits at either a primary care physician's office, an urgent care centre, or an emergency department.

Of important note, the majority of these studies were retrospective and identified cohorts based on whether patients had previously self-selected a DTC service or sought in-person care. There may be important differences among patients that choose these services. For example, one study found that patients using Teladoc were younger, less likely to have used healthcare prior to the visit, and more likely to live further away from an urgent care centre. Further, many of these studies evaluated claims and had large sample sizes, and it is possible significant findings may have been due to chance or bias. Economic evaluations in the studies exploring costs were weak. Lastly, one of the studies was funded by the platform being tested and is therefore at risk of sponsorship bias.

### Specialist Clinics

Of the 13 studies involving specialist virtual care, 7 were for routine outpatient specialist care (5 in neurology,<sup>19,22,25,27,28</sup> 1 urogynaecology,<sup>24</sup> 1 pediatric gastroenterology,<sup>18</sup> 3 for post-operative follow-up care (pediatric urological surgery,<sup>23</sup> prostatectomy,<sup>29</sup> plastic surgery<sup>30</sup>), 2 provided care at a continuing care facility,<sup>20,26</sup> and one was for palliative care.<sup>21</sup> Of the routine follow-up settings, 5 were in the United

States, 1 was in the United Kingdom (pediatric gastroenterology), and 1 was in Canada (adult neurology clinic). Two of the post-operative visit studies were in the United States and 1 in the Netherlands (facial surgery). Both continuing care facility studies were in the United States and the one studying pediatric palliative care was in Australia.

Six studies were randomized controlled trials.<sup>18,22,24,27,29,30</sup> Among the 7 cohort studies, 4 studied a virtual cohort only, asking participants to reflect on previous costs and travel time to estimate potential cost savings.<sup>19-21,25</sup> Two studies matched in-person and virtual cohorts; one on surgical case<sup>23</sup> and the other on a variety of variables including patient age, sex, race, primary language, insurer, preregistration visit frequency, distance to clinic, subspecialty type, prior appointment no-shows, and date of registration in the program<sup>28</sup>. One study compared direct appointment costs between in-person and virtual visits.<sup>26</sup> Encounters in both groups were during the same time periods (November 2002 and July 2008) for psychiatry; however, analyses were not adjusted for potential confounding variables and the characteristics of patients receiving virtual and in-person visits were not compared. The outcomes of this study were exclusively based on distance from the continuing care facility to the specialist clinic and their model of reimbursement for travel costs, which may not be generalizable to Alberta.

#### *Virtual vs. In-Person Visits*

Shah S et al.<sup>6</sup> evaluated the impact of virtual visits on overall visit frequency in a cohort of patients attending outpatient neurology ambulatory clinics in the United States (519 were registered in the virtual visit program and 519 attended in person).<sup>28</sup> Immediately after registration with the virtual visit program, the number of in-person visits among registered users decreased (1.1 visit reduction per person-year), but this effect diminished over time. After 18 months, the in-person visit rate was similar between patients registered in the virtual visit program and those not registered. Over the 1.5-year period, the use of virtual visits reduced in-person visits by 33%, but the total number of visits (virtual plus in-person visits) increased by 80%.<sup>28</sup>

Dorsey et al.<sup>22</sup> and Finkelstein et al.<sup>23</sup> found that none of the participants receiving virtual visits required an in-person visit during the course of the study.<sup>22,23</sup> Jones et al.<sup>24</sup> evaluated telephone visits for urogynaecology follow-up and found that patients receiving virtual visits were more likely to receive a referral to a primary care provider (48.1%) than those receiving in-person care (23.6%) ( $p=0.008$ ).<sup>24</sup>

Akobeng et al.,<sup>18</sup> Finkelstein et al.,<sup>23</sup> and Robb et al.<sup>27</sup> compared the appointment compliance rate (the proportion of scheduled appointments that were completed) between virtual and in-person visits. All three found no difference in compliance between virtual and in-person visits. Akobeng et al.<sup>18</sup> found that consultation by telephone significantly reduced consultation time overall by 4.3 minutes per consultation ( $p<0.001$ ), without affecting quality of life, parent or patient satisfaction with care, or acuity of disease.<sup>18</sup> Jones et al.<sup>24</sup> also found that the mean telephone consultation duration was shorter (10.94 minutes) compared with in-person consultation (25.9 minutes);<sup>24</sup> however, this was not statistically assessed.

Among video visits, the total visit duration was also shorter than in-person visits.<sup>23,27</sup> However, the proportion of the visit that patients spent with their physician was longer during video visits compared to in-person consultations in both studies. Finkelstein et al.<sup>23</sup> found that patients spent less time waiting to see the physician during virtual visits ( $p<0.0001$ )<sup>23</sup> and Robb et al.<sup>27</sup> reported a mean total visit time of 126 minutes for in-person visits compared to 39 minutes for virtual visits ( $p<0.001$ ), through time avoided for travel and parking.<sup>27</sup> Viers et al.<sup>29</sup> examined post-operative follow-up video visits for men recovering from radical prostatectomy and found that virtual visits were equivalent in time efficiency

relative to in-person office visits, measured by the difference in total time devoted to patient care, total patient face time, patient–staff face time, or patient waiting time.<sup>29</sup>

### *Healthcare Utilization*

Finkelstein et al.<sup>23</sup> explored post-operative follow-up virtual visits and evaluated their impact on subsequent utilization of urgent healthcare. No difference was found in either the number of ED visits or readmission rates between the virtual or in-person visits within 30 days of surgery.<sup>23</sup>

### *Cost*

12 studies reported on outcomes either related to patient costs, time, or travel (10 studies) or healthcare system or facility costs (7 studies). Economic evaluation approaches included cost-consequence analysis (8 studies), cost-minimization analysis (1 study), cost-utility analysis (1 study), or cost-effectiveness analysis (1 study). One study reported only on time saved (effectiveness evaluation).

Of the six studies evaluating patient costs, all reported positive cost savings. Appireddy et al.<sup>19</sup> reported that video visits for outpatient neurology clinics, catering predominantly to seniors, in Kingston, Ontario, reported on average that patients save CA\$52.83 (range CA\$31.26–\$94.53) total out of pocket per patient visit.<sup>19</sup> Robb et al.<sup>27</sup> reported an average cost savings of US\$49 per patient visit (routine clinic video visits in the United States with neurologists for adults with multiple sclerosis) ( $p=0.02$ ).<sup>27</sup> There was no difference in patient-reported satisfaction with care in either study.

Jones et al.<sup>24</sup> evaluated routine follow-up telephone visits in the United Kingdom for urogynaecology<sup>24</sup> and found no significant difference in direct or indirect costs to patients over the 6-month follow-up period between telephone and in-person groups. Viers et al.<sup>29</sup> compared the money spent by patients to attend virtual and in-person visits (United States) and reported cost savings of US\$48 per patient visit ( $p<0.0001$ ). The study further reported no difference in patient-reported satisfaction with care.<sup>29</sup>

Finkelstein et al.<sup>23</sup> evaluated post-operative follow-up video visits for children recovering from urological surgery in the United States and found significant patient cost savings, mainly due to substantial travel avoidance. The median direct visit cost saving of a virtual visit (family-reported) was US\$20 per family for each visit ( $p<0.0001$ ). The estimated opportunity costs for virtual visits (US\$0) were significantly less than those for an in-person visit (US\$62.73) ( $p<0.0001$ ).<sup>23</sup>

Paganoni et al.<sup>25</sup> evaluated video visits in the United States for patients with amyotrophic lateral sclerosis (ALS), taking account of the difference in effectiveness between virtual and in-person visits. This cost-effectiveness study adjusted costs for medical usefulness, using a rating measure. Physicians, patients, and caregivers agreed virtual visits were 75% as effective as in-person visits. When cost savings were adjusted for medical usefulness, patients would save US\$997 per visit (\$119 for a virtual visit and \$1,116 for an in-person visit).<sup>25</sup>

In addition to saving patients financial costs, 6 studies reported that virtual visits also saved patients time, through avoided travel and missed work. Considering the total time required for a visit, patients reported saving 80 minutes,<sup>19</sup> 90 minutes,<sup>27</sup> and over 3 hours.<sup>22,23</sup> The median travel distance reported by studies varied (30.1km<sup>19</sup> to 100 miles<sup>22</sup>). One study found that patients receiving virtual visits reported a significantly shorter waiting time compared to those receiving in-person visits ( $p=0.01$ ).<sup>30</sup> The median travel distance reported was 95 miles.<sup>29</sup> Finkelstein et al.<sup>23</sup> and Viers et al.<sup>29</sup> found that virtual visits resulted in patients missing less work ( $p<0.0001$ )<sup>23,29</sup> or school and other activities ( $p<0.0001$ ).<sup>23</sup>

Healthcare system or facility costs were evaluated in 7 studies. Akobeng et al.<sup>18</sup> and Jones et al.<sup>24</sup> reported costs of the visits as standalone costs (excluding costs for staff, equipment, prescriptions, follow-up healthcare, etc.), Paganoni et al.<sup>25</sup> estimated cost-effectiveness, Appireddy et al.<sup>19</sup> estimated opportunity costs, and Barbour et al.,<sup>20</sup> Bradford et al.,<sup>21</sup> and Rabinowitz et al.<sup>26</sup> reported on cost savings by avoiding significant travel for physicians or for patient reimbursement. All 7 studies reported virtual visits were less expensive than in-person visits, resulting in cost savings to the healthcare system.

Akobeng et al.<sup>18</sup> studied routine outpatient telephone follow-up visits in the United Kingdom for pediatric gastroenterology and reported a lower mean visit cost to the National Health Service for a telephone consultation compared to an in-person visit (GB £35.41 vs. GB £51.12).<sup>18</sup> Similarly, Jones et al.,<sup>24</sup> also in the United Kingdom, reported lower costs for routine outpatient telephone visits (urogynaecology) (GB £31.75 versus GB £72.17). Further, this study found no difference in the quality adjusted life year (QALY) between groups. Under the funding threshold of GB £20k per QALY gained, the probability that the intervention is cost-effective was approximately 35%.<sup>24</sup>

Paganoni et al.<sup>25</sup> also studied the cost-effectiveness of scheduled video visits for routine visits for patients with amyotrophic lateral sclerosis (ALS) in the United States. Prior to adjusting for effectiveness as described above, healthcare institution costs were US\$354 per virtual visit and US\$799 per in-clinic visit. When cost savings were adjusted for medical usefulness, the base-case estimate indicated that the healthcare system would save US\$327 (adjusted virtual visit cost US\$472). Positive cost savings would continue for the healthcare system, until patients reached 3 in-clinic visits and 2 virtual visits, at which point patients would still experience a cost saving but the healthcare system would see a cost increase of US\$144.<sup>25</sup>

Opportunity costs, from the healthcare perspective in Ontario, Canada, were evaluated by Appireddy et al.<sup>19</sup> at an outpatient hospital clinic for follow-up neurology visits with adults (65+ years). Using available provincial outpatient costing data, the total estimated healthcare savings for the virtual visit pilot project (conducted from August 2018 to January 2019) was CA\$23,832-\$28,584. The savings included direct costs (nursing, diagnostic tests, operating, and recovery room), functional centre indirect costs (meals, facilities management, and plant operations), and costs for patient-specific drugs and supplies.<sup>19</sup>

Barbour et al.,<sup>20</sup> Rabinowitz et al.,<sup>26</sup> and Bradford et al.<sup>21</sup> demonstrated significant cost savings for the healthcare system and continuing care facilities through travel avoidance, either when physicians traveled to facilities or when patients were transported to a clinic. Barbour et al.<sup>20</sup> and Rabinowitz et al.<sup>26</sup> evaluated the use of virtual visits for continuing care facilities, both in the United States and using video visits with support of facility staff. Bradford et al.<sup>21</sup> studied virtual visits for pediatric palliative care study in Australia. In all three settings, usual care either required patients to be transported to the physicians, or the physicians would travel to the facilities or patients' homes. Cost implications were estimated through transporting patients or physician travel. Barbour et al.<sup>20</sup> did not include costs of establishing the infrastructure to provide virtual care and Rabinowitz et al.<sup>26</sup> did not include the cost of the actual encounter. Neither study considered downstream costs related to prescriptions, imaging, or other healthcare utilization measures.

