Review

Connecting the World of Healthcare Virtually: A Scoping Review on Virtual Care Delivery

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Abstract: Virtual care extends beyond the walls of healthcare organizations to provide care at a distance. Although virtual care cannot be regarded as a solution for all health-related inquiries, it provides another care delivery channel for specific patient populations with appointments that do not require in-person physical examinations or procedures. A scoping review was conducted to define the meaning of virtual care, understand how virtual care has influenced the healthcare industry and is being expanded to complement the existing healthcare system, and describe the outcomes of using virtual care for patients and providers. Findings from the scoping review suggest that virtual care encompasses the provision of care using advanced video conferencing technology to support remote care that takes place between patients and providers and the use of virtual reality technology to simulate care environments. Some of virtual care's use in healthcare includes application to pain and anxiety management, virtual consultations and follow-up visits, rehabilitation and therapy services, outpatient clinics, and emergency services. Lastly, from a provider and patient perspective, while both saw benefits of virtual care and scored the service relatively high on satisfaction after using virtual care, the greatest barrier to using virtual care may be technological challenges.

1. Introduction

Self-management of health is an essential part of everyday life. Historically, provider-centric models have been used by healthcare organizations (e.g., hospitals). In provider-centric models, patients seek care by visiting a provider's office or making trips to healthcare facilities. For example, a patient wishing to receive diabetes education for insulin management would need to visit a diabetes education clinic with data from their glucometers to show a registered nurse (RN), dietician, or physician so that they are able to receive the necessary support from their providers. With technological advances in healthcare, there is an opportunity to enhance existing patient–provider relationships by creating new tools to support a patient-centric model of care. This patient-centric model of care occurs when providers and healthcare organizations are trying to provider better access to care from a patient's perspective, which can include offering services such as telehealth visits. Virtual care provides the opportunity for the description above to become a reality, as virtual care is able to increase the level of convenience for patients to access care from their providers.

Many technologies exist in the global communications market to support virtual connections through real-time asynchronous communication, such as Skype® or FaceTime®. These technologies connect family and friends regardless of geographic location and/or time differences. When it comes to healthcare, there are privacy concerns in using these common tools in terms of Personal Identifiable Information (PII) and Protected Health Information (PHI). PII refers to information that recognizes individuals based on unique identifiers, such as a name, social insurance number, and/or driver's license [1]. A person's PHI refers to information generated from medical records, such as name, medical record

numbers, or biometric identifiers, but it may also contain many of the identifiers in PII, such as name, driver's license number, or passport number [1]. With this in mind, companies from all around the globe have developed tools specifically for use in healthcare. These tools allow for compliance with local privacy regulations; for example, companies in the U.S. comply with the Health Insurance Portability and Accountability Act (HIPAA) [2]. In Canada, virtual tools comply with the Freedom of Information and Protection of Privacy Act (FIPPA) according to the Office of the Information and Privacy Commissioner and the Personal Information Protection and Electronic Documents Act (PIPEDA) [3]. Hence, around the globe, countries have different regulations that vendors must comply with in order to produce technologies that are acceptable by the privacy and security standards of these various countries. These acts serve the purpose of protecting an individual's private information from wrongful use or distribution into the black hole of our information-heavy world.

As the use of many of these tools does not require the physical presence of both the patient and provider, virtual care has become the generic term used to refer to this model of care. Although virtual care is not a new concept, it is not well understood by the general public in terms of the types of the services virtual care can offer or how virtual care services are provided compared to traditional telehealth or even face-to-face visits. The major difference between these three modalities of services is the location of patients. Face-to-face visits are obvious in that the patient would be collocated with their provider, whether it is in their provider's office, or a provider in the community, such as a community health worker who visits a patient in the patient's home. For traditional telehealth, it means that a patient will be attending their remote consultation with their provider from a healthcare facility through a designated space where video conferencing equipment has been set up on both the patient and provider's side to have a video consultation. Finally, virtual care in this particular context means that the patients and providers can be anywhere, such as in the comfort of their own home rather than having to travel to the hospital. Hence, the objective of this research is to explore the world of virtual care and the tools that are specifically designed to be applied to healthcare services. This study will (1) define the meaning of virtual care; (2) understand how virtual care has influenced the healthcare industry; (3) understand how virtual care is being expanded to complement the existing healthcare system, and (4) describe the outcomes of using virtual care for patients and providers.

2. Materials and Methods

The protocol followed for this scoping review aligns with a five-step framework outlined by Arksey and O'Malley, and advanced by Levac et al. [4]. The framework includes identifying the research questions and relevant studies, selecting studies, data extraction from the selected articles, and a dissemination of the results [4]. An ethics review was completed at the University of Victoria by the Research Ethics Coordinator and Research Ethics Vice-Chair from the Office of Research Services. Upon review, it was deemed that this project does not involve human subjects and is limited to the use of publicly available data or articles; hence, it is exempt from a full human research ethics review.

2.1. Identifying Research Questions

The scoping review answered the following research questions:

1. How is virtual care defined?
2. How has virtual care influenced the healthcare industry?
3. How is virtual care being expanded to complement the existing healthcare system?
4. What are the outcomes of virtual care for patients' and caregivers' perspectives?

2.2. Identifying Relevant Studies

As part of this scoping review, literature from the following databases were searched: Medline®, PubMed®, CINAHL®, IEEE Xplore®, ISI Web of Science®, Biomed Central®,

Applied Science®, and Technology Index®. Two important search criteria to note are publication dates and keywords. The published literature from the past 10 years was reviewed in depth and breadth in the topic area (i.e., virtual care). Keywords that were searched in these databases include but are not limited to those shown in the Table 1 below.

Table 1. Keywords for database search.

Virtual Care	Online Care	Mobile Doctor	Devices	Telehealth
Video Conference	Monitoring	Virtual Clinics	WebRTC	Distance
Telemedicine	Technology	Digital Health	Virtual Visits	Application

2.3. Selecting Studies

Covidence® is the online platform used for systematic review management. Zotero® is an electronic reference management system used to store all potential studies to be included in this scoping review. Zotero® provides the ability to store all studies in a virtual library, which can then be imported into Covidence® to complete an initial title and abstract screening. Following a title and abstract screening in Covidence®, a number of irrelevant articles were eliminated, resulting in a list of articles that would require full-text reviews. Two investigators were involved with approving articles for inclusion in the scoping review. A meeting was set up via video conference to discuss any discrepancies between the investigators when deciding to include or exclude an article. Articles were included if they touched on at least one of the research questions and involved the use of virtual care technology at a distance, and excluded otherwise. Articles were also excluded if they were not a full study. As a result, a PRISMA diagram was produced, visually depicting the process of elimination. Duplicate articles were automatically removed from Covidence® if they had the same author and title. Studies deemed irrelevant were summarized with the reasons for their exclusion. Following the selection of studies, data charting was performed to list the authors, date, title, method, results, limitations, and any other fields as necessary for each article that was screened.

2.4. Data Charting

Data charting was completed on all 34 studies included from the PRISMA Diagram in Figure 1. Information extracted from each article included the: authors' names, the publication date, title, method, results, limitations, and any other fields as necessary for each article that was screened. Full results of data charting are consolidated into tables below in Appendices A and B.

2.5. Dissemination of Results

As part of the data-charting process, themes for each article were documented in the table that relate to one or more of the four research questions this scoping review answers. These themes include consumer perspectives on virtual care, whether it be a provider or a patient, how virtual care can be defined, as well as applications of virtual care. Consumer perspectives include user experience, both from the provider side of care and from the receiver end. This helps inform the direction of virtual care in the future. Currently, virtual care is a relatively broad topic, as can be seen from the keywords table in Section 2.2; therefore, a selection of care services provided remotely, or are simulated, such as through virtual reality, can all fall under the umbrella of virtual care. Lastly, given the broad definition virtual care can encompass, applications of virtual care can also thrive or fail in various settings, such as pain management or follow-up visits. The results section below will further discuss the details uncovered from data charting with references.