Barbour et al.<sup>20</sup> reported that even though the cost of the virtual visit (US\$117.30 per visit) wasn't reimbursed to the continuing care facility, the visit cost was often lower than the facility's average cost for transporting patients to a visit in the neurologist's office, and thus further reduced liability. The transporting costs were variable, ranging from most expensive (US\$500 for ambulance with attendant)

to least expensive (approximately US\$109 for wheelchair with attendant). In addition to potential cost savings to both the facility and healthcare system, patients and caregivers preferred virtual visits to in-person visits. Patient transportation risks were eliminated and avoiding transport also meant fewer cancellations due to inclement weather. Neurologists also noted the patient seemed more "relaxed" or at ease than those attending in-person visits. Acuity of disease, as measured by the Unified Parkinson's Disease Rating Scale, declined over the period of observation.<sup>20</sup>

Rabinowitz et al.<sup>26</sup> similarly reported cost savings through travel avoidance. The one-way distance to the nursing homes was 35 miles in Vermont (44 minutes) and 104 miles in New York (120 minutes). Of the 278 virtual encounters conducted over the 5.7-year study period, 106 were in Vermont and 172 were in New York. If each of the encounters had occurred separately, a total of 843.5 hours of travel time, 43,000 miles, and US\$3,700 in fuel costs would have been saved through virtual visits, compared to in-person consultations. Additional costs for patient-to-physician travel ranged from US\$33,739 to \$67,477, and for physicians travelling to patients ranged from US\$84,347 to \$253,040. The videoconferencing equipment and service costs were US\$24,426. Therefore, the total savings estimated over the study period were US\$13,060-\$46,798 (if patients travelled to physicians) or US\$63,668-\$232,361 (if physicians travelled to patients). In some cases, it may be possible to "stack" encounters (i.e., transport multiple patients together), which would reduce cost savings. If four resident visits were possible for each in-person trip, the savings would decrease to 26.4 workdays, 10,750 miles and US\$925 in gasoline costs. Personnel costs (patient-to-physician travel) would range from US\$8,435-\$16,869 and physician costs (physician-to-patient travel) would range from US\$21,087-\$42,173. However, the authors noted that even 2 patients transported at one time was a rare event.<sup>26</sup>

Bradford et al.<sup>21</sup> also found that the mean cost of virtual visits (US\$247 per visit) was lower than costs for reimbursing patients for travel to the outpatient hospital clinic (US\$748 per visit) or costs for physicians and nurses to travel to patients' homes for an in-person home visit (US\$1214 per visit), when all travel modes were considered. Air travel (n=24/95) significantly increased the in-person home visit cost. When road only travel was assumed, the mean cost of the in-person home visit was US\$508 per visit. The marginal cost for virtual visits was US\$123 in both scenarios. A cost-minimization analysis was used to estimate the cost differences between virtual and in-person visits. The authors stated the analysis assumed that equivalent outcomes would have occurred across groups and noted there may be other benefits and limitations of the different delivery models, which were not able to be valued.<sup>21</sup>

The overall quality of studies in the specialist setting was moderate. Approximately half were randomized controlled trials; however, most were in a small sample size, did not follow patients over time, and had significant missing data or attrition. The certainty of evidence on specialist virtual visits was similarly moderate. While many reported positive cost and time savings for patients, these were considering short-term outcomes only and that the savings will be dependent on each unique patient situation. This may be particularly important when considering studies that avoided significant travel costs (e.g., airfare, accommodations) or large distances driven, as these savings may not be generalizable to all patients. Further, some studies reported significant savings to the healthcare system, which may only apply in similar models whereby physicians travel to patients and are remunerated for costs by the healthcare system.

In conclusion, virtual visits in specialist care saved time, travel, and costs for patients and families, continuing care facilities, and the healthcare system. Whether for routine follow-up visits or post-operative care, virtual visits did not require additional in-person care and had the same attendance rate as in-person visits. One study in the United States (routine follow up) found that implementation of

virtual outpatient neurology ambulatory clinics decreased in-person visits over a 1.5-year period; however, the total number of visits increased.

Possibly the most commonly reported benefit among studies evaluating specialist virtual visits related to the time and cost savings and travel avoided for patients. Virtual visits saved patients significant time, mainly through avoiding travel. Patients were also able to save costs through attending virtually, both for avoiding travel and parking costs and also from taking less time off work.

Virtual visits additionally appeared to result in positive cost savings to the healthcare system. However, the majority of studies reporting cost savings to the government evaluated virtual visit programs that otherwise would require physicians to travel to patients or reimburse patients for travel costs, which often included airfare and accommodations. Another study reported opportunity costs of in-person visits at an outpatient hospital clinic, through freeing up resources such as staff and office space. Other studies reported savings as the fee structure for telephone consultations was less than an in-person visit, but this may not be generalizable across all systems.

Few of the studies in specialist routine follow-up or post-operative clinics did not explore healthcare system cost implications, nor were subsequent ED visits or hospitalizations monitored. None of the studies evaluating virtual visits with specialists reported outcomes related to prescribing patterns or referrals for laboratory testing, diagnostic imaging, or other specialist referrals. One study adjusted costs for a medical-usefulness rating and found substantial cost savings to the healthcare system. However, because virtual visits were not deemed as effective as in-person visits, there is a threshold at which virtual visits are no longer cost-effective. This threshold is likely to vary depending on various factors and should be considered in each setting.

## Overall Conclusions of Review

This review identified 29 studies exploring the cost implications of virtual visits on overall volume of visits, practice patterns, subsequent healthcare utilization, or cost. Study quality was overall low and results were not consistent across studies, which likely was related to different contexts, comparators, time periods, patient selection approaches, and outcomes. Less than a quarter of studies were randomized trials and among these, the process of randomization, including allocation concealment, was poorly described and at risk of numerous biases.

The quality of cohort studies was similarly low. The risk of confounding was high, even among those that adjusted analyses for potential confounders. These were often traditional baseline demographic variables, which may not be those most relevant with respect to virtual visit experience or outcomes. For example, comfort with technology (or available support through a friend or family member), transportation barriers, income level, the patient-physician relationship, and insurance coverage, among others. This may be particularly important when evaluating follow-up care, as the behaviour driving the patient's decision to seek additional follow-up care may be related to the motivation driving the decision to choose in-person or virtual care, particularly in the case of commercial DTC platforms. Further, cohort study quality was low due to risk of selection, outcome measurement, and reporting bias.

The certainty of evidence was low. In primary care, the number of studies were few (5) and too heterogeneous to be able to draw conclusions. In the DTC setting, findings were inconsistent and the

provider type was often not reported. In specialist care, the certainty of evidence was moderate. Overall, several studies reported patients save time and money through virtual visits. Considering the travel avoidance, this is not surprising. Some patients typically would require air travel and lodging, which, depending on the payer model, could have substantial costs for the healthcare system or patients, whether through direct costs or opportunity costs. However, these potential cost savings are context-specific and may not be generalizable to other health systems. The long-term implications were not examined in most of the studies included in this review. To better understand the long-term cost implications of virtual visits, rigorous evaluations are needed that consider direct, indirect, opportunity, and downstream costs.

Virtual visits provide an opportunity for patient-centric care by making services more accessible, convenient, and affordable for patients. However, the convenience and potential cost savings need to be considered within the context of quality of care, patient safety, and provider and staff satisfaction and experience.

## Authorship and Committee Members

### *Researchers*

- Meg Lunney (primary researcher and writer), Lisa Cook, and Lauren Seal (contributor to the search strategy design)

### *Scientific Reviewers*

- Judy Seidel, Braden Manns, Chandra Thomas, Kerry McBrien, Jonathan Choy, Shy Amlani, and Linda Slocombe

## Appendix A

### List of Abbreviations

ACSC: Ambulatory Care-Sensitive Conditions  
 COVID-19: Coronavirus Disease-2019  
 DTC: Direct-to-Consumer  
 ED: Emergency Department  
 EMR: Electronic Medical Record  
 OECD: Organisation for Economic Co-operation and Development  
 GP: General Practitioner  
 QALY: Quality Adjusted Life Year  
 RCT: Randomized Controlled Trial  
 UK: United Kingdom  
 US: United States

### Detailed Search and Screening Methods

#### Search Strategy

An extensive literature search was performed on 23 June 2020 with support from Lauren Seal, a librarian at Alberta Health Services Knowledge Resource Service. Key databases were searched: OVID (Medline + PubMed) and CINAHL and Google Scholar. The TRIP medical database was additionally searched for grey literature.

**Table 1. Search Terms and Results Across the Databases**

OVID (Medline/PubMed)	
1	Telemedicine/ (22457)
2	exp Videoconferencing/ (1818)
3	Telecommunications/ (4789)
4	(virtual adj2 care).ti,ab,kw. (229)
5	(virtual adj2 health).ti,ab,kw. (474)
6	ehealth.ti,ab,kw. (3578)
7	mhealth.ti,ab,kw. (4321)
8	exp Telephone/ (22318)
9	exp Electronic Mail/ (2675)
10	e-mail.ti. (639)
11	Patient Portals/ (363)
12	"patient portal".ti,ab,kw. (951)
13	Remote Consultation/ (4738)
14	exp "Costs and Cost Analysis"/ (236077)
15	"cost effective".ti,ab,kw. (131773)
16	"cost utility".ti,ab,kw. (4535)
17	"cost benefit".ti,ab,kw. (11666)

18	"health economic".ti,ab,kw. (8725)
19	"economic evaluation".ti,ab,kw. (11966)
20	"indirect cost".ti,ab,kw. (5796)
21	"direct cost".ti,ab,kw. (7104)
22	"cost minimiz".ti,ab,kw. (1090)
23	"cost comparison".ti,ab,kw. (1260)
24	exp models, economic/ (14967)
25	"emergency department visit".ti,ab,kw. (6496)
26	"urgent care visit".ti,ab,kw. (188)
27	exp Hospitalization/ (238324)
28	exp "Referral and Consultation"/ (74499)
29	Prescriptions/ (3337)
30	"digital imaging".ti,ab,kw. (4471)
31	"Lab* test".ti,ab,kw. (44317)
32	"parking cost".ti,ab,kw. (12)
33	"cost of illness".ti,ab,kw. (2039)
34	burden*.ti,ab,kw. (209948)
35	"burden of illness".ti,ab,kw. (1732)
36	economic*.ti,ab,kw. (276962)
37	absenteeism.ti,ab,kw. (5774)
38	presenteeism.ti,ab,kw. (1140)
39	workplace.ti,ab,kw. (35590)
40	productiv*.ti,ab,kw. (90985)
41	expenditure*.ti,ab,kw. (55679)
42	employment.ti,ab,kw. (54954)
43	wage*.ti,ab,kw. (7696)
44	"time los".ti,ab,kw. (1939)
45	"income los".ti,ab,kw. (342)
46	"daily activit".ti,ab,kw. (16779)
47	14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 (1262543)
48	"virtual visit".ti,ab,kw. (132)
49	"video visit".ti,ab,kw. (71)
50	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 48 or 49 (59007)
51	exp Physicians/ (140226)
52	physician*.ti,ab,kw. (384875)
53	doctor*.ti,ab,kw. (124692)
54	("primary care" adj2 physician*).ti,ab,kw. (20001)
55	specialist*.ti,ab,kw. (94774)
56	"primary care".ti,ab,kw. (112979)
57	(allergist* or immunologist* or anesthesiologist* or cardiologist* or dermatologist* or endocrinologist* or gastroenterologist* or gynecologist* or gynaecologist* or oncologist* or hematologist* or hepatologist* or internist* or nephrologist* or neurologist* or ophthalmologist* or pathologist* or paediatrician* or pediatrician* or psychiatrist* or radiologist* or respirologist* or rheumatologist* or urologist* or surgeon*).ti,ab,kw. (439821)
58	"primary care doctor".ti,ab,kw. (1043)
59	"family doctor".ti,ab,kw. (4594)

60 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 (1058838)  
 61 47 and 50 and 60 (4217)  
 62 limit 61 to (yr="2000 -Current" and english) (3379)

**CINAHL**

S1 (MM "Telehealth+") OR (MM "Telemedicine")  
 S2 (MM "Videoconferencing+")  
 S3 (MM "Telecommunications")  
 S4 (MM "Telephone+")  
 S5 (MM "Email")  
 S6 (MH "Patient Portals")  
 S7 TI virtual N2 care OR AB virtual N2 care OR TI Virtual N2 health\* OR AB virtual N2 health\* OR TI ehealth OR AB ehealth OR TI mhealth OR AB mhealth OR TI email OR AB email OR TI "patient portal\*" OR AB "patient portal\*"  
 S8 (MM "Remote Consultation")  
 S9 TI "virtual visit\*" OR AB "virtual visit\*" OR TI "video visit\*" OR AB "video visit\*" 177  
 S10 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 40,961  
 S11 (MH "Costs and Cost Analysis+") 126,101  
 S12 TI "cost effective\*" OR AB "cost effective\*" OR TI "cost utility" OR AB "cost utility" OR TI "cost benefit\*" OR AB "cost benefit\*" OR TI "health economic\*" OR AB "health economic" OR TI "economic evaluation\*" OR AB "economic evaluation\*" OR TI "indirect cost\*" OR AB "indirect cost\*" 51,705  
 S13 TI "direct cost\*" OR AB "direct cost\*" OR TI "cost minimiz\*" OR AB "cost minimiz\*" OR TI "cost compar\*" OR AB "cost compar\*" OR TI "emergency department visit\*" OR AB "emergency department visit\*" OR TI "urgent care visit\*" OR AB "urgent care visit\*" OR TI "digital imaging" OR AB "digital imaging" 9,088  
 S14 (MH "Hospitalization+") 104,324  
 S15 (MH "Referral and Consultation+") 45,645  
 S16 (MH "Prescriptions, Drug+") 12,502  
 S17 TI "economic model\*" OR AB "economic model\*" OR TI "lab\* test\*" OR AB "lab\* test\*" OR TI "parking cost\*" OR AB "parking cost\*" OR TI "cost of illness\*" OR AB "cost of illness\*" OR TI burden OR AB burden 86,119  
 S18 TI "burden of illness\*" OR AB "burden of illness\*" OR TI economic\* OR AB economic\* OR Ti absenteeism OR AB absenteeism OR TI presenteeism OR AB presenteeism OR Ti workplace OR AB workplace OR TI productiv\* OR AB productiv\* 127,621  
 S19 TI expenditure OR AB expenditure OR TI employment OR AB employment OR TI wage\* OR AB wage\* OR Ti "time los\*" OR AB "time los\*" OR TI "income los\*" OR AB "income los\*" OR TI "daily activit\*" OR AB "daily activit\*" 64,980  
 S20 (MH "Physicians+") 121,050  
 S21 (MH "Primary Health Care") 66,892  
 S22 TI physician\* OR AB physician\* OR TI doctor\* OR AB doctor\* OR TI "primary care" N2 physician\* OR AB "primary care" N2 physician\* OR TI specialist\* OR AB specialist\* OR TI "primary care" OR AB "primary care" OR TI "primary care doctor\*" OR AB "primary care doctor\*" 306,378  
 S23 ( TI (allergist\* or immunologist\* or anesthesiologist\* or cardiologist\* or dermatologist\* or endocrinologist\* or gastroenterologist\* or gynecologist\* or gynaecologist\* or oncologist\* or hematologist\* or hepatologist\* or internist\* or nephrologist\* or neurologist\* or ophthalmologist\* or pathologist\* or paediatrician\* or pediatrician\* or psychiatrist\* or radiologist\* or respirologist\* or rheumatologist\* or urologist\* or surgeon\*) ) OR ( AB (allergist\* or immunologist\* or anesthesiologist\* or cardiologist\* or dermatologist\* or endocrinologist\* or gastroenterologist\* or gynecologist\* or gynaecologist\* or oncologist\* or hematologist\* or hepatologist\* or

internist\* or nephrologist\* or neurologist\* or ophthalmologist\* or pathologist\* or paediatrician\* or pediatrician\* or psychiatrist\* or radiologist\* or respirologist\* or rheumatologist\* or urologist\* or surgeon\* ) OR TI "family doctor\*" OR AB "family doctor\*" 137,542

S24 S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 524,391

S25 S20 OR S21 OR S22 OR S23 507,209

S26 S10 AND S24 AND S25 2,093

S27 S10 AND S24 AND S25 Limiters - Published Date: 20000101-20201231  
2,046

S28 S10 AND S24 AND S25 Limiters - Published Date: 20000101-20201231  
2,016

### Google Scholar

(telemedicine OR "virtual care" OR "virtual health" OR ehealth OR mhealth OR phone OR e-mail OR "patient portals" OR "remote consultation") AND ("primary care" OR "general practice" OR "family practice" OR physician OR doctor OR specialist) AND (cost OR economic).

## Inclusion and Exclusion Criteria

Title, abstract and full-text screening was conducted by Meg Lunney and Lisa Cook. Studies were included in the review according to pre-specified eligibility criteria.

**Table 2. Eligibility criteria for study inclusion into the review.**

Inclusion Criteria	Exclusion Criteria
<b>Population</b>	<b>Population</b>
<ul style="list-style-type: none"> <li>• Patient: Any pediatric or adult patient for any condition</li> <li>• Provider: Any medical doctor (primary care physician OR specialist)</li> </ul>	<ul style="list-style-type: none"> <li>• Non-OECD countries</li> <li>• Shared care models</li> <li>• Non-physician provider</li> <li>• Multidisciplinary teams where visit between physician and patient is not evaluated separately</li> </ul>
<b>Intervention</b>	<b>Intervention</b>
<ul style="list-style-type: none"> <li>• Synchronous (telephone and/or video) interaction between a physician and patient for the purpose of outpatient ambulatory care. Patients attend the visit from their place of residence.</li> </ul>	<p><i>Modality</i></p> <ul style="list-style-type: none"> <li>• Traditional telehealth (patients must travel to a facility to attend a visit)</li> <li>• Traditional telehealth (patient joins call from healthcare facility, not their home)</li> <li>• Remote monitoring</li> </ul> <p><i>Purpose</i></p> <ul style="list-style-type: none"> <li>• Screening, triage, reminders (treatment, appointments), hospital discharge follow-up, programs (motivation, behaviour change, etc.), military care, procedures (scoping, pathology, surgeries, etc.), disaster relief/aircraft/space/ship, during COVID-19 pandemic.</li> </ul>
<b>Outcomes</b>	<b>Outcomes</b>
<ul style="list-style-type: none"> <li>• Visit frequency (number or rate)</li> <li>• Visit duration</li> <li>• Attendance</li> <li>• Prescribing outcomes</li> <li>• Referrals (lab testing, diagnostic imaging, specialists)</li> <li>• Follow-up care (primary care, emergency department visits, hospitalizations)</li> <li>• Cost (direct, indirect, and opportunity from perspective of patient, physician, and/or healthcare system)</li> <li>• Quality-adjusted life year</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
<b>Study design</b>	<b>Study design</b>
<ul style="list-style-type: none"> <li>• RCT (traditional, stepped wedge)</li> </ul>	<ul style="list-style-type: none"> <li>• Qualitative study (flag relevant ones for intro/disc)</li> </ul>

<ul style="list-style-type: none"> <li>• Pragmatic trial</li> <li>• Evaluation</li> <li>• Cohort study (pre/post OR exposed/not exposed)</li> <li>• Systematic reviews</li> </ul>	<ul style="list-style-type: none"> <li>• Case studies</li> <li>• Simulation studies</li> <li>• Commentaries/perspectives/editorials (flag relevant ones for intro/disc)</li> </ul>
<b>Other</b>	<b>Other</b>
<ul style="list-style-type: none"> <li>• English language</li> <li>• 2010 to current</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>