3. Results

The PRISMA diagram generated from the elimination of articles throughout the screening process is shown in Figure 1 below.
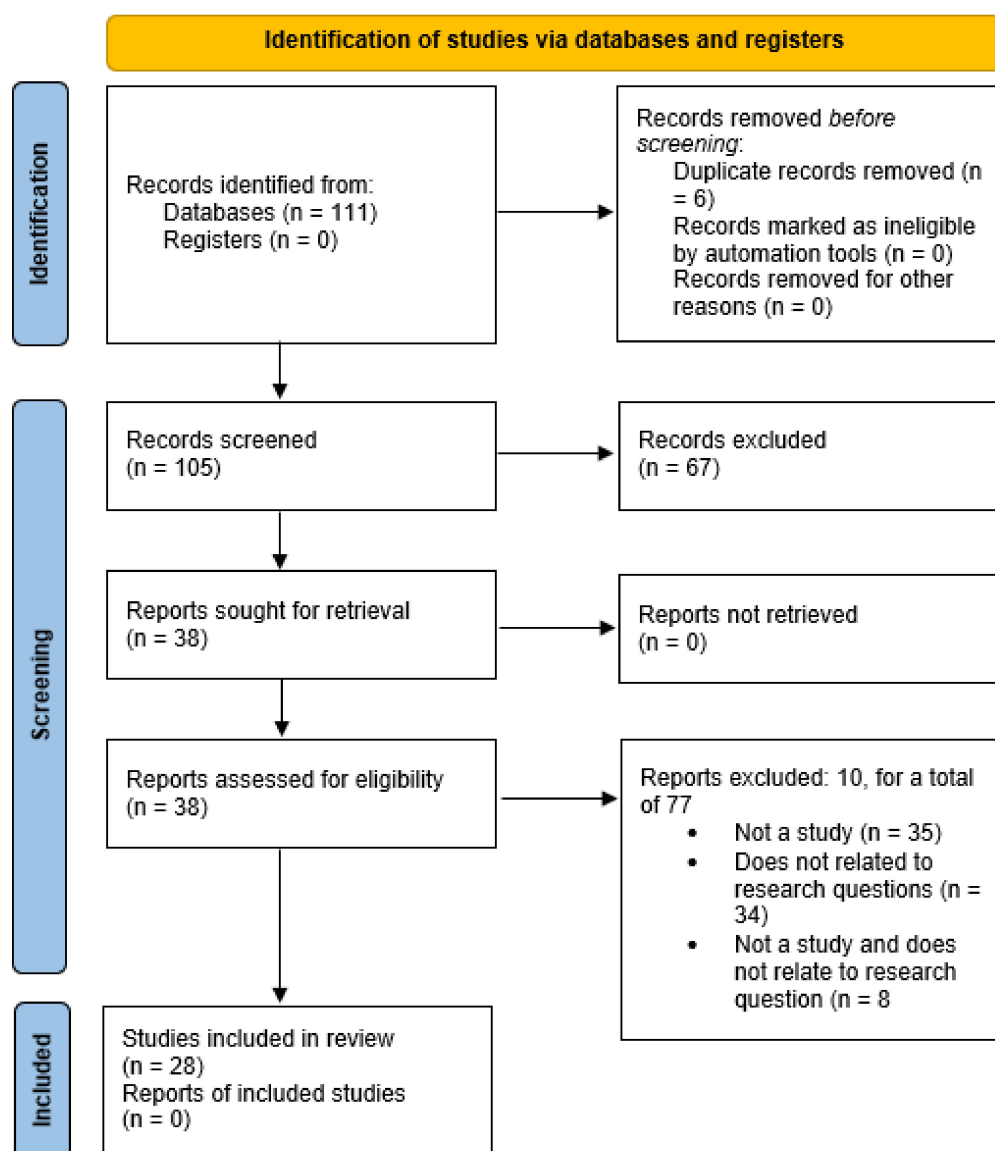
Figure 1. PRISMA diagram.

Given that the range of articles searched in this scoping review was relatively large, there were no search criteria that limited how recent an article had to be in order to be included in the project. This produced an interesting result in that the majority of articles included in this study were published within the last five years ($\geq$015); only 29.41% (10/34) were published before 2015. Even including the percentages of excluded articles, that decreases to just 20.79% (21/101) of the articles on the topic of virtual care being published before 2015. Based on these statistics, it can be seen that more research on virtual care has been done in recent years. Then, the articles were reviewed with attention to the following themes: (1) the definition of virtual care, (2) the influence of virtual care on the healthcare industry, (3) the expansion of virtual care to complement the existing healthcare system, and (4) consumer perspectives of virtual care.

3.1. Definition of Virtual Care

Based on the selection of articles uncovered in this scoping review, virtual care can encompass the provision of care through using advanced video conferencing technology between patients and providers remotely or using virtual reality technology to simulate care environments. De Jong et al. [5] defined virtual care and its application as, "integrated web-based technology that combines self-management, data sharing, and communication

between patients and professionals". Others, such as Gordon et al. [6] also noted that virtual health can be defined as the utilization of real-time video consultation with a provider over the Internet, and that they expect the need for virtual care will continue to grow as the use of mobile devices and patient demand for immediate and convenient access to care increase. However, virtual reality is typically not defined as virtual care. Virtual reality is a tool that can support virtual care. This will be discussed in more detail in the following sections.

3.2. Influence of Virtual Care on the Healthcare Industry

In recent years, virtual care has expanded. It now touches on multiple aspects of healthcare, including pain and anxiety management, virtual consultations and follow-up visits, rehabilitation and therapy services, outpatient clinics, and emergency services.

3.2.1. Pain and Anxiety Management

Virtual care has been applied to the management of pain and anxiety associated with the diagnosis of hematologic diseases; for example, the examination of bone marrow is an essential step in the diagnosis and management of hematologic diseases; hence, "patients undergoing bone marrow aspiration and biopsy procedures commonly experience pain, anxiety and stress" [7]. Nevertheless, distraction has proven to be an effective nonpharmacologic intervention to decrease pain and anxiety [7]. Virtual reality goggles were used by adults in an outpatient cancer center to determine whether the visual and auditory stimuli provided by the goggles "would decrease the amount of pain and anxiety experienced by patients during bone marrow aspiration and biopsy procedures, as compared to the practice of viewing a television with sound" [7]. Vital signs were collected from both groups; however, the results showed that there were no significant decreases in the level of pain experienced by the group wearing goggles versus the group watching television [7]. Although distraction through virtual reality did not prove effective in this scenario, other studies further investigate the appropriateness of using virtual reality in clinical environments.

According to Birnie et al. [8], "needle procedures are among the most distressing aspects of pediatric cancer-related treatment. Virtual Reality (VR) distraction offers promise for needle-related pain and distress given its highly immersive and interactive virtual environment." The researcher studied the ease of use and acceptability of using a VR intervention with children diagnosed with cancer who were undergoing the implantation of an intravenous access device (IVAD) for needle insertion [8]. The researchers found that 82% of study participants found the intervention easy to use, 94% found the intervention easy to understand, and 94% indicated they would like to use the intervention for subsequent needle procedures [8]. In addition to this, the study findings revealed no adverse events such as nausea or dizziness were reported by the participants; hence, with the right refinements based on the need of each clinical procedure, VR can still provide an alternative intervention for pain management.

Pain intensity has also been observed with VR treatment in a study by Scapin [9]. Scapin [9] studied the effect of VR treatment upon the perception of pain in two burned children who were hospitalized in a Burn Treatment Center in Southern Brazil. "For assessing pain, a facial pain rating scale was applied at four times; just before the dressing, during the dressing without the use of VR, during the dressing with VR, and after the use of VR" [9]. The researcher found that the application of VR during burn treatments showed relevant effects, as the children were immersed in the VR environment during the dressing procedure [9]. This also meant that the amount of sedation that was originally required was also decreased; hence, VR could be used as a nonpharmacological intervention for pain management.

Schneider et al. [10] studied the use of VR as a distraction intervention to relieve the levels of distress in adults undergoing chemotherapy for breast, colon, and lung cancer. Similar to an earlier study, no significant decrease in stress levels was observed; however,

82% of respondents in their study preferred to use VR for future treatments. The study participants "stated that using VR made the treatment seem shorter and that chemotherapy treatments with VR were better than treatments without the distraction intervention" [10].

In summary VR has been used to distract individuals while they are undergoing painful treatments such as burn care. VR has also been successfully used to help individuals manage their anxiety. The approach holds considerable promise for use in managing pain and anxiety associated with other types of treatments. With the right amount of refinement to this technology, it can adapt to any clinical setting. Although this intervention may not result in significant levels of pain or anxiety reduction, it does help in making complex procedures less difficult to experience.