## Appendix B

**Table 3. Common Terminology and Definitions**

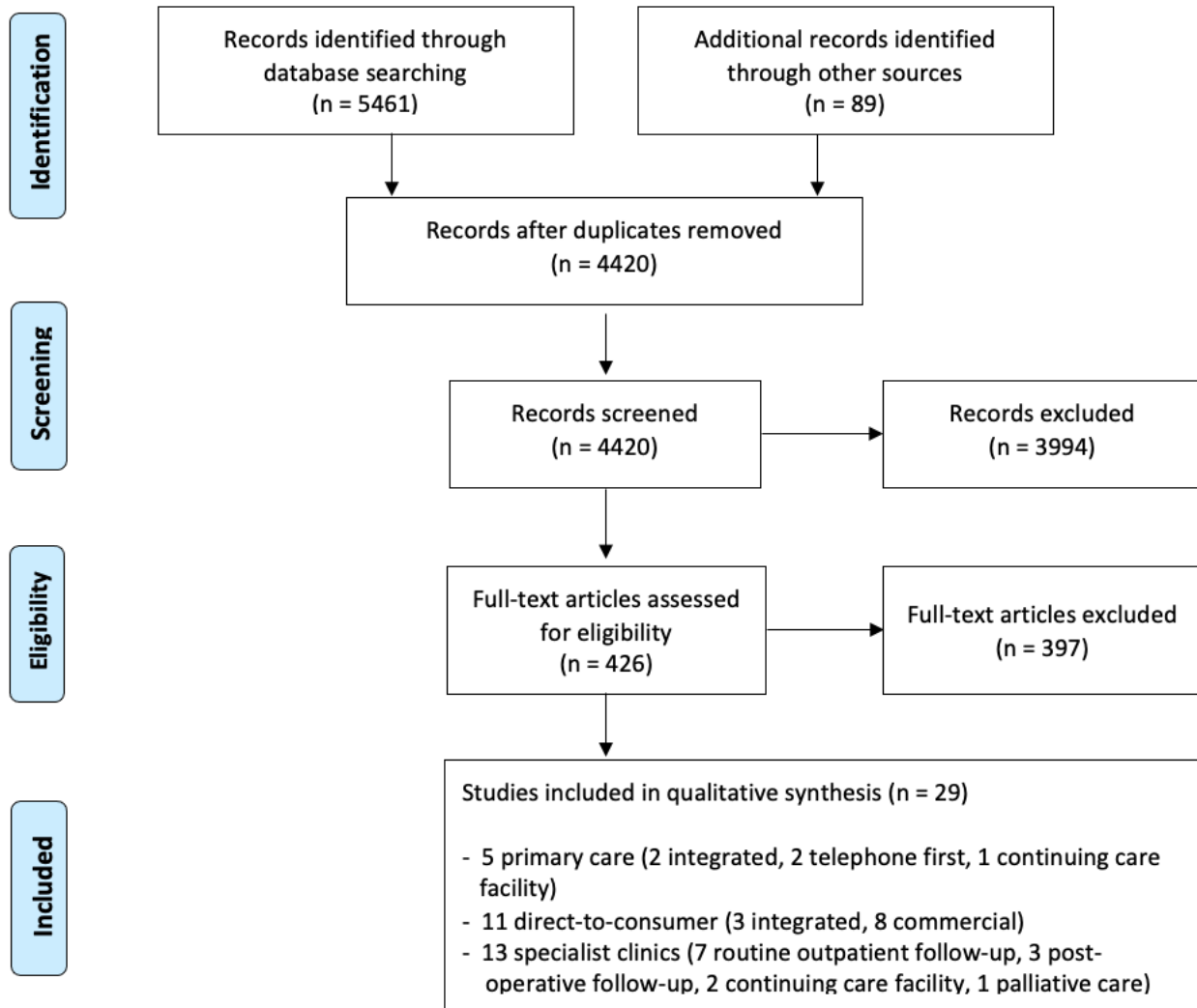
<b>Term(s)</b>	<b>Description</b>	<b>Author/Article</b>
<b>Commercial Model</b>	A model of care whereby virtual visits are offered through a commercial provider (for example, Teladoc). While not always described, these models of care	Shi et al. <sup>[14]</sup>
<b>Continuing Care Facility</b>	A range of services that support the health and wellbeing of individuals either living independently in their own homes (Home Care), with assistance (Designated Supportive Living), or in a Long Term Care setting	Alberta Health Services <sup>[33]</sup>
<b>Cost Analysis</b>	A form of economic evaluation that compares cost outcomes between two or more alternatives; however, efficacy or effectiveness outcomes are not examined	Drummond et al. <sup>[34]</sup>
<b>Cost-Consequence Analysis</b>	A form of economic evaluation that reports disaggregated costs and a range of outcomes separately to allow readers to form their own opinions on relevance and relative importance to decision making	Drummond et al. <sup>[35]</sup>
<b>Cost-Effectiveness Analysis</b>	A form of economic evaluation that measures relative costs and benefits of interventions and comparators, with costs expressed in monetary units, and effects in clinical units	Gomersall et al. <sup>[36]</sup>
<b>Cost-Minimization Analysis</b>	A form of economic evaluation that measures and compares only costs of the intervention and comparator studied	Gomersall et al. <sup>[36]</sup>
<b>Cost-Utility Analysis</b>	A form of economic evaluation that measures costs and benefits/health effects, with costs expressed in monetary units, and health effects in Quality Adjusted Life Years (QALYs) or Disability Adjusted Life Years (DALYs)	Gomersall et al. <sup>[36]</sup>
<b>Direct-to-Consumer (DTC)</b>	A subset of virtual visits whereby healthcare services are marketed directly to and initiated by patients, similar to a walk-in model. DTC visits can be offered by existing health centres or as standalone commercial platforms	Elliot and Shih <sup>[37]</sup>
<b>Effectiveness Evaluation</b>	A form of economic evaluation that compares the effect/s between two or more alternatives; however, cost outcomes are not examined	Drummond et al. <sup>[34]</sup>
<b>Integrated Virtual Care</b>	A model of care whereby virtual visits are included in the same health system or network as in-person care services and provided as an adjunct to in-person care. The level of integration may vary depending on if the nature of the visit is walk-in or routine follow-up/	Virtual Care Task Force <sup>[38]</sup>
<b>Outcome Description</b>	A form of economic evaluation that describes consequence outcomes within one group only	Drummond et al. <sup>[34]</sup>
<b>Retail Health Clinic</b>	A walk-in clinic designed for convenience and access that offers a limited menu of primary care services and on-demand patient appointments	Hoff and Prout <sup>[39]</sup>

<p><b>Telephone-First Strategy:</b></p>	<p>A practice-wide policy that requires every patient asking to see a physician to initially meet by telephone (on the same day) in attempt to address the problem virtually. If the patient and physician both agree the virtual visit was adequate, a further in-person visit is not required</p>	<p>Newbould et al.<sup>[5]</sup></p>
<p><b>Virtual Visit</b></p>	<p>A clinical interaction that does not require the patient and provider to be in the same room at the same time. Specifically for this review, a virtual visit was defined as a real-time medical encounter between a physician and a patient occurring by videoconference (i.e., video visit) or telephone</p>	<p>McGrail et al.<sup>[2]</sup></p>

## Appendix C

### Results of Screening and Details of Eligible Studies

Figure 1. Flow Chart



**Table 4. Descriptions of Included Studies**

REFERENCES	DETAILS	KEY FINDINGS
<b>Theme: Primary Care (Integrated Virtual Visits)</b>		
<b>MCGRAIL ET AL. (2017)</b>	<p>Cohort study using administrative healthcare data. Cost-consequence analysis. British Columbia, Canada. Primary care (mix of known and new provider).</p> <p>Video vs. in person.</p> <p>Sample size: 26,717 patients (5441 virtual patients and 21,176 in-person patients).</p> <p>Follow-up period: No individual patient follow-up. Used claims data over 2011-2014. Virtual visits became publicly funded in 2012.</p>	<p><b><i>Impact of virtual visits on overall visit volume:</i></b> There was no difference in subsequent follow-up primary care visits between virtual visits (1.6%) and in-person visits (1.43%). However, more virtual visits with a known provider were more likely to result in a follow-up visit (2.22%) compared to virtual visits with a new provider (0.97%) (<math>p &lt; 0.001</math>).</p> <p><b><i>Impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals:</i></b> Virtual visits more often resulted in a prescription compared to in-person visits, and less often resulted in a referral for laboratory testing or diagnostic imaging (<math>p &lt; 0.001</math>). Within virtual visits, provider attachment did not affect prescribing patterns.</p> <p>Both lab testing and diagnostic imaging referrals were higher among virtual visits than in-person visits (<math>p &lt; 0.001</math>). Among virtual visits only, those with a known provider were more often ordered to lab testing or diagnostic imaging compared to new provider visits.</p> <p>Surgical specialist referrals were more common among in-person visits compared to virtual visits (<math>p &lt; 0.001</math>). No difference was reported in medical specialty referrals.</p> <p><b><i>Impact of virtual visits on costs (primary care spending):</i></b> Both groups (video and in person) showed an increasing trend in primary care spending before the index visit. After the intervention, patients with a virtual visit had a lower spending trend than their matched controls (CA <math>-3.79</math>, <math>p = 0.01</math>).</p> <p>After the intervention, the known provider group showed a decreasing spending trend (CA <math>-8.68</math>, <math>p &lt; 0.001</math>) compared to the</p>

REFERENCES	DETAILS	KEY FINDINGS
<p><b>MCKINSTRY, ET AL. (2010)</b></p>	<p>Cross-sectional study. Effectiveness evaluation. Scotland, UK. Primary care.</p> <p>Telephone vs. in person.</p> <p>Sample size: 106 patients (47 telephone and 59 in person) and 19 doctors (provided both telephone and in-person consults).</p> <p>Follow-up period: None.</p>	<p>new provider group, with the values approaching each other by the end of the follow-up period.</p> <p>The impact of virtual visits on subsequent emergency department visits or hospitalizations was not evaluated.</p> <p><b>Other outcomes:</b> Younger patients and physicians were more likely to use and provide virtual visits (<math>p &lt; 0.001</math>). Older and sicker patients were more likely to see a known provider, whereas the lowest socioeconomic groups were the least likely (<math>p &lt; 0.001</math>).</p> <p>Referrals to specialists and laboratory and imaging services were not included in the cost outcome because, in the BC context, primary care physicians do not typically incur these costs.</p> <p><b>Study quality</b> Overall moderate risk of bias due to potential risk of confounding, selection, and reporting bias.</p> <p><b>Impact of virtual visits on overall visit volume:</b> Visits by telephone were overall shorter compared to in person (4.6 minutes vs. 9.7 minutes, respectively; <math>p &lt; 0.001</math>).</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent ED visits or hospitalizations, or cost was not evaluated.</p> <p><b>Other outcomes:</b> Telephone visits presented fewer problems; included less data gathering, counseling/advice, and rapport building; and were less likely to “obtain sufficient information to include or exclude likely relevant diagnoses” (all <math>p &lt; 0.001</math>). Patient involvement and satisfaction outcomes were similar in both consultation types.</p>

REFERENCES	DETAILS	KEY FINDINGS
		<p><b>Study quality</b> Overall high risk of bias due to potential confounding, selection, and missing data bias.</p>
<b>Theme: Primary Care (Telephone-First Strategy)</b>		
<p><b>MILLER, ET AL. (2019)</b></p>	<p>Retrospective cohort analysis using EMR (electronic medical record) data. Effectiveness evaluation. Northern Ireland. Primary care (patients in a socioeconomically deprived urban setting attached to a primary care clinic). Telephone-first strategy (after) vs. in-person visit (before). One urban primary care practice (11,500 panel size and 8 GPs). 9,100 patients contacted the primary care team in each year of the study.  Follow-up period: No individual patient follow-up. Data were evaluated from 2 years pre-intervention to 1-year post-introduction of the telephone-first system, a total of 36 months.</p>	<p><b>Impact of virtual visits on overall visit volume:</b> There was an increase in the total number of primary care consultations following the introduction of the telephone-first system (3,384 visits/month before and 4,412 visits/month after) (<math>p &lt; 0.001</math>). A 133% increase of telephone consultations and a 39% decrease of face-to-face consultations was observed.</p> <p><b>Impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals:</b> The telephone-first system did not affect the number of laboratory tests ordered.</p> <p><b>Impact of virtual visits on subsequent emergency department visits or hospitalizations:</b> The telephone-first system did not affect the number of hospital referrals, primary clinic out-of-hours, or ED attendances.</p> <p>The impact of virtual visits on costs, or other outcomes, was not evaluated.</p> <p><b>Study quality</b> Overall moderate risk of bias.</p>
<p><b>NEWBOULD, ET AL. (2017)</b></p>	<p>Cross-sectional cohort study. Cost-consequence analysis. UK.  Primary care practices using the telephone-first approach supported by two commercial companies (Doctor First and GP Access).</p>	<p><b>Impact of virtual visits on overall visit volume:</b> There was an increase in the total number of visits (both telephone and in person) after the introduction of the telephone-first strategy: 16.5 visits/day/1000 patients (before) to 21.8 (after) (<math>p &lt; 0.001</math>). The number of in-person visits reduced by 38% and the number of telephone visits increased 12-fold (<math>p &lt; 0.001</math>).</p>