3.2.2. Virtual Consultations and Follow-Up Visits

In a study by Abbot et al. [11], virtual consults were found "to expedite diagnostic and therapeutic interventions for veterans with incidentally discovered pulmonary nodules". A total of 157 virtual consults were completed, and a comparison between virtual visits versus in-person visits spanned a duration of 6 months [11]. Findings from this study indicate a decrease both in cost and the time required to complete each visit virtually. "For all virtual consults, the mean time to completion of consultation was 3.2 days. Subsequent in-person consultations during the first 6 months of virtual consults occurred within a mean time of 20.5 days. The average thoracic surgery outpatient facility visit was $228 per in-person consultation, whereas the virtual consult cost was $120 per episode, a 47.4% decrease [11]. In another study, Schneider and Hood [12] compared telephone-based virtual outpatient clinics with traditional in-person outpatient clinics as they were used to follow up on general surgery patients. "Of 107 subjects randomized to virtual follow-up, 98 (92%) were successfully contacted by telephone, of which 10 (10%) had postoperative issues and 3 of whom ultimately attended a conventional clinic for follow-up. Of 102 subjects randomized to the conventional outpatient clinic follow-up, 83 (81%) attended the appointment, of which 16 (19%) had postoperative concerns" [12]. From both these studies, feedback has been positive, and most participants also expressed preference for virtual follow-up visits in the future.

As virtual healthcare continues to expand, Gordon et al. [6] examined the costs of virtual visits over a period of three weeks compared to in-person visits in retail health clinics, urgent care centers, emergency departments, or primary care physician visits. They applied a cross-sectional, retrospective analysis of insurance company claims with a total of 4635 virtual visits and 55,310 non-virtual visits included. The costs for retail health clinics, urgent care centers, emergency departments, and primary care physician visits were estimated to be $36, $153, $1735, and $162 higher in non-virtual visits than virtual visits, respectively [6]. Trends observed from these studies indicate an overall patient and healthcare provider satisfaction with virtual visits. In particular, follow-up visits may be one of the most appropriate appointment types to be conducted virtually, given that physical assessments are often not required. In addition to this, there was also a substantial decrease in the costs associated with completing virtual versus in-person visits.

3.2.3. Rehabilitation and Therapy Services

Tele-rehabilitation allows patients to access rehabilitation services remotely through video conferencing in their own homes. Virtual reality (VR) has been applied to patient balance training in the past, "which [has] been shown to reduce postural instability in patients with Parkinson's Disease (PD)" [13]. In the multi-centered study by Gandolfi et al. [13], 38 PD patients were assigned to receive telerehabilitation treatments using the Nintendo Wii Fit system in their homes, while another group of 38 PD patients were assigned to in-clinic sensory integration balance training (SIBT). Analysis revealed that "static and dynamic postural control was improved in the PD patients who had received in-home VR-based balance training (TeleWii), while improvements in mobility and dynamic balance were greater, on average, in those who had received in-clinic SIBT... In addition, the total

cost of rehabilitation using TeleWii was lower than that of SIBT". The study did lack instrumental evaluations to assess balance performance, postural reactions, and changes in muscle strength; however, virtual reality is still considered a feasible alternative to in-clinic SIBT [13].

In a similar study, researchers examined the "effects of VR augmented balance training on the sensory integration of postural control under varying attentional demands and compared the results to those in a conventional balance (CB) training group and an untrained control group." A longitudinal, randomized controlled trial was used with sensory organization tests (SOTs), and verbal reactions times (VRTs) were recorded [14]. "Both VR and CB training improved sensory integration for postural control in people with PD, especially when they were deprived of sensory redundancy" [14].

Finally, a study by Klein et al. [15] described the application of virtual reality over 5 weeks to "improve gait and mobility in people with a history of falls, poor mobility, or postural instability." In their study, a retrospective data analysis was conducted on clinical records of patients who were recruited to training by walking on treadmills while dodging virtual obstacles. The results after 5 weeks indicated time to completion increases in three tests—the Up and Go Test (TUG), Two-Minute Walk Test (2MWT), and Four-Square Step Test (FSST)—by 10.3%, 9.5%, and 13%, respectively. Therefore, the combination of treadmill training and virtual obstacles appear to be both practical and effective for physical therapy treatments, especially if patients do not need to leave the comfort of home [15]. As can be seen from the examples in the studies described above, there is an opportunity to successfully integrate remote rehabilitation interventions, also known as tele-rehabilitation, into healthcare. For patients who require this service, reducing the need to travel to an in-person clinic also provides greater convenience and an opportunity to improve physical function (if they are already physically challenged).

3.2.4. Outpatient Care

A virtual outpatient clinic was established as a cloud-based, multicomponent outpatient clinic and studied by De Jong et al. [5] to assess the feasibility and functionality of virtual outpatient clinics. "The [virtual outpatient clinic] consists of 6 digital tools that facilitate self-monitoring (blood pressure, weight and pain) and communication with peers and providers (chat and videoconferencing) connected to a cloud-based platform and the hospital patient portal to facilitate access to (self-collected) medical data" [5]. Feasibility, adherence, usage statistics, technical issues identified, and qualitative responses were assessed, indicating that most participants successfully used all options of the virtual outpatient clinic and expressed positive attitudes to the use of the various tools within the virtual outpatient clinic. "The adherence was 7/19 for weight scale, 11/19 for blood pressure monitor, and 14/20 and 17/20 for pain score and daily questions, respectively. The adherence for personal health record was 13/20 and 12/20 for the patient portal system" [15]. The participants in this virtual outpatient clinic were more technically savvy. As a result, the findings from this study may not be generalized to the greater population, as people who are comfortable with more technology are more likely to accept the use of various tools within a virtual outpatient clinic.

Healey et al. [16] conducted a randomized trial aimed at determining whether a virtual outpatient clinic is an acceptable alternative to a traditional outpatient clinic for a range of general surgical patients' post-discharge. All patients who were admitted under one general surgical service over the span of the study period were assessed and randomized to receive either virtual outpatient clinic or outpatient clinic appointments. The following points summarize the results obtained from a follow-up questionnaire sent to the participants:

- 98/107 (91.6%) patients in the virtual outpatient clinic group were successfully contacted.
- 83/102 (81.4%) patients in the outpatient clinic group were successfully contacted.
- 10 patients in the virtual outpatient clinic group reported ongoing issues.

- 6 patients in the outpatient clinic group reported ongoing issues.
- 78/82 (95%) of patients in the virtual outpatient clinic group were happy with their overall experience.
- 34/61 (56%) of patients in the outpatient clinic group were happy with their overall experience.
- 68/81 (83%) of patients in the virtual outpatient clinic group preferred a virtual outpatient clinic appointment in the future.
- 41/61 (67%) of patients in the outpatient clinic group preferred a virtual outpatient clinic appointment in the future.

It is standard practice to follow-up with patients from surgical discharge; however, the demand and resource balance typically tips to the demand side. Therefore, a virtual outpatient clinic can help reduce unnecessary in-clinic visits to provide the resources to patients who are more in need of physical care.

3.2.5. Emergency Services

Research suggests that VR may be useful in the context of emergency services such as those provided to children who have sickle cell anemia when they experience a vaso-occlusive crisis. In America, approximately 100,000 of the total population are affected by sickle cell disease, and about 300,000 infants are born with sickle cell disease each year. "Children require prescriptions for pain medication, often opioids, during a vaso-occlusive crisis experienced at home, but they seek medical care in the emergency department when the pain is not improving" [17]. In their study, the investigators attempted to determine the effects of using virtual reality on acute pain in pediatric patients with sickle cell disease experiencing a vaso-occlusive crisis. A sample of 15 participants were either assigned to a control group that received standard intravenous narcotics treatments or an intervention group that received virtual reality along with standard treatment [17]. "Pain was assessed using the Numerical Rating Scale (NRS) and the Face, Legs, Activity, Cry, Consolability (FLACC) scale. Data were analyzed using an independent sample t test" [17]. The results suggest that although there was no significant statistical difference between the pain scores of both control and intervention groups, the study does help confirm that introducing nonpharmacologic treatments may be beneficial for pediatric patients experiencing pain, as it is a distraction technique to help ease pain [17].

3.3. Expansion of Virtual Care to Complement the Existing Healthcare System

Virtual care, in all shapes and forms, have also been used in health professional training and education (in addition to patient care). VR has been used for remote training of healthcare professionals. Remote training has taken the form of online training platforms, virtual reality, as well as use of virtual patients.

3.3.1. Online Training Platforms

In a study by Tong et al. [18], a post-treatment investigation of the effectiveness of five automated "self-help cognitive behavior e-therapy programs for generalized anxiety disorder (GAD), panic disorder with or without agoraphobia (PD/A), obsessive–compulsive disorder (OCD), posttraumatic stress disorder (PTSD), and social anxiety disorder (SAD) offered to the international public via Anxiety Online, an open-access full-service virtual psychology clinic for anxiety disorders" was undertaken. Participants (n = 255) were asked to evaluate each of five online therapy programs [18]. Overall, there were significant observed reductions on all five anxiety disorder clinical severity ratings, a decreased number of clinical diagnoses, and an increased confidence in the self-management of mental healthcare [18].

In a study conducted by Trong et al. [19], the researchers provided an overview of an online training program for health professionals aimed at enhancing their skills in supporting pregnant women attempting to stop smoking. The online program offers "5 interactive case simulations and comprehensive discussion of patient visits, short lectures on relevant

topics from leading experts, interviews with real patients who have quit, and a dedicated website of pertinent links and office resources" [19]. The incentive for health professionals to undergo training is up to 4.5 h of continuing education credits, but other benefits include understanding the 5As (ask, advise, assess, assist and arrange) counseling approach [19]. "Although clinical guidelines consistently recommend screening and counseling by pre-natal care providers, only half or pregnant smokers receive counseling... Reasons for the low level of cessation counseling include providers' self-reported lack of awareness of or agreement with existing guidelines, lack of self-efficacy, lack of training, lack of systems to support counseling activities, and lack of patient and provider materials" [19]. Therefore, an online training program improves time management for both patients and providers (increases flexibility in scheduling training) and helps sharpen the skills of providers aimed at encouraging pregnant women to quit smoking and remain smoke-free post-partum.

3.3.2. Virtual Reality

Virtual reality has been used for medical use cases, such as therapy treatments as discussed in earlier sections. "Applications of VR in pharmacy include adjunctive or replacement treatment for pharmacotherapy in pain management, anxiety and other disorders, pharmacological modeling for drug discovery, pharmacist education and training, and patient counselling and behavior modification" [20]. The results obtained from many clinical studies indicated that the majority of the subjects reported positive experiences with VR, as it alleviates stress and anxiety from certain illnesses through providing distraction [20]. Despite the positive results, Ventola [20] notes the fact that the younger populations tend to be more willing to use VR compared to older populations. However, this is understandable, as there can never be a solution that satisfies everyone.

Dyer's research work [21] involved using the technology to teach medical students and other health professionals' empathy toward older adults through virtual reality by allowing them to "simulate being a patient with age-related diseases and to familiarize medical students with information resources related to the health of older adults." The software used in the study created an immersive virtual environment. Each virtual reality kit contained an Alienware® laptop, Oculus Rift® headset with a sensor and a Leap Motion® hand-tracking device, which cost a total of $2000–$2500 [21]. As a result, not only did the project successfully introduce an innovative teaching modality, VR also "enhanced students' understanding of age-related health problems and increased their empathy for older adults with vision and hearing loss or Alzheimer's disease" [21]. This is a great segue into the next study, as [22] evaluate the use of virtual patients to supplement education for health professionals in pediatric dentistry.

3.3.3. Virtual Patients

According to Papadopoulos et al. [22], a child virtual patient (VP) was programmed and called Erietta. Erietta is an 8-year-old girl who visits the dentist with her mother for the first time. "Communication techniques such as Tell–Show–Do and parents' interference management were the basic elements of the education scenario on which the VP was based" [22]. A total of 103 dental students were placed into an experimental group, which was exposed to the simulation, and a control group, which did not receive the simulation. Both groups were asked in the end to complete a questionnaire following their participation in the research [22]. The majority of participants provided a positive evaluation of the simulation. There was a 69% satisfaction rate among the experimental group who expressed preference for using VP to supplement traditional training [22]. In another study by Papadopoulos et al. [23], the researchers created a virtual patient to support learning processes; however, this time, the virtual patient that was created was specific to a primary care context. From this follow-up research, the researchers found they could visualize the following aspects of the students' learning process, namely clinical reasoning and reflections in the context of the learning cycle. The research demonstrated that VP models could complement clinical and theoretical teachings and help fill the gaps

of traditional education. As a result, students found the new VP model interactive and straightforward, and it also encouraged self-directed learning plus reflective abilities [23].

3.4. Consumer Perspectives on Virtual Care

Given the previous sections discussed applications of virtual care and some of the positive aspects of adopting virtual care in varying aspects of healthcare, the following section digs deeper into consumer perspectives, including opinions of both patients and providers, as satisfaction has become an increasingly important measure in the deployment of any solution.

3.4.1. Patient Perspectives

In another study [24], researchers compared "the satisfaction of obstetric patients who received one-third of their antenatal visits in videoconference (virtual care) compared to those who received 12–14 face to face visits in clinic with their physician/midwife." Satisfaction surveys were sent out to 378 patients from the virtual care cohort and 795 patients who received traditional obstetric services between 2013 and 2015 [24]. The virtual care cohort reported significantly higher overall satisfaction; however, the researchers noted that the virtual care model was selected more by those who were not experiencing pregnancy for the first time [24]. Therefore, one can conclude that although virtual care can provide a great alternative to traditional care, it may not be the most optimal choice for all patients.

Nalverro's research group [25] implemented a Virtual Health Room (VHR) initiative in a village in Sweden. The study evaluated patient perceptions and the usability of the VHR as well as its contributions to their healthcare. Study participants were asked to complete a 13-question version of the Patient Activation Measure (PAM), patients' demographic information, as well as a questionnaire that asked for information about their satisfaction with their VHR visit [25]. The researchers found that "respondents with lower PAM scores were less satisfied with the technical performance of the VHR, but equally likely to think the VHR made a good contribution to access to healthcare...In contrast, older patients were less likely to value the contribution of VHR, but no less likely to be satisfied with its technical performance...There were no relationships between level of education and distance travelled and perceptions of the VHR" [25]. Again, even though virtual care services have overall been well accepted by patients, they can never address the needs of all individuals.

A final example to provide patient perspectives of virtual care is in the area of postoperative education, discharge instructions, and follow-up appointments for new ostomates post-discharge. White et al. [26] studied 10 patients who attended two outpatient virtual visits following hospital discharge. The virtual visits were completed through advanced video conferencing software. "All patients successfully completed two virtual visits from their homes... 90% felt these visits helped with ostomy management and agreed they should be part of a discharge plan...All patients felt comfortable with a virtual format...Common themes discussed included poaching and skin irritation" [26]. The researchers concluded that virtual visits are feasible, and patients are also satisfied with the virtual format when addressing certain types of care goals. As mentioned before, virtual visits may be very beneficial for consult-type visits, but they are still limited if physical assessments are required [26].

3.4.2. Provider Perspectives

A group of investigators at the Nemours Children's Health System launched a Nemours App for Asthma as part of their new digital strategy to provide tools in a single platform. "This kind of an app provides immediate access, another thing that millennial consumers look for. And then we also measure costs and people and growth. We are looking at one or two other chronic conditions that we would want to market, but immediately thereafter we are going to work on a well child. This is how families have

a healthcare coach in the palm of their hand" [27]. The app helps clinicians to create an asthma plan for asthma patients in their patient record; however, the plan will only be provided to the family unless clinicians put the plan into the notes section for families to easily access and print out at home [27]. At first, clinicians anticipated themselves to be overwhelmed with extra work they needed to complete; however, the results of the research suggest that not only was the volume manageable, but it was also an effective way to address questions from patients and their families [27]. "It became apparent how absolutely critical telehealth was going to be to provide instant access to a physician who could see and hear the child, and provide guidance in the case of early exacerbations" [27].

In another study, Mammen et al. [28] discussed physician perceptions of virtual visits for Parkinson's disease (PD). Delivering care remotely has become increasingly valuable and beneficial; however, there is a lack of qualitative data from both patients and providers on how they perceive virtual visits; therefore, the researchers conducted a qualitative analysis about how patients and providers perceived virtual visits related to Parkinson's disease. "The sentiment analysis for patients was strongly favorable (+2.5) and moderately favorable for physicians (+0.8). Physician scores were lowest (−0.3) for the ability to perform a detailed motor examination remotely" [28]. As a result, although both patients and providers perceived virtual visits favorably, technical challenges varied on a case-by-case basis, which affected their satisfaction with remote care [28].

The results of this scoping review suggest there is an overall positive reaction to virtual care approaches by healthcare providers and patients. Based on this review, it can be stated that virtual care, whether in the form of video conferencing technology that supports remote consultations or as a supplementary care tool in the form of virtual reality, has expanded to many differing aspects of healthcare. This expansion has influenced pain and anxiety management, virtual consultations and follow-up visits, rehabilitation and therapy services, outpatient clinics, and emergency services. Although the findings in each of these areas have not proven virtual care to be a significantly effective intervention, the recipients of care have mostly expressed their interest to incorporate virtual care services into their future care. Technological barriers cannot be neglected either, as with the elderly and frail population, virtual care may not be the most suitable; hence, millennials will be the drivers for the future of virtual care.