REFERENCES	DETAILS	KEY FINDINGS
	<p>Telephone-first strategy (after) vs. in-person visit (before).</p> <p>Sample size: 147 practices using telephone-first approach (80 Doctor First and 67 GP Access).</p> <p>Follow-up period: No individual patient follow-up. Data were evaluated from 1-year before and 1-year after the date when the telephone-first approach was introduced, for a total of 2 years.</p>	<p><b>Impact of virtual visits on subsequent emergency department visits or hospitalizations:</b></p> <p>Introduction of the telephone-first approach was followed by a small (2.0%) increase in hospital admissions (<math>p=0.006</math>), no initial change in ED attendance, but a small (2% per year) decrease in the subsequent rate of rise of ED attendance (<math>p=0.005</math>).</p> <p><b>Impact of virtual visits on costs:</b></p> <p>Mean costs attributable to the telephone-first approach initially increased for inpatient admissions for ambulatory care-sensitive conditions (mean change in cost: GB £4,013 per 1,000 patients; 95% CI: 73-8,083) and inpatient admissions coded as emergency (GB £7,105 per 1,000 patients; 95% CI: 66-14,272). No initial change in cost was reported for emergency department or outpatient attendance or inpatient admissions coded as elective. When considering the total change in costs over the first 12 months, only costs for inpatient admissions for ambulatory care-sensitive conditions and inpatient admissions coded as elective were significantly different, both reflecting an increase in costs: GB £6,970 per 1,000 patients, 95% CI: 2,464-11,600 (hospital admissions for ACSCs) and GB £7,993 per 1,000 patients, 95% CI: 807-15,249 (elective hospital admissions).</p> <p>The impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals was not evaluated.</p> <p><b>Other outcomes:</b></p> <p>Patients reported improvements through telephone visits with respect to length of time seen, but other scores showed telephone visits were more negative compared to in-person visits. A wide variation between practices was reported, with some practices experiencing a substantial reduction in workload and others a large increase.</p> <p><b>Study quality</b></p>

REFERENCES	DETAILS	KEY FINDINGS
<p>Overall moderate risk of bias due to potential confounding, selection, and reporting bias.</p>		
<p><b>Primary Care (Continuing Care Facility)</b></p>		
<p><b>SHAH, ET AL. (2016)</b></p>	<p>Prospective cohort study. Effectiveness evaluation. New York, USA. Primary care geriatric clinic (residents of a senior living community).</p> <p>Virtual care platform (Health-e-Access platform - video and audio communication and synchronous file transfer) vs. usual care (not described).</p> <p>Sample size: 22 senior living communities: 6 intervention groups (479 residents) and 16 control groups (1,058 residents).</p> <p>Follow-up period: One year: intervention participants contributed 8,194 person-months and control participants contributed 21,321 person-months.</p>	<p><b>Impact of virtual visits on subsequent emergency department visits or hospitalizations:</b></p> <p>Over the course of the one-year study period, patients receiving virtual care had a 29% lower rate of emergency department visits for ambulatory care-sensitive conditions: 0.138 visits/person-year for virtual vs. 0.195 visits/person-year for in person (unadjusted rate ratio: 0.71, 95% CI: 0.53-0.94).</p> <p>After adjusting the emergency department visit rate for participant and facility characteristics, ED visits (for ambulatory care-sensitive conditions) decreased in the virtual visit group at an annual rate of 34% (RR: 0.661, 95% CI: 0.444-0.982), whereas, in the control group there was no statistically significant change in use over time (RR: 1.01, 95% CI: 0.90-1.14). However, this effect was not significant over time (p=0.0622).</p> <p>The impact of virtual visits on overall visit volume, practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals) or cost was not evaluated.</p> <p><b>Other outcomes:</b></p> <p>Participants receiving virtual care were more likely to live in an independent living facility (as opposed to assisted) compared to those receiving in-person care.</p> <p><b>Study quality</b></p> <p>Overall moderate risk of bias due to potential confounding and selection bias.</p>
<p><b>Theme: Direct-To-Consumer (Integrated)</b></p>		
<p><b>DAVIS, ET AL. (2019)</b></p>	<p>Retrospective cohort study. Effectiveness evaluation. Colorado, USA. DTC platform embedded within the patient portal in the EMR to connect patients with board-certified or board-eligible emergency physicians.</p>	<p><b>Impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals:</b></p> <p>A lower rate of antibiotic utilization for acute sinusitis was observed within the virtual visit group (67%) than within usual care</p>

REFERENCES	DETAILS	KEY FINDINGS
<b>LOVELL, ET AL. (2019)</b>	<p>Adults with acute sinusitis.</p> <p>Telephone/video (board-certified or board-eligible emergency physicians based in an academic practice) vs. in person (primarily community-based nurse practitioners or physician assistants, but also included was a minority of family practice physicians).</p> <p>Sample size: 157 patients (57 virtual, 100 in person).</p> <p>Follow-up period: None.</p>	<p>(92%) (<math>p &lt; 0.001</math>). No difference in antibiotic utilization was found whether a patient was evaluated by telephone or by video.</p> <p>The impact of virtual visits on overall visit volume, subsequent emergency department visits or hospitalizations, cost, or other outcomes was not evaluated.</p> <p><b>Study quality</b> Overall high risk of bias due to potential confounding and selection bias.</p>
	<p>Retrospective, cross-sectional cohort study using insurance claims. Cost-consequence analysis. Utah and Southern Idaho, USA.</p> <p>DTC platform offered through Intermountain Healthcare (not-for-profit integrated healthcare system that includes hospitals, clinics, employed caregivers, an insurance organization and a system-sponsored telemedicine program). Platform is integrated with patient's EMR. Physician specialty not described.</p> <p>Patients with low-acuity urgent conditions.</p> <p>Video vs. in-person visits (at three options: urgent care centre, primary care office, or emergency department). Physician specialty was not described.</p> <p>Sample size: 182,853 claims (1,531 virtual, 4,377 urgent care, 4,388 primary care, and 2,285 emergency department).</p>	<p><b><i>Impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals:</i></b></p> <p>There were no differences in antibiotic use between virtual visits and all three forms of in-person care (urgent care centre, primary care office, emergency department). Laboratory testing and diagnostic imaging rates were lower in virtual visits, compared to all three forms of in-person care.</p> <p><b><i>Impact of virtual visits on subsequent emergency department visits or hospitalizations:</i></b></p> <p>There were no differences in subsequent healthcare utilization (evaluation and management, emergency department visit, hospitalization, or any follow-up visit) between care received virtually, at an urgent care centre, or at a primary care clinic. Patients that received their initial visit at an ED reported higher follow-up rates of all types. However, a greater proportion of patients seeking initial care at an emergency department had a history of a heart attack, were older, more likely to receive a diagnosis for an upper respiratory or urinary tract infection, and less likely to receive a diagnosis for sinusitis, compared to those seeking virtual care (<math>p &lt; 0.001</math>).</p>

REFERENCES	DETAILS	KEY FINDINGS
	<p>Follow-up period: 21 days.</p>	<p><b>Impact of virtual visits on costs:</b></p> <p>The average cost of the initial visit for the virtual platform (US\$45) was significantly lower than for urgent care (US\$136, <math>p&lt;0.001</math>), primary care clinics (US\$114, <math>p&lt;0.001</math>), and the emergency department (US\$1,384, <math>p&lt;0.001</math>).</p> <p>Pharmacy costs for virtual visits (US\$111) were similar to urgent care and primary care clinics, but slightly lower than the emergency department (US\$153, <math>p=0.034</math>).</p> <p>Follow-up costs for virtual visits (US\$288) were not significantly different than those for urgent care, but were significantly lower than those for primary care clinics (US\$490, <math>p=0.038</math>) and the emergency department (US\$1,782, <math>p&lt;0.001</math>).</p> <p>The average total cost for a virtual visit (US\$429) was significantly lower than that for an urgent care visit (US\$661, <math>p&lt;0.001</math>), primary care clinic visit (US\$707, <math>p&lt;0.001</math>) and an emergency department visit (US\$3,403, <math>p&lt;0.001</math>).</p> <p>Patients receiving virtual care were asked where they would have sought care if virtual visits had not been available. Combining responses with estimated costs found a projected savings of US\$323 in allowed costs per claim, or US\$494,544 total for the study population of 1,531 virtual visit claims.</p> <p>The impact of virtual visits on overall visit volume or other outcomes was not evaluated.</p> <p><b>Study quality</b></p> <p>Overall high risk of bias due to potential confounding, selection, and reporting bias.</p>
<p><b>NORD, ET AL. (2019)</b></p>	<p>Prospective cohort study. Cost analysis. Pennsylvania, USA.</p>	<p><b>Impact of virtual visits on overall visit volume:</b></p> <p>Of the 172 patients that completed a follow-up survey, 74% reported they did not seek additional care following their virtual visit.</p>

REFERENCES	DETAILS	KEY FINDINGS
	<p>DTC platform (JeffConnect app) available at the Jefferson Health academic medical centre, allowing for on-demand telemedicine call with an emergency physician. Physician is able to access the patient's EMR during consultation.</p> <p>Telephone/video vs. hypothetical in-person visit (patients were asked where they would have gone for care had virtual visit not been available, and that response was used as a comparator, estimated from costing literature).</p> <p>Sample size: 650 patients. Follow-up period: 10-14 days.</p>	<p><b>Impact of virtual visits on costs:</b></p> <p>Patients that received virtual visits stated if they didn't use the platform, 12% would have gone to the emergency department, 33% would have done to urgent care, 5% would have went to a retail health clinic, 34% would have gone to see their doctor, and 16% would have done nothing. This resulted in an estimated 'savings from diversion' of US\$57 to \$238.</p> <p>Patients were asked in the follow-up survey if they sought subsequent care within 2-3 days of the virtual visit. 172 of the 650 patients completed the survey. Of the 172 patients, 5% went to the emergency department, 4% went to urgent care, 1% went to a retail health clinic, 15% saw their doctor and 74% did not seek additional care. This resulted in an estimated 'costs reported post-visit' of US\$38 to \$118.</p> <p>Estimated net cost savings range between US\$19 and \$121, using the the overall savings from diversion (range US\$57-\$238) and the overall follow-up costs reported post-visit (range US\$38-\$118)that were reported in the literature.</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent emergency department visits or hospitalizations, or other outcomes were not evaluated.</p> <p><b>Study quality</b></p> <p>Overall moderate risk of bias due to potential outcome measurement and reporting bias.</p>
<b>Theme: Direct-to-Consumer (Commercial)</b>		
<b>ASHWOOD, ET AL. (2017)</b>	<p>Retrospective cohort using claims data. Cost analysis. California, USA. Walk-in DTC (Teladoc). Adults seeking treatment for acute respiratory illness.</p>	<p><b>Impact of virtual visits on overall visit volume:</b></p> <p>12% of virtual visits replaced visits to other providers, and 88% represented new utilization.</p>

REFERENCES	DETAILS	KEY FINDINGS
	<p>Telephone/video vs. in person. Physician specialty not described.</p> <p>Sample size: 2,943 patients (981 virtual and 1,962 in person).</p> <p>Follow-up period: 2 days (individual patient follow-up). The study timeframe for the cohort spanned from 1-year pre-implementation of Teladoc to 1-year post-implementation).</p>	<p><b><i>Impact of virtual visits on costs:</i></b></p> <p>Per episode, virtual visits were about 50% of the cost of a physician office visit and less than 5% of the cost of an emergency department visit. Estimates expect the virtual visit would result in a US\$20 reduction in cost to the patient.</p> <p>Spending for subsequent healthcare services (pharmacy, laboratory testing, diagnostic imaging, etc.) following visits was lower for virtual care compared to in-person visits. However, follow-up evaluation and care management costs were higher after virtual visits when compared to visits that had occurred in a physician's office (US\$9 vs. \$6, respectively; <math>p=0.01</math>).</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent emergency department visits or hospitalizations, or other outcomes was not reported.</p> <p><b>Study quality</b></p> <p>Overall moderate risk of bias due to potential confounding, selection, and outcome measurement bias.</p>
<p><b>GORDON, ET AL. (2017)</b></p>	<p>Cross-sectional, retrospective cohort study using commercial insurance claims data. Cost-consequence analysis. USA. Walk-in (commercial DTC platform, LiveHealth Online, owned by Anthem, Inc). Adults and children with specific acute, nonurgent conditions.</p> <p>Video (physician specialty varied: internal medicine, primary care, general medicine, pediatrics) vs. in person (retail health clinics, primary care physician offices, urgent care centres, and emergency departments).</p> <p>Sample size: 59,945 visits (4,635 virtual visits and 55,310 in-person visits). Pharmacy data was</p>	<p><b><i>Impact of virtual visits on overall visit volume:</i></b></p> <p>Virtual visits had similar follow-up outpatient visit rates (evaluation and management) (28.09%) as those at a retail health clinic (28.59%) and primary care office (28.10%), more than those at an urgent care centre (25.6%) (<math>p=0.001</math>), and less than those at an emergency department (34.2%) (<math>p&lt;0.001</math>).</p> <p><b><i>Impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals:</i></b></p> <p>Virtual visits were significantly more likely to result in an antibiotic prescription than any of the in-person options. Prescribing rates for broad-spectrum antibiotics were also significantly higher in virtual visits compared to retail health clinics, urgent care centres, or emergency departments, and the same as primary care physician offices.</p>