4. Discussion

From the scoping review, it can be seen that virtual care refers to the use of video technology to connect patients and healthcare providers together regardless of where each party is located. The use of this technology has also influenced a variety of clinical settings, such as pain management, mental health, rehabilitation and therapy services, outpatient clinics, and emergency services. With mostly positive perceptions of the technology, virtual reality technology has also become a part of virtual care by augmenting the virtual care experience. "VR technology has become increasingly affordable, flexible and portable, enabling its use for therapeutic purposes in both inpatient and outpatient environments" [20]. The expansion of tools and technology that support virtual care have complemented the traditional "bricks and mortar" medical practice while at the same time improving healthcare education. Remote training of health professionals using online modules or simulations of virtual patients have been well received by students, with the majority of health professionals expressing interest in using a similar mode of training in the future or applying virtual care to their practice. As Shumaher et al. [29] state, "It is known that the creation of a web-based educational system consists not only in the digitization of texts or printed materials, but in providing its own language, principles, tools and methods, which makes the virtual learning environment (VLE) a space dynamic and interactive, current, closer to the reality of the user and extremely rich, as it allows the use of different media resources that make the teaching-learning process more creative, interesting and powerful." Lastly, consumer perspectives on virtual care from both patients and providers have been positive as well, especially among patients. It is undeniable that

convenience and efficiency play a great factor in patients' choice for virtual care. However, the technology can still be a barrier to receiving care for some groups such as the elderly.

To list a few of the efficiencies of virtual care compared to traditional visits, wait time is often decreased, and the need to travel to an onsite location for care is removed, hence also decreasing or eliminating transportation costs. As previously mentioned in the study by Gordon et al. [6], the costs associated with patients visiting in-person health clinics, urgent care centers, emergency departments, and primary care physician visits were estimated to be $36, $153, $1735, and $162 higher in non-virtual visits than virtual visits, respectively. Aside from cost and wait times, the satisfaction level in patients who have received care virtually did not decrease compared to traditional visits. In fact, depending on the type of visit required, patients often expressed interest to include virtual visits in their future care plan. Other efficiencies and benefits that do not directly relate to care can be the environmental impact.

As many are familiar with the 2020 global pandemic caused by coronavirus, this has led to some dramatic changes in the way people live and work [30,31]. Governments all around the world have mandated the closure of non-essential services, such as restaurants and entertainment venues, while essential services, such as clinical programs, pharmacies, public transportation, and grocery stores continue to remain open during the pandemic. Given the risks of the pandemic, many countries also began the practice of social distancing, hence reducing the need to visit a care facility, and having virtual visits where possible became the public's preference [30,31]. With an increase in virtual visits, the need to travel decreased; therefore, this is a perk in terms of environmental impacts and decreasing the carbon footprint on this planet [32]. Progressively, virtual care can become the norm for many patients and providers, and it may be hard for some to revert back to traditional practice. If it was not for COVID-19, virtual care uptake and expansion may not have occurred at such speeds.

In terms of the implications of virtual care on health informatics practice, we can expect there to be many collaborations between health informatics professionals and healthcare organizations in joint research projects on the implementation of virtual care [30,31]. This can include being a consultant for healthcare organizations as they implement a new virtual care technology or conducting evaluations of the post-implementation of virtual care technologies. If evaluations produce positive outcomes (e.g., [30–33]), the government may also devote more funding toward future virtual care research or wide-scale implementations. This will also affect the training and education for health informatics programs.

Health informatics is a relatively new program in many universities, and some do not even offer this program. Most students benefit from this program if they have career interests to work in the healthcare sector as an informatics professional. It is common for graduates of the program to become a liaison between technology and medical professionals, as they implement technological solutions required by clinical workflows [34]. Given that virtual care will potentially transform the way care has been delivered, it would be worthwhile to incorporate courses as part of the curriculum that cover the successes and failures of virtual care implementations. As an example, the Health Information Science program at the University of Victoria is planning to add an elective course on virtual care to trial the popularity of this topic prior to further embedding this as part of their mandatory course structure. Contents of the course can entail the implementation process of a virtual care tool, with real-life examples or guest speakers who have the knowledge and experience of virtual care implementations [31]. Future learning experiences in work settings terms can also include opportunities to work on virtual care projects [31], which can ultimately open up new employment opportunities for students.

Limitations of the study include the selection of articles. The majority of the articles selected were from the United States or other countries around the globe, with very little from Canada. Therefore, the results of the scoping review reflect the status of virtual care elsewhere and will not accurately reflect its state in Canada. Given this is a scoping review, often the more articles included, the less biased the results will be. Even though the study

began with a search of 111 articles, only 28 articles were included in the end results. Hence, the accuracy of this study can be improved if more articles were included.

Future research can expand on the knowledge built from the scoping review to conduct an observational research study on the implementation of virtual care technologies at a clinic, hospital, or even at a broader level, such as healthcare organizations in Canada. This will allow oversight from initiation of implementation to the final uptake of the virtual care technology by end users. Both challenges and benefits of the implementation process can be documented, along with the drivers for implementation, and the goals to be achieved as a result. Upon uptake, end user satisfaction can also be measured to produce a comprehensive research of a virtual care implementation project, which can ultimately provide a foundation for additional virtual care projects in Canada given one of the limitations of this study was the lack of Canadian articles.

5. Conclusions

By connecting patients and providers remotely, virtual care has made its presence in different aspects of healthcare, including healthcare education, as well as positive impressions from end consumers. As technology advances, virtual care becomes more accessible, and utilization will increase; hence, acceptance of virtual care and the technology that supports it can also increase in parallel. The technology supporting virtual care, such as video conferencing tools and virtual reality, will also mature to enhance patient and provider experience in using those tools.

Author Contributions: C.L. conceptualized the research questions, methodology, and wrote the article. E.M.B. helped to conceptualize the research questions, methodology, review articles, and assisted with the writing. A.W.K. reviewed the paper and provided feedback on the content and methodology for finalizing the paper. All authors have read and agreed to the published version of the manuscript.

Appendix A

Table A1. Covidence® articles excluded.

Article# (In Order of Which it Was Processed in Covidence®)	Article Name and Author	Exclusion Reason
108	Ackerman 2017 Ackerman, Mary Lou; Virani, Tazim; Billings, Barry Digital Mental Health—Innovations in Consumer-Driven Care Nursing Leadership (1910-622X) 2017;30(3):63–72 2017	Does not discuss application of virtual care tool
6	Adams 2011 Adams, E. C.; Rodgers, C. J.; Harrington, R.; Young, M. D. B.; Sieber, V. K. How we created virtual patient cases for primary care-based learning Medical Teacher 2011;33(4):273–278 2011	Is not a study
104	Agnola 2018 Agnola, Danny Transforming digital health services in Australia Journal of Pharmacy Practice & Research 2018;48(3):283–286 2018	Only provides high-level overview of digital health strategy in Australia and not virtual care
46	Anderson 2001 Anderson DG; Stenzel C Internet patient care applications in ambulatory care Journal of Ambulatory Care Management 2001;24(4):1–38 2001	Does not relate to research questions
40	Arndt 2018 Arndt, Rachel Z. Providing virtual care from the other side of the globe Modern Healthcare 2018;48(32):0030–0030 2018	Is not a study
100	Arndt 2018 Arndt, Rachel Z. Physical therapy and rehab go virtual Modern Healthcare 2018;48(26/27):0030–0030 2018	Is not a study
39	Bashford 2011 Bashford, Curt POINT OF VIEW. Virtual Care: How telemedicine is transforming the delivery of emergency medical services in the field EMS World 2011;40(10):31–35 2011	Is not a study
78	Bhattacharyya 2017 Bhattacharyya, Rahul; Jayaram, Prem Ruben; Holliday, Robin; Jenkins, Paul; Anthony, Iain; Rymaszewski, Lech The virtual fracture clinic: Reducing unnecessary review of clavicle fractures Injury 2017;48(3):720–723 2017	Does not relate to research questions
11	Butler 2014 Butler, Anneliese; Canamucio, Anne; Macpherson, David; Skoko, Jennifer; True, Gala Primary care staff perspectives on a virtual learning collaborative to support medical home implementation JGIM: Journal of General Internal Medicine 2014;29(2):579–588 2014	Is not a study
92	Carolan-Rees 2015 Carolan-Rees, G; Ray, Af The ScanTrainer obstetrics and gynaecology ultrasound virtual reality training simulator: A cost model to determine the cost viability of replacing clinical training with simulation training Ultrasound 2015;23(2):110–115 2015	Does not relate to research questions