REFERENCES	DETAILS	KEY FINDINGS
	<p>available for 31,744 visits (3,182 virtual visits and 29,562 in-person visits).</p> <p>Follow-up period: 3 weeks.</p>	<p>Lab testing was significantly lower in virtual visits than all in-person visits. Diagnostic imaging referral rates were significantly lower in virtual visits compared to those at a primary care physician office, urgent care centre, or emergency department; however, they were the same as at a retail health clinic.</p> <p><b><i>Impact of virtual visits on subsequent emergency department visits or hospitalizations:</i></b></p> <p>Virtual visits reported significantly fewer follow-up ED visits and hospitalizations than after in-person visits occurring at a primary care physician office, urgent care centre, or emergency department, but the same as those at a retail health clinic.</p> <p><b><i>Impact of virtual visits on costs:</i></b></p> <p>When comparing the direct costs of the visit, virtual visits were less expensive than all in-person options (retail health clinic, primary care physician office, urgent care centre, or emergency department). Relative cost ratios (USD for in-person visit / USD for virtual visit) for the visit cost were all above 1.0 (with a lower 95% CI above 1.0). The greatest cost saving was found when comparing the visit cost of a virtual visit (\$49) to an emergency department visit (\$1,404), which had a relative cost ratio of 28.75 (95% CI: 28.39-29.36).</p> <p>Follow-up medical costs were lowest in the virtual visit group compared to in-person visits at the urgent care centre, emergency department, and the primary care clinic groups, and the same as at the retail health clinic. Pharmacy costs were similarly lowest in the virtual visit group compared to all in-person visits: at retail health clinics (relative cost ratio 1.08; 95% CI: 1.01-1.15) and primary care clinics (1.15; 95% CI: 1.08-1.23), except urgent care centres or emergency department visits, where there was no difference.</p> <p>Total costs (index visit, follow-up, and pharmacy costs, all USD) were lowest in the virtual visit group (\$339) compared to in-person</p>

REFERENCES	DETAILS	KEY FINDINGS
		<p>visits at the retail health clinic (\$375), primary care clinic (\$501), urgent care centre (\$492), or emergency department (\$2,074). Relative total cost ratios (comparator/virtual) were 1.11 (retail health clinic), 1.48 (primary care clinic), 1.45 (urgent care centre), 6.12 (emergency department). 95% CI for these estimates were not provided.</p> <p>No other outcomes were evaluated.</p> <p><b>Study quality</b> Overall high risk of bias due to potential confounding, selection, and reporting bias.</p>
<b>MARTINEZ, ET AL. (2018)</b>	<p>Cross-sectional study. Outcome description. USA. Walk-in DTC (Online Care platform, Amwell). Patients with an encounter for respiratory tract infection (sinusitis, pharyngitis, bronchitis, or other).</p> <p>Video only. All patients received virtual care and the analysis compared visits resulting in a prescription outcome with those not resulting in a prescription. Physician specialty varied: internal medicine, primary care, emergency medicine, other.</p> <p>Sample size: 8,437 encounters (7,747 patients with 85 physicians).</p> <p>Follow-up visit: None.</p>	<p><b>Impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals:</b></p> <p>Among 8,437 encounters for respiratory tract infections with 85 physicians, 5,580 (66.1%) resulted in prescription of an antibiotic, 1,309 (15.5%) resulted in prescription of a non-antibiotic medication, and 1,548 (18.3%) resulted in no prescription.</p> <p>Physicians' mean adjusted rates of antibiotic prescribing ranged from 19% to 90% (interquartile range, 56%-77%). Receiving a prescription for an antibiotic was strongly associated with a rating care of 5 stars (adjusted odds ratio, 3.23; 95%CI, 2.67-3.91). Patients who received a prescription for a non-antibiotic medication also rated their care more highly (adjusted odds ratio, 2.21; 95% CI, 1.80-2.71).</p> <p>The impact of virtual visits on overall visit volume, subsequent emergency department visits or hospitalizations, costs, or other outcomes was not evaluated.</p> <p><b>Study quality</b> Overall low risk of bias.</p>
<b>RAY, ET AL. (2019)</b>	<p>Retrospective cohort study using claims data. Effectiveness evaluation. USA. Walk-in DTC</p>	<p><b>Impact of virtual visits on overall visit volume:</b></p>

REFERENCES	DETAILS	KEY FINDINGS
	<p>(commercial, not specified). Children with acute respiratory infections.</p> <p>Virtual platform (not specified) vs. in-person visit (primary care clinic or urgent care centre). Physician specialty not described.</p> <p>Sample size: 528,213 encounters (4,604 virtual, 38,408 urgent care, and 485,201 primary care provider).</p> <p>Follow-up period: 21 days.</p>	<p>Virtual visits were more likely to require additional follow-up care, both at the 2- and 21-day follow-up. After 2 days of the index visit, 5% of virtual visits resulted in follow-up care, as did 2% and 1% of in-person urgent care and primary care index visits, respectively (<math>p &lt; 0.001</math>). After 21 days of the initial visit, 11% of virtual visits resulted in follow-up care compared to 10% and 9% of in-person urgent care and primary care index visits, respectively (<math>p &lt; 0.001</math>).</p> <p><b>Impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals:</b></p> <p>Children attending virtual visits were less likely to receive guideline-concordant antibiotic management, compared with matched in-person visits at other settings (<math>p &lt; 0.001</math>). Those receiving a virtual visit were more likely to receive an antibiotic and less likely to receive streptococcal testing (among visits with a diagnosis of streptococcal pharyngitis) (<math>p &lt; 0.001</math>).</p> <p>The impact of virtual visits on subsequent emergency department visits or hospitalizations, cost, or other outcomes was not evaluated.</p> <p><b>Study quality</b></p> <p>Overall low risk of bias.</p>
<b>SHI, ET AL. (2018)</b>	<p>Retrospective cohort study using claims data. Effectiveness evaluation. USA. Walk-in DTC (commercial, not specified). Adults (with pharmaceutical coverage) seeking care for acute respiratory infections.</p> <p>Virtual platform (not specified) vs. in person (primary care office or urgent care centre). Physician specialty not described.</p> <p>Sample size: 1,167,468 visits (38,839 virtual visits, 942,613 primary care in-person visits, 186,016 urgent care in-person visits).</p>	<p><b>Impact of virtual visits on overall visit volume:</b></p> <p>Virtual visits had a higher frequency of follow-up visits than in-person visits in the other settings (10% in virtual visits, 6% in primary care providers, and 7% in urgent care) (<math>p &lt; 0.001</math>).</p> <p>Among the follow-up visits of patients initially receiving virtual care, 42% sought further virtual care and 41% went to a primary care provider. Among the follow-up visits of patients initially receiving care at a primary care clinic, 91% followed-up at another clinic. Among the follow-up visits of patients initially receiving care at an urgent care centre, 49% went back to the urgent care centre and 45% went to a primary care provider clinic.</p>

REFERENCES	DETAILS	KEY FINDINGS
	<p>Follow-up period: 21 days.</p>	<p><b><i>Impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals:</i></b></p> <p>Virtual visits resulted in fewer antibiotic prescriptions than visits at either a primary care clinic (<math>p &lt; 0.01</math>) or urgent care centre (<math>p &lt; 0.001</math>).</p> <p>Broad-spectrum antibiotic prescribing was lower among virtual visits compared to in-person primary care provider and urgent care visits (<math>p &lt; 0.001</math>).</p> <p>Guideline-concordant antibiotic management was higher for patients engaged in virtual visits compared to visits to primary care providers and urgent care (<math>p &lt; 0.001</math>).</p> <p>Among patients with a streptococcal pharyngitis diagnosis, streptococcal testing occurred in 1% of the virtual visits, 67% of primary care visits, and 78% of urgent care visits (<math>p &lt; 0.001</math>).</p> <p>The impact of virtual visits on subsequent emergency department visits, hospitalizations, cost, or other outcomes was not evaluated.</p> <p><b>Study quality</b></p> <p>Overall moderate risk of bias due to potential confounding, selection, and reporting bias.</p>
<p><b>USHER-PINES, ET AL. (2014)</b></p>	<p>Retrospective cohort study using insurance claims data. Effectiveness evaluation. California, USA. Walk-in DTC (Teladoc).</p> <p>Telephone/video vs. in person (physician's office or emergency department). Physician specialty not described.</p> <p>Sample size: 74,909 claims: (2,718 claims of Teladoc users and a random sample of 72,191 claims of nonusers of Teladoc - control).</p> <p>Follow-up period: 21 days.</p>	<p><b><i>Impact of virtual visits on overall visit volume:</i></b></p> <p>Patients attending a Teladoc visit were less likely to have a follow-up visit for a similar condition compared to patients attending physician's offices or the emergency department (<math>p &lt; 0.01</math>).</p> <p>The timing of Teladoc visits closely resembled the timing of ED visits. 34% of Teladoc visits occurred on weekends and holidays, in contrast to 8% of office visits.</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent emergency department visits or hospitalizations, or cost was not evaluated.</p>

REFERENCES	DETAILS	KEY FINDINGS
<b>USHER-PINES, ET AL. (2015)</b>	<p>Retrospective cohort study using claims data. Effectiveness evaluation. California, USA. Walk-in DTC (Teladoc). Acute respiratory infections.</p> <p>Telephone/video vs. in person (physician's office). Physician specialty not described.</p> <p>Sample size: 86,368 (1,219 Teladoc users and 85,149 nonusers of Teladoc – control).</p> <p>Follow-up period: 3 days.</p>	<p><b>Other outcomes:</b> Compared to patients who visited a physician's office for a similar condition, adult Teladoc users were younger and less likely to have used healthcare before the introduction of Teladoc.</p> <p><b>Study quality</b> Overall moderate risk of bias due to potential confounding and selection bias.</p> <p><b>Impact of virtual visits on prescribing, laboratory testing, diagnostic imaging, and specialist referrals:</b> The antibiotic prescribing rate for all acute respiratory infection visits was not different between Teladoc and in person at physician offices. However, more Teladoc visits (86.5%) resulted in a prescription for a broad-spectrum antibiotic, compared to in-person visits (56.3%) (p&lt;0.01).</p> <p>The impact of virtual visits on overall visit volume, subsequent emergency department visits or hospitalizations, cost, or other outcomes was not evaluated.</p> <p><b>Study quality</b> Overall high risk of bias due to potential confounding, selection, and reporting bias.</p>
<b>USHER-PINES, ET AL. (2016)</b>	<p>Retrospective cohort study using claims data. Effectiveness evaluation. California, USA. Walk-in DTC (Teladoc). Purpose of visit not specified.</p> <p>Telephone/video vs. in person (physician's office). Physician specialty not described.</p> <p>Sample size: 3,043 Teladoc users and 214,944 non-users of Teladoc (control).</p> <p>Follow-up period: 28 days.</p>	<p><b>Impact of virtual visits on prescribing, diagnostic imaging, lab testing, and specialist referrals:</b> Of applicable pharyngitis encounters, streptococcal testing was ordered in 49.5% of physician office encounters and 3.4% of virtual encounters (p&lt;0.01).</p> <p>Of applicable low back pain encounters, appropriate imaging studies within 28 days (x-ray, magnetic resonance imaging, computed tomography scan) were not significantly different among physician office visits and virtual encounters (p=0.2).</p>