Table A1. *Cont.*

Article# (In Order of Which it Was Processed in Covidence®)	Article Name and Author	Exclusion Reason
105	Charalambous 2019 Charalambous, Andreas Utilizing the Advances in Digital Health Solutions to Manage Care in Cancer Patients Asia Pac J Oncol Nurs 2019;6(3):234–237 2019	Does not relate to virtual care
86	Chen 2019 Chen, Hang; Wang, Xianfeng Sharp Reilly-type inequalities for a class of elliptic operators on submanifolds Differential Geometry and its Applications 2019;63:1–29 2019	Does not relate to virtual care
64	Crabb 2019 Crabb, Stephanie Digital Health: Promise, Perils, and Perspective Journal of AHIMA 2019;90(5):32–35 2019	Is not a study
4	Dorn 2019 Dorn, Spencer D. Gastroenterologists Without Borders: Using Virtual Care to Reach Beyond the Clinic Walls Gastroenterology 2019; 157(2): 2019	Is not a study
62	DupuitsFMH 2002 Dupuits FMH The effects of the Internet on pharmaceutical consumers and providers Disease Management & Health Outcomes 2002;10(11):679–691 2002	Does not relate to virtual care
24	Ferenc 2015 Ferenc, Jeff Virtual care center connects worlds of technology and nature Health Facilities Management 2015;28(12):6–6 2015	Is not a study
48	Ferenc 2016 Ferenc, Jeff Spreading telehealth know-how to other hospitals H&HN: Hospitals & Health Networks 2016;90(8):20–20 2016	Is not a study
61	Fotsch 1998 Fotsch E Internet. Medical intranets create virtual healthcare malls hfm (Healthcare Financial Management) 1998;52(1):26–26 1998	Is not a study
58	Fowler 2014 Fowler, Christianne; Haney, Tina; Rutledge, Carolyn M. An Interprofessional Virtual Healthcare Neighborhood for Caregivers of Elderly With Dementia Journal for Nurse Practitioners 2014;10(10):829–834 2014	Is not a study
33	Fronczek 2019 Fronczek, Ann E. Nursing Theory in Virtual Care Nursing Science Quarterly 2019;32(1):35–38 2019	Only talks about theory
2	Gavarkovs 2019 Gavarkovs, Adam G. Behavioral Counseling Training for Primary Care Providers: Immersive Virtual Simulation as a Training Tool Front. Public Health 2019;9(7):116 2019	Does not relate to research questions
59	Grube 2015 Grube, Mark E Making the Case for Virtual Healthcare. What CEOs and trustees need to know about this emerging field Healthcare Executive 2015;30(2):68–68 2015	Is not a study

Table A1. *Cont.*

Article# (In Order of Which it Was Processed in Covidence®)	Article Name and Author	Exclusion Reason
35	Hafner-Fogarty 2018 Hafner-Fogarty, Rebecca mHEALTH UPDATE. THE NEED GROWS TO INCREASE ACCESS TO VIRTUAL CARE For the Record (Great Valley Publishing Company, Inc.) 2018;30(10):33–33 2018	Is not a study
87	Hilton 2017 Hilton, Lisette Create a virtual HS clinic Dermatology Times 2017;38(6):23–43 2017	Does not relate to research questions
47	Hogan 2018 Hogan, Timothy P.; Luger, Tana M.; Volkman, Julie E.; Rocheleau, Mary; Mueller, Nora; Barker, Anna M.; Nazi, Kim M.; Houston, Thomas K.; Bokhour, Barbara G. Patient Centeredness in Electronic Communication: Evaluation of Patient-to-Health Care Team Secure Messaging Journal of Medical Internet Research 2018;20(3):26–26 2018	Does not relate to virtual care
81	Jelliman 2016 Jelliman, Pauline; Downes, Bob; Mannix, Tracy; Foote, Liz; Chaponda, Mas HIV community virtual clinic: an innovative service development to ensure the needs those who cannot attend hospital HIV clinics are effectively met HIV Nursing 2016;16(2):58–58 2016	Is not a study
15	Jennings 2017 Jennings, Terry 'Virtual clinics' a success story for BOP renal service Kai Tiaki Nursing New Zealand 2017;23(9):22–24 2017	Is not a study
1	Johnston 2016 Johnston, Barb; Yellowlees, Peter Telepsychiatry Consultations in Primary Care Coordinated by Virtual Care Navigators PS 2016;67(1):142–142 2016	Is not a study
45	Kehoe 2016 Kehoe, Bob Health network advances virtual care visits for chronic diseases Health Facilities Management 2016;29(5):7–7 2016	Is not a study
69	Ketchell 2018 Ketchell, Robert Ian Telemedicine is the way forward for the management of cystic fibrosis—the case in favour Paediatric Respiratory Reviews 2018; 26:19–21 2018	Does not relate to research questions
34	Kulkarni 2019 Kulkarni, Ameya Navigating Loneliness in the Era of Virtual Care New England Journal of Medicine 2019;380(4):307–309 2019	Does not relate to research questions
107	Landi 2018 Landi, Heather Digital Health Leaders, Cardiologists Ponder the Launch of Apple's New ECG Device Healthcare Informatics 2018 2018	Does not relate to virtual care

Table A1. *Cont.*

Article# (In Order of Which it Was Processed in Covidence®)	Article Name and Author	Exclusion Reason
37	Litwin 2019 Litwin, Sasha; Canning, Matthew; Clemens, Julia; Danukarjanto, Claire; Vandenbergh, Nancy; Wallace, Emma; Ostrow, Olivia 114 Virtual care as a quality improvement intervention to reduce low-acuity return visits to the paediatric emergency department... 96th Annual Conference of the Canadian Paediatric Society, June 6–8 2019, Toronto, Canada Paediatrics & Child Health (1205–7088) 2019;24(): e43–e44 2019	Is not a study
94	Lougheed 2019 Lougheed, Tim Time to embrace the promise of virtual health care CMAJ: Canadian Medical Association Journal 2019;191(11): E320–E321 2019	Does not relate to research questions
74	Lowery 2014 Lowery, Bobby; Corbett, Robin Webb; King, Carol Ann; Brown, Sylvia T.; Faser, Jr., Karl E. Virtual Clinic—Opening the Clinic Door to Interprofessional Education and Practice Journal for Nurse Practitioners 2014;10(10): e69–e76 2014	Does not relate to research questions
12	Mace 2015 Mace, Scott The reality of virtual care Healthcare Leadership Review 2015;25(7):1–8 2015	Is not a study
44	Mace 2015 Mace, Scott Diversification and Virtual Care Services HealthLeaders Magazine 2015;18(3):22–23 2015	Does not relate to research questions
106	MacLeod 2018 MacLeod, Janice Digital Health Technology in Diabetes Care: It's transforming the way people with diabetes communicate with personal health care teams and treat and manage their disease Today's Dietitian 2018;20(8):40–43 2018	Does not relate to research questions
95	McLaughlin 2016 McLaughlin, Kelly Virtual psychology clinic helps the hard to reach Journal of Physiotherapy 2016;62(2):120 2016	Is not a study
67	Montayre 2018 Montayre, Jed Nursing the future: Braving possibilities, challenges and dilemmas Nursing Praxis in New Zealand 2018;34(1):5–6 2018	Does not relate to virtual care
109	Nunn 2016 Nunn, Sandra Watson Joins the Digital Health Record Mix Radiology Today 2016;17(12):22–25 2016	Is not a study Does not relate to virtual care
60	Pallarito 1996 Pallarito K Virtual healthcare—linking firms to form all-star teams Modern Healthcare 1996;26(12):42–47 1996	Does not relate to research questions
43	Palmer 2018 Palmer, Sarah Jane Virtual care: smartphone apps launched for atrial fibrillation British Journal of Cardiac Nursing 2018;13(1):40–41 2018	Is not a study

Table A1. *Cont.*

Article# (In Order of Which it Was Processed in Covidence®)	Article Name and Author	Exclusion Reason
42	Pearson 2018 Pearson, John F.; Rodriguez, Jorge A.; Safran, Charles Virtual Care as a Specialty JAMA: Journal of the American Medical Association 2018;319(24):2559–2560 2018	Is not a study
56	Real 2017 Real, Francis J.; DeBlasio, Dominick; Samaan, Zeina; Beck, Andrew F.; Klein, Melissa D.; McLinden, Daniel; Ollberding, Nicholas J.; Davis, David; Cruse, Bradley A Virtual Reality Curriculum for Pediatric Residents Decreases Rates of Influenza Vaccine Refusal Academic Pediatrics 2017;17(4):431–435 2017	Does not relate to research questions
85	Roberts 2015 Roberts, Simon; Spain, Brian; Hicks, Chelsea; London, James; Tay, Stanley Telemedicine in the Northern Territory: An assessment of patient perceptions in the preoperative anaesthetic clinic Australian Journal of Rural Health 2015;23(3):136–141 2015	Does not relate to virtual care
13	Roth 2019 Roth, Mandy Virtual care is no longer optional: What's now, what's next, and how to get there Healthcare Leadership Review 2019;38(2):1–5 2019	Is not a study
17	Rothschild 2003 Rothschild SK; Lapidos S Virtual integrated practice: integrating teams and technology to manage chronic disease in primary care Journal of Medical Systems 2003;27(1):85–93 2003	Does not relate to research questions
63	Russell 2018 Russell, Amy; Spence, Brian Virtual Simulation in Radiologic Science Education Radiologic Technology 2018;90(2):169–171 2018	Does not relate to research questions Does not relate to virtual care
77	Sechi 2016 Sechi, A.; Sawyer, E.; Ng, W.; Connor, S. Proving cost-effectiveness through implementation of a nurse-led inflammatory bowel disease (IBD) patient advice line and virtual clinic (CHEAP) J. GENCA 2016;26(2):4–6 2016	Is not a study Does not relate to research questions
66	Shah 2013 Shah, B; Campbell, P; Ford, C; Goyal, S; Lim, K S Re: The Portsmouth-based refinement scheme: a role for virtual clinics in the future? Eye (Lond). 2012 Oct;26(10):1288–94 Eye 2013;27(7):892–893 2013	Is not a study Does not relate to research questions
14	Shaw 2018 Shaw, James; Jamieson, Trevor; Agarwal, Payal; Griffin, Bailey; Wong, Ivy; Bhatia, R. Sacha Virtual care policy recommendations for patient-centred primary care: findings of a consensus policy dialogue using a nominal group technique J Telemed Telecare 2018;24(9):608–615 2018	Does not relate to research questions
55	SilvadosSantos 2017 Silva dos Santos, Gabriela; de Melo Tavares, Cláudia Mara; de Faria Pereira, Cosme Sueli; Eleutério Ferreira, Rejane Reflective Analysis Article Reflections on the Use of Virtual Social Networks in Care for Persons with Chronic Disease Journal of Nursing UFPE/Revista de Enfermagem UFPE 2017;11(2):724–730 2017	Does not relate to virtual care Does not relate to research questions

Table A1. *Cont.*

Article# (In Order of Which it Was Processed in Covidence®)	Article Name and Author	Exclusion Reason
83	Succar 2013 Succar, T; Zebington, G; Billson, F; Byth, K; Barrie, S; McCluskey, P; Grigg, J The impact of the Virtual Ophthalmology Clinic on medical students' learning: a randomised controlled trial Eye 2013;27(10):1151–1157 2013	Does not relate to virtual care
52	TuaniCandidodeOliveiraSalvador 2018 Tuani Candido de Oliveira Salvador, Pétala; dos Santos Mariz, Camila Maria; Fortes Vítor, Allyne; Ferreira Júnior, Marcos Antônio; Domingues Fernandes, Maria Isabel; Amado Martins, José Carlos; Pereira Santos, Viviane Euzébia Validation of virtual learning object to support the teaching of nursing care systematization Revista Brasileira de Enfermagem 2018;71(1):11–19 2018	Does not relate to research questions Does not relate to virtual care
51	Yeun-SimJeong 2019 Yeun-Sim Jeong, Sarah; Kwang-Ok Lee The Emergence of Virtual Reality Simulation and Its Implications for Nursing Profession Korean Journal of Women Health Nursing 2019;25(2):125–128 2019	Is not a study
32	Zhu 2019 Zhu, Xi; Tu, Shin-Ping; Sewell, Daniel; Yao, Nengliang (Aaron); Mishra, Vimal; Dow, Alan; Banas, Colin Measuring electronic communication networks in virtual care teams using electronic health records access-log data International Journal of Medical Informatics 2019;128(): 46–52 2019	Does not relate to research questions Does not relate to virtual care
102	The virtual hypertension clinic | Ovid ;():	Is not a study Does not relate to research questions
38	Research Shows Virtual Care's Impact on Patient Acquisition For the Record (Great Valley Publishing Company, Inc.) 2018;30(5):27–27 2018	Is not a study
10	Patients embrace virtual care more than physicians Healthcare Leadership Review 2018;37(8):12–12 2018	Is not a study
57	NHS doctors train using virtual reality to improve care for people with diabetes Operating Theatre Journal 2019;(345):4–4 2019	Is not a study Does not relate to research questions
93	Jeffrey S. Gurock. The Jews of Harlem: The Rise, Decline, and Revival of a Jewish Community. | The American Historical Review | Oxford Academic 2018;123(2): 598-599	Does not relate to research questions Does not relate to virtual care
7	Humana health plan centered on virtual primary care Healthcare Leadership Review 2019;38(5):13–13 2019	Is not a study
99	Health Care Technology Today PT in Motion 2018;10(2):32–41 2018	Does not relate to research questions Does not relate to virtual care
98	Establishing the reliability and concurrent validity of physical performance tests using virtual reality equipment for community-dwelling healthy elders: Disability and Rehabilitation 2015; 37(12): 1097-101.	Does not relate to research questions
36	AAFP, Zipnosis team for virtual care Healthcare Leadership Review 2018;37(5):18–18.	Is not a study Does not relate to research questions
82	A Chance to Wait Is a Chance to Educate: Exploring Virtual Technology for the Delivery of Patient Health and Wellness Information at Mayo Clinic in Arizona: Journal of Hospital Librarianship 2012; 12(4): 317-326.	Does not relate to research questions

Appendix B

Table A2. Data charting full results.

Author	**Wilson Pecci, A.**	**Glennon, C.**
Date	2017	2018
Title	Innovative digital health tools offer "seamless" patient experience	Use of Virtual Reality to Distract From Pain and Anxiety
Publication	Healthcare Leadership Review	Oncology Nursing Forum
Method	Measure app usage	Quasi-experimental study. T tests and Chi square tests
Setting	Nemuors Children's Health System	Outpatient cancer center
Subjects	Clinicians creating asthma plans	97 adults
Results	Clinicians thought they were going to be overwhelmed, but the volume was very reasonable, and it was a good way to answer questions	Experimental and control groups showed a decrease in pain and anxiety from pre to post procedure
Limitations	Older patients might not be suitable for this app	Similarities between experimental and control groups. Small sample size
Themes (edu, using, intro, consumer/doc pers)?	Clinician perspectives	Using virtual care
Notes	App for healthcare plan	VR can be considered a type of virtual care intervention
Author	**Abbott, D.**	**Birnie, K.**
Date	2018	2018
Title	Financial and Temporal Advantages of Virtual Consultation in Veterans Requiring Specialty care	Usability Testing of an Interactive Virtual Reality Distraction Intervention to Reduce Procedural Pain in Children and Adolescents with Cancer
Publication	Military Medicine	Journal of Pediatric Oncology Nursing
Method	Virtual consultation compared with in-person consultations over 6 months	Three iterative cycles of mixed method usability testing with semi-structured interviews
Setting	Veteran Affairs, Thoracic surgery outpatient clinic	Pediatric care center
Subjects	157 veterans	17 children and adolescents
Results	Overall cost was decreased to 64% per veteran encounter with virtual consults	94% would like to use VR in subsequent needle procedures. No adverse events were reported
Limitations	Virtual consult is influenced by referring provider bias. Generalizability of virtual consult cost savings is more easily shown with a fixed budget such as that of the VA, which may not be the case for other facilities. No collection of patient outcomes	Small sample from a single tertiary pediatric care center. Lacked participants undergoing IVAD access for the first time, and participants reported low levels of preprocedural stress
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care	Using virtual care
Notes	Benefits and potential cost savings of virtual care	VR can be considered a type of virtual care intervention
Author	**Schneider, S.M.**	**Cornejo-Palma, D.**
Date	2007	2019
Title	Virtual reality: A distinction intervention for chemotherapy	Virtual postoperative clinic: Can we push virtual postoperative care further upstream?
Publication	Oncology Nursing Forum	BMJ Quality & Safety
Method	Crossover design where participants served as their own control	Randomized controlled trial comparing telephone-based virtual outpatient with an actual outpatient clinic for follow up of general surgery patients 6–8 weeks after discharge from hospital
Setting	Cancer treatment center	Outpatient clinic
Subjects	123 chemotherapy patients	107 subjects randomized to virtual follow up 102 subjects randomized to conventional clinic follow up