REFERENCES	DETAILS	KEY FINDINGS
		<p>Of applicable bronchitis encounters, antibiotics were appropriately avoided in 27.9% of physician office encounters and 16.7% of virtual encounters (<math>p &lt; 0.01</math>).</p> <p>The impact of virtual visits on overall visit volume, subsequent emergency department visits or hospitalizations, or cost was not evaluated.</p> <p><b>Other outcomes:</b></p> <p>Virtual visit users were not preferentially located in underserved communities. However, each additional minute of travel time to an urgent care centre was associated with a 0.3% increase in the odds of being a virtual visit user (<math>p &lt; 0.01</math>).</p> <p><b>Study quality</b></p> <p>Overall moderate risk of bias due to potential confounding and selection bias.</p>
<b>Theme: Specialist Care</b>		
<b>AKOBENG, ET AL. (2015)</b>	<p>Randomized controlled trial, cost-consequence analysis. Manchester, UK. Specialty care (pediatric gastroenterology). Routine outpatient follow-up of children and adolescents with IBD.</p> <p>Telephone vs. in person.</p> <p>Sample size: 86 patients (44 telephone and 42 in person).</p> <p>Follow-up period: 24 months.</p>	<p><b>Impact of virtual visits on overall visit volume:</b></p> <p>Consultation by telephone significantly reduced consultation time overall by an average of 14.3 minutes per consultation (<math>p &lt; 0.001</math>). The proportion of outpatient appointments attended by telephone was the same as the proportion attended in person.</p> <p><b>Impact of virtual visits on subsequent emergency department visits or hospitalizations:</b></p> <p>One participant in each consultation group had one or more hospital admissions due to inflammatory bowel disease.</p> <p><b>Impact of virtual visits on costs:</b></p> <p>The mean cost of a telephone consultation to the National Health Service (NHS) is less than an in-person visit (GB £35.41 vs. GB £51.12, respectively; <math>p &lt; 0.001</math>).</p>

REFERENCES	DETAILS	KEY FINDINGS
<p><b>APPIREDDY, ET AL. (2019)</b></p>	<p>Cross-sectional cohort study. Cost-consequence analysis. Kingston, Ontario, Canada. Specialty care (outpatient neurology clinic catering predominantly to seniors 65+ years). Routine follow-up outpatient visits with specialist).</p> <p>Video (through a secure Web platform hosted by the Ontario Telemedicine Network) vs. in person (participants were asked to compare their virtual experience and costs with prior in-person healthcare).</p> <p>Sample size: 75 patients.</p> <p>Follow-up period: None.</p>	<p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals) was not reported.</p> <p><b>Other outcomes:</b></p> <p>There was no difference in quality of life, parent or child satisfaction with care, disease relapse or anthropometric measures. No adverse events were noted for either intervention.</p> <p><b>Study quality</b></p> <p>Some concerns due to missing outcome data, potential intervention deviations, and possible outcome measurement bias.</p> <p><b>Impact of virtual visits on costs:</b></p> <p>The median total patient time saved through virtual visits was 80 minutes (range: 50-102), of which 44 minutes (21-69) was travel time. The median total travel distance avoided was 30.1km (11.2-82.2). The median estimate for total out-of-pocket patient cost savings through virtual visits was CA\$52.83 (\$31.26-\$94.53).</p> <p>The estimated healthcare savings (opportunity cost for in-person hospital outpatient care) for the virtual visit pilot project (conducted from August 2018 to January 2019) was CA\$23,832-\$28,584. These savings were estimated used available provincial outpatient costing data for reference, which included direct costs (nursing, diagnostic tests, operating, and recovery room), functional centre indirect costs (meals, facilities management, and plant operation), and costs for patient-specific drugs and supplies.</p> <p>The impact of virtual visits on overall visit volume, practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent emergency department visits or hospitalizations was not reevaluated.</p> <p><b>Other outcomes:</b></p> <p>All patients reported a high level of satisfaction with virtual visit, and claimed they had a better experience with the virtual visit</p>

REFERENCES	DETAILS	KEY FINDINGS
<p><b>BARBOUR, ET AL. (2016)</b></p>	<p>Retrospective cohort using chart review. Cost-consequence analysis. Pennsylvania, USA. Specialty care (neurology). Routine follow-up outpatient visits with neurologists for adults with Parkinson's disease living in continuous care facilities.</p> <p>Video (after implementation of video visits at a continuous care facility) vs. in person (before video visits, patients were transported by care facility to the neurologist office). During video visits, the subspecialist had the ability to remotely pan, tilt, or zoom the remote camera at the continuous care facility for a controlled visual examination of the patient.</p> <p>Sample size: 16 patients.</p> <p>Follow-up period: 20 months.</p>	<p>compared with an in-person visit. Further, all felt their health issue was appropriately addressed during the virtual visit.</p> <p><b>Study quality</b> Overall moderate risk of bias due to potential selection and missing data bias.</p> <p><b>Impact of virtual visits on costs:</b> The cost per virtual visit was US\$117.30. For a standard 30-minute in-person office visit, Medicare reimburses the continuous care facility US\$160.75. In the study setting, the costs for virtual visits were not reimbursed. Therefore, the cost to Medicare was substantially reduced, and potential cost savings to the hospital were also realized by not having to provide an exam room and staff to maintain it.</p> <p>Even though the cost of the virtual visit wasn't reimbursed, the visit cost was often lower than the facility's average cost for transporting patients to a visit in the neurologist's office and reduced liability. The transporting costs were variable, ranging from most expensive (US\$500 for ambulance with attendant) to least expensive (approximately US\$109 for wheelchair with attendant).</p> <p>The impact of virtual visits on overall visit volume, practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent emergency department visits or hospitalizations was not evaluated.</p> <p><b>Other outcomes:</b> UPDRS (Unified Parkinson's Disease Rating Scale) scores declined over the period of observation, from a range of 18-60 at study start to 28-72 at study end.</p> <p>Patients and caregivers preferred virtual visits to in-person visits. Neurologists also noted the patient seemed more "relaxed" or at ease than those attending in-person visits.</p>

REFERENCES	DETAILS	KEY FINDINGS
<b>BRADFORD ET AL. (2014)</b>	<p>Cohort study. Cost minimization analysis. Queensland, Australia. Specialty care (pediatric palliative care). Palliative care visits with pediatrician.</p> <p>Video vs. in-person care (two options: in-person home visit consultation [pediatrician and nurse travel to patient's home] or hospital outpatient department consultations [patients and families travel to clinic and are reimbursed AU \$0.15/km travelled by road and the full cost of air transport]).</p> <p>Sample size: 95 consultations.</p> <p>Follow-up period: No individual patient follow-up, physician's caseload over a 2-year period was assessed.</p>	<p>Patient transportation risks were eliminated through virtual visits, as was the liability. Avoiding transport also meant fewer cancellations due to inclement weather.</p> <p><b>Study quality</b> Overall low risk of bias.</p> <p><b>Impact of virtual visits on costs:</b> The mean cost of virtual visits (AU\$247) was lower than both the outpatient hospital clinic (AU\$748) and the in-person home visit (AU\$1214), when all travel modes were considered. Air travel (n=24/95) significantly increased the in-person home visit cost. When road only travel was assumed, the mean cost of the in-person home visit was AU\$508. The marginal cost for virtual visits was AU\$123 in both scenarios.</p> <p>The impact of virtual visits on overall visit volume, practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent emergency department visits or hospitalizations was not evaluated.</p> <p><b>Other outcomes:</b> The analysis of this study assumes that equivalent outcomes would have occurred in all three approaches, which was not formally tested.</p> <p><b>Study quality</b> Overall low risk of bias.</p>
<b>DORSEY, ET AL. (2013)</b>	<p>Randomized controlled trial. Cost-consequence analysis. New York, USA. Specialty care (neurology). Routine follow-up outpatient visits with neurologists for adults with Parkinson's disease.</p> <p>Video vs. in person.</p>	<p><b>Impact of virtual visits on overall visit volume:</b> Appointment compliance (proportion of scheduled visits that were completed) was equal between virtual and in-person visits. None of the participants assigned to virtual visits required an in-person visit during the course of the study.</p> <p><b>Impact of virtual visits on costs:</b></p>

REFERENCES	DETAILS	KEY FINDINGS
	<p>Sample size: 21 patients (9 virtual and 11 in person).</p> <p>Follow-up period: 7 months.</p>	<p>Compared with in-person visits, each virtual visit saved participants 100 miles of travel and 3 hours of time. The average total time spent was significantly less in the virtual visit group (52.6 minutes) compared to the in-person group (255.3 minutes) (<math>p &lt; 0.001</math>).</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), or subsequent emergency department visits or hospitalizations was not evaluated.</p> <p><b>Other outcomes:</b> Virtual visits did not impact patient quality of life, motor score, or patient-assessed quality of care.</p> <p><b>Study quality</b> Overall some concerns due to potential risk of bias arising from the randomization process and possible outcome measurement and reporting bias.</p>
<p><b>FINKELSTEIN, ET AL. (2020)</b></p>	<p>Prospective cohort study. Cost-consequence analysis. Boston, USA. Specialty care (pediatric urology). Post-operative follow-up visits with urologists for children recovering from urological surgery.</p> <p>Video vs. in person.</p> <p>Sample size: 207 patients (107 virtual, 100 in person); 8 pediatric urologists.</p> <p>Follow-up period: 30 days.</p>	<p><b>Impact of virtual visits on overall visit volume:</b> Appointment compliance (proportion of scheduled visits that were completed) was equal between virtual and in-person visits. The number of additional in-person clinic visits was not different between groups. Median time spent with the physician was 1 minute longer for the virtual visits (5 vs. 4 minutes, <math>p = 0.0104</math>).</p> <p><b>Impact of virtual visits on subsequent emergency department visits or hospitalizations:</b> There was no significant difference in the number of emergency department visits or readmission rates within 30 days of surgery.</p> <p><b>Impact of virtual visits on costs:</b> Virtual visits took much less patient time (median of 15 minutes compared to 250 minutes) and resulted in patients missing less work, school, or other activities (<math>p &lt; 0.0001</math>).</p>

REFERENCES	DETAILS	KEY FINDINGS
		<p>Estimated costs incurred by families for visits were significantly less for virtual visits compared to in-person visits. The median direct visit cost (family-reported) was US\$0 for a virtual visit and US\$20 for an in-person visit (<math>p &lt; 0.0001</math>). The medial overall cost incurred was US\$0 (0-228.20) for a virtual visit and US \$95 (1.00-4,558.02) for an in-person visit. Opportunity costs for virtual visits (US\$0) were significantly less than those for an in-person visit (US\$62.73) (<math>p &lt; 0.0001</math>). When a US\$22.81 average hourly wage was considered, the opportunity costs associated with an in-person visit were US\$95 per visit and US\$5.70 for a virtual visit.</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), or other outcomes was not reported.</p> <p><b>Study quality</b> Overall high risk of bias due to potential confounding, selection, missing data, and outcome measurement bias.</p>
<b>JONES, ET AL. (2018)</b>	<p>Randomized controlled trial. Cost utility analysis. Sheffield, England, UK. Specialty care (urogynaecology). Routine outpatient care for women with urinary incontinence.</p> <p>Telephone vs. in person.</p> <p>Sample size: 195 patients randomized (98 virtual and 97 in person).</p> <p>Follow-up period: 6 months.</p>	<p><b>Impact of virtual visits on overall visit volume:</b> The mean duration of the telephone consultation was 10.94 minutes, compared with a mean duration of 25.9 minutes for patients attending an in-person consultation (not assessed statistically).</p> <p>The number of resulting primary care provider referrals was higher in the telephone group (43) compared to the in-person group (33) (<math>p = 0.015</math>) and the proportion of patients with at least one primary care provider referral was higher among the telephone group compared to the in-person group (48.1% vs. 23.6%, respectively) (<math>p = 0.008</math>).</p> <p><b>Impact of virtual visits on costs:</b> Consultation costs for the virtual visit group were less than half the costs of the in-person group (GB £31.75 versus GB £72.17). There was no significant difference in direct or indirect costs to</p>

REFERENCES	DETAILS	KEY FINDINGS
		<p>patients over the 6-month follow-up period between telephone and in-person groups.</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), or subsequent emergency department visits or hospitalizations was not evaluated.</p> <p><b>Other outcomes:</b></p> <p>There was no significant difference in QALY between patients in the telephone or in-person groups. Under the funding threshold of GB £20k per QALY gained, the probability that the intervention is cost-effective was approximately 35%.</p> <p><b>Study quality</b></p> <p>Some concerns due to potential intervention deviations and outcome measurement bias.</p>
<p><b>PAGANONI, ET AL. (2019)</b></p>	<p>Cohort study. Cost-effectiveness analysis. Massachusetts, USA. Specialty care (neurology) Scheduled visits for patients with amyotrophic lateral sclerosis (ALS).</p> <p>Video (Vidyo platform) vs. in person (costs prior to video visit implementation).</p> <p>Sample size: 97 patients.</p> <p>Follow-up period: There was no individual patient follow-up after each encounter to explore subsequent healthcare utilization. The cohort was followed for a 1-year period to estimate the annual costs of virtual visits compared to in-person encounters.</p>	<p><b>Impact of virtual visits on costs:</b></p> <p>Without adjusting for effectiveness (medical usefulness), patient costs were US\$89 per virtual visit and US\$1,116 per in-clinic visit. Healthcare institution costs were US\$354 per virtual visit and US\$799 per in-clinic visit.</p> <p>Virtual visits were determined, by physicians, patients, and caregivers, as being three-quarters as effective as in-person visits (using a medical usefulness rating measure).</p> <p>When cost savings (all USD) were adjusted for medical usefulness, the base-case estimate indicated that patients would save \$997 (adjusted virtual visit cost \$119) and the institution would save \$327 (adjusted virtual visit cost \$472). If all visits in a year were virtual, after adjusting for medical usefulness, patients would save 89% for a total annual savings of \$3,988 compared with the annual cost of all in-clinic visits. Institutions would save 41% for a total annual savings of \$1,310.</p>

REFERENCES	DETAILS	KEY FINDINGS
<p><b>RABINOWITZ, ET AL. (2010)</b></p>	<p>Cohort study. Cost-consequence analysis. New York and Vermont, USA. Specialty care (psychiatry). Underserved rural nursing home residents. Details of visit (on-demand vs. scheduled) not described.</p> <p>Video (nurse assisted patients) vs. in person (either the nursing home would transport patients to the community hospital or the psychiatrist would travel to the nursing home).</p> <p>Sample size: 278 encounters for 106 nursing home residents.</p> <p>Follow-up period: No individual patient follow-up. Data were included over a 5.7-year period.</p>	<p>If visits were divided between in-person (2/year) and virtual (2/year), after adjusting for medical usefulness, patients would save \$1,194 and institutions would save \$655. If one more in-person visit is added per year (3 in-clinic visits and 2 virtual visits), patients would still experience a cost savings of \$878 but the healthcare institute would see a cost increase of \$144.</p> <p>The impact of virtual visits on overall visit volume, practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent emergency department visits or hospitalizations, or other outcomes was not evaluated.</p> <p><b>Study quality</b> Overall low risk of bias.</p> <p><b>Impact of virtual visits on costs:</b> There were 278 encounters over the 5.7-year study period. The one-way distance to the nursing homes was 35 miles in Vermont (44 minutes) and 104 miles in New York (120 minutes). Of the 278 encounters, 106 were in Vermont and 172 were in New York.</p> <p>If each of the encounters had occurred separately, a total of 843.5 hours of travel time, 43,000 miles, and US\$3,700 in fuel costs would be saved through virtual visits, compared to in-person consultations. Additional costs for patient-to-physician travel ranged from US\$33,739 to \$67,477. and additional costs if physician travelled to patients ranged from US\$84,347 to \$253,040. The videoconferencing equipment and service costs were US\$24,426. Therefore, the total savings estimated over the study period were US\$13,060-\$46,798 (if patients travelled to physicians) or US\$63,668-\$232,361 (if physicians travelled to patients).</p> <p>If four resident visits were possible for each in-person trip, the savings would decrease to 26.4 workdays, 10,750 miles and US\$925 in gasoline costs. Personnel costs (patient-to-physician travel) would range from US\$8,435-\$16,869 and physician costs</p>

REFERENCES	DETAILS	KEY FINDINGS
<p><b>ROBB, ET AL. (2019)</b></p>	<p>Randomized cross-over study. Cost-consequence analysis. New York, USA. Specialty care (neurology). Routine clinic visits with neurologists for adults with multiple sclerosis.</p> <p>Video (Zoom platform) vs. in person.</p> <p>Sample size: 36 patients completed all visits and survey.</p> <p>Follow-up period: 6 months.</p>	<p>(physician-to-patient travel) would range from US\$21,087-\$42,173.</p> <p>The impact of virtual visits on overall visit volume, practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent emergency department visits or hospitalizations, or other outcomes was not evaluated.</p> <p><b>Study quality</b> Low risk of bias.</p> <p><b>Impact of virtual visits on overall visit volume:</b> Virtual visits were found to be feasible, with a high percentage of visits completed within a pre-specified time window and no statistically significant difference in completion compared with in-person visits.</p> <p>66% of the visit was spent with the physician during a virtual visit compared with 26% for an in-person visit (p&lt;0.001).</p> <p><b>Impact of virtual visits on costs:</b> Participants reported saving an average of nearly 90 minutes (p&lt;0.001) and US\$49 per visit when attending virtually (p=0.02).</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), or subsequent emergency department visits or hospitalizations was not evaluated.</p> <p><b>Other outcomes:</b> The patient-reported quality of visits was equivalent between virtual and in-person visits. Most participants reported that connecting via Zoom was easy and rated audiovisual quality as good or very good. All participants attending virtually reported good or very good communication with the physician.</p>

REFERENCES	DETAILS	KEY FINDINGS
<p><b>SHAH, ET AL. (2018)</b></p>	<p>Retrospective cohort study using administrative data. Effectiveness evaluation. Massachusetts, USA. Specialty care (neurology). Patients attending outpatient neurology ambulatory clinics.</p> <p>Video vs. in person.</p> <p>Sample size: 1,038 patients (519 virtual and 519 in person).</p> <p>Follow-up period: Data used in the study included an 18-month period prior to virtual visit registration and 18-month period after registration (a total of 3 years) to monitor the impact of virtual visit registration on overall visit frequency. Individual encounters were not followed to assess for subsequent healthcare utilization (for example, if a virtual visit hadn't adequately addressed the complaint).</p>	<p><b>Study quality</b></p> <p>Overall some concerns due to potential intervention deviations, missing outcome data, outcome measurement bias, and reporting bias.</p> <p><b>Impact of virtual visits on overall visit volume:</b></p> <p>Immediately after registration with the virtual visit program, virtual visits decreased in-person visits (1.1 visit reduction per person-year). After four quarters, the in-person visit rate among virtual visit users was equivalent to that among the control cohort. Over the 1.5-year period, in-person visits decreased by 33% but the total number of visits (virtual plus in-person visits) increased by 80%. At a population level, for every 3.5 virtual visits performed, an in-person visit was averted.</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), subsequent emergency department visits or hospitalizations, cost, or other outcomes was not evaluated.</p> <p><b>Study quality</b></p> <p>Overall moderate risk of bias due to potential confounding, selection, and reporting bias.</p>
<p><b>VIERS, ET AL. (2015)</b></p>	<p>Randomized controlled trial. Cost-consequence analysis. Minnesota and Wisconsin, USA. Specialty care (urology). Post-operative follow-up visits with urologists for men recovering from radical prostatectomy to treat prostate cancer.</p> <p>Video vs. in person.</p> <p>Sample size: 70 men randomized, 55 completed the study (28 video visits and 27 in-person control).</p> <p>Follow-up period: None.</p>	<p><b>Impact of virtual visits on overall visit volume:</b></p> <p>Video visits were equivalent in efficiency relative to in-person office visits. There was no difference in total time devoted to patient care, total patient face time, patient–staff face time, or patient waiting time.</p> <p><b>Impact of virtual visits on costs:</b></p> <p>Video visits incurred lower costs, including distance traveled (median 0 vs. 95 miles), travel time (0 vs. 95 min), work missed (0 vs. 1 day), and money spent (US\$0 vs US\$48; all p&lt;0.0001).</p> <p>The impact of virtual visits on practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), or</p>

REFERENCES	DETAILS	KEY FINDINGS
<b>WESTRA, ET AL. (2015)</b>	<p>Randomized controlled trial. Effectiveness evaluation. The Netherlands. Specialty care (plastic surgery). Post-operative follow-up visits after face surgery (blepharoplasty, lipofilling, forehead lift, excision of xanthelasma).</p> <p>Video (Cisco) vs. in person.</p> <p>Sample size: 46 patients randomized (25 virtual and 21 in person). 31 were analyzed (16 virtual and 15 in person).</p> <p>Follow-up period: None.</p>	<p>subsequent emergency department visits or hospitalizations was not evaluated.</p> <p><b>Other outcomes:</b> There were no significant differences in patient perception of visit confidentiality, efficiency, education quality, or overall satisfaction. There was a high level of urologist satisfaction for both video visits and in-person office visits.</p> <p><b>Study quality</b> Overall some concerns due to potential risk of bias arising from the randomization process, possible intervention deviations, missing outcome data, and outcome measurement bias.</p> <p><b>Impact of virtual visits on costs:</b> Patients receiving virtual visits reported a significantly shorter waiting time compared to those receiving in-person visits (<math>p=0.01</math>).</p> <p>The impact of virtual visits on overall visit volume, practice patterns (prescribing, laboratory testing, diagnostic imaging, and specialist referrals), or subsequent emergency department visits or hospitalizations was not evaluated.</p> <p><b>Other outcomes:</b> Overall patient satisfaction was equal for both groups, but a significant difference in the dimensions 'general satisfaction' (virtual group more satisfied) and 'accessibility and convenience' (virtual group more satisfied) was found. Patients receiving virtual care reported significantly lower satisfaction in patient-physician communication compared to those receiving in-person consultations.</p> <p><b>Study quality</b> Overall some concerns due to potential risk of bias arising from the randomization process, possible intervention deviations, missing outcome data, and outcome measurement bias.</p>



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