Table A2. *Cont.*

Author	Schneider, S.M.	Cornejo-Palma, D.
Results	Patients state that using VR made treatment seem shorter, and chemo treatments with VR are better. Positive experiences did not result in a decrease in symptom distress	92% of 107 subjects successfully contacted by phone, of which 10% had postoperative issues, and three of whom attended a conventional clinic for follow up. 81% of 102 subjects attended the appointment, of which 16% had postoperative concerns. Most patients in both groups expressed a preference for virtual follow up in the future
Limitations	Single study site and lack of standardized measures to capture satisfaction with use of VR during chemo. Intervention was only used once with each patient	N/A
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care Consumer perspectives	Using virtual care Consumer perspective
Notes	VR is a good tool for virtual care as a distractor	Consumer preference for virtual care
Author	**Gandolfi, M.**	**De Jong, J.**
Date	2017	2018
Title	Telerehabilitation for Postural Instability in Parkinson's Disease: A Multicenter, Single-Blind, Randomized Controlled Trial	A Cloud-Based Virtual Outpatient Clinic for Patient-Centered Care: Proof of Concept Study
Publication	BioMed Research International	Journal of Medical Internet Research
Method	Multicenter study. 76 patients were randomly assigned to either receive VR telerehabilitation or in-clinic SIBT	Six digital tools that support self-monitoring. Assessed the feasibility, usage stats, technical issues, adherence, and conducted qualitative interviews with all participants
Setting	Patient homes	Outpatient clinic
Subjects	76 Parkinson's disease patients	20 participants from Internal Medicine and Dermatology departments
Results	VR is a feasible alternative to in-clinic SIBT for reducing postural instability in PD patients having a caregiver	Qualitative data showed that performance and effort expectancy scored high among participants, indicating that using the VOC is convenient and time saving
Limitations	Lack of instrumental evaluation to assess balance performance, postural reactions, and changing muscle strength and lean body mass	Nonrandomized convenience sample, as participants with interest in technology and digitalization are more likely to participate in this study. Short study period
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care	Using virtual care
Notes	VR as a type of virtual care intervention	Tools that support remote monitoring
Author	**Diaz-Hennessey, S.**	**Gordon, A.**
Date	2019	2017
Title	Virtual Reality: Augmenting the Acute Pain Experience in Children	Virtual Visits for Acute, Nonurgent Care: A Claims Analysis of Episode-Level Utilization
Publication	Pediatric Nursing	Journal of Medical Internet Research
Method	Randomized sample. Control group received standard ED treatment, intervention group received VR. Pain assessed using Numerical Rating Scale	Cross-sectional, retrospective analysis of claims from a large commercial health insurer was performed to compare care and cost of patients receiving care via virtual visits for a condition of interest
Setting	Acute care pediatric emergency department	Varied depending on the type of care
Subjects	15 participants aged 8–17	Patient less than 65 years of age without serious chronic conditions
Results	Pain scores reported by patients were not significantly lower when using VR than those receiving standard treatment. Average length of stay was shorter for patients in the intervention group. Self-reported pain scores did not vary significantly, but observed pain scores had a significant difference.	59,945 visits were included (4635 virtual, 55310 nonvirtual). Lab rates for virtual visits were lower than in-person locations, and imaging rates for virtual visits were lower than in-person locations. RHC, UCC, ED, and PCP were $36, $153, $1735 and $162 more expensive than virtual visits, respectively
Limitations	Small sample size and researcher bias. Length of stay could have been increased for a number of other factors that do not relate to patient's pain	Accuracy of diagnosis in claims may be a concern for virtual visits, as there is no physical examination. Claims do not provide complete information on the reasons patients chose a specific site of care.

Table A2. *Cont.*

Author	Diaz-Hennessey, S.	Gordon, A.
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care	Using virtual care
Notes	VR as a tool for virtual care	Cost savings of virtual care
Author	**Healy, P.**	**Klein, B.**
Date	2019	2011
Title	Virtual outpatient clinic as an alternative to an actual clinic visit after surgical discharge: A randomised controlled trial	Anxiety online a virtual clinic: Preliminary outcomes following completion of the five fully automated treatment programs for anxiety disorders and symptoms
Publication	BMJ Quality & Safety	Journal of Medical Internet Research
Method	All patients admitted under one general surgical service over the study period were assessed. If eligible for inclusion, randomization and follow-up methods were explained to receive either a VIRTUAL OUTPATIENT CLINIC or an OPC appointment	Naturalistic participant choice, quasi-experimental design to evaluate each of the 5 anxiety online fully automated self-help e-therapy programs
Setting	Outpatient clinic	Anxiety e-therapy programs online
Subjects	209 patients included	225 participants. Participants needed to have at least subclinical levels of one of the anxiety disorders to be offered the e-therapy program
Results	91.6% in VIRTUAL OUTPATIENT CLINIC group successfully contacted, 81.4% in OPC group were successfully contacted. 95% of VIRTUAL OUTPATIENT CLINIC patients were very happy with their overall experience compared with 56% in the OPC group. 83% in VIRTUAL OUTPATIENT CLINIC and 67% in OPC preferred VIRTUAL OUTPATIENT CLINIC appointment in the future	Significant improvements were found on 21/25 measures across the five fully automated self-help programs. Reductions on all five anxiety disorder/clinical disorder severity ratings, increased confidence in managing one's own mental healthcare, and decreases in the total number of clinical diagnoses
Limitations	Follow-up questionnaire was devised to assess the outcomes of interest in this study, as it has not been previously validated, unlike the patient satisfaction questionnaire which has been validated	Open-access, participant choice, naturalistic trial, so the lack of a control group makes it impossible to conclude whether the improvements are a result of the active e-therapy programs
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care Consumer perspective	Using virtual care Consumer perspectives
Notes	Consumer preference for virtual care	e-therapy
Author	**Roth, S.**	**Scapin, S.**
Date	2014	2017
Title	Clinical Experience Using a 5-Week Treadmill Training Program with Virtual Reality to Enhance Gait in an Ambulatory Physical Therapy Service	Use of virtual reality for treating burned children: Case reports.
Publication	Physical Therapy	Revista Brasileira de Enfermagem
Method	Retrospective data analysis	Case report on the use of VR in pain intensity during dressing change of two burned children
Setting	Ambulatory clinic	Burn Treatment Center
Subjects	60 patients	2 burned children
Results	Treadmill training with VR appears to be an effective and practical tool that can be applied in an outpatient physical therapy clinic. May also augment cognitive and functional aspects	VR can become an important non pharmacological method for treating pain in burned children
Limitations	Use of retrospective analysis with no control group and lack of objective cognitive assessment	Small sample size. Only based on case reports; hence, results cannot be generalized
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care	Using virtual care
Notes	VR as a tool for virtual care	VR can be considered a type of virtual care intervention

Table A2. *Cont.*

Author	Tejera, S.	Ventola, C.L.
Date	2016	2019
Title	A New Form of Communication Between Rheumatology and Primary Care: The Virtual Consultation	Virtual Reality in Pharmacy: Opportunities for Clinical, Research and Educational Applications
Publication	Reumatologia Clinica	P&T: A Peer-Reviewed Journal for Managed Care & Formulary Management
Method	Observational and retrospective study Virtual practices were made through a computerized program, DRAGO	Clinical studies on applications of VR for pharmacotherapy in pain management, anxiety and other disorders, drug discovery, education/training, and patient counseling
Setting	Three healthcare centers	Inpatient and outpatient therapeutic purposes
Subjects	44 primary care physicians with a reference population of 70,693 inhabitants	Subjects from clinical studies
Results	Closer contact with primary care, rapid resolution of doubts about rheumatic disease in patients, improvement of training in rheumatic disorders, prioritizing patients requiring early assessment by a rheumatologist	In spite of increasing awareness regarding VR in the medical and pharmacy community, how or whether to apply this technology in clinical practice remains unclear. As technology improves, VR's influence can be increased in clinical, research, educational, and patient counseling practices in pharmacy
Limitations	No patient satisfaction surveys	Technical capabilities; inability to incorporate data from wearables, EHRs, patient portals or biosensors, unrealistic avatars interfere with VR immersion, potential inefficacy of less advanced VR systems
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care	Using virtual care
Notes	Virtual consultation for rheumatology can reduce unnecessary visits	Trends for VR in pharmacy
Author	Weissman, S.	White, T.
Date	2018	2019
Title	Implementing a Virtual Health Telemedicine Program in a Community Setting	Virtual Postoperative Visits for New Ostomates
Publication	Journal of Genetic Counseling	CIN: Computers, Informatics, Nursing
Method	Recruited genetic counselors for virtual health clinical workflows	Survey data analyses, content analysis described video interactions
Setting	Nine prenatal and cancer clinics	Patient homes
Subjects	Patients in the nine clinics, unclear of sample size	10 postoperative patients
Results	Decreased wait times, allowed patients to be seen in a clinic closer to their homes, ability for one GC to staff geographically disparate clinics on the same day	All patients successfully complete two virtual visits from their homes. 90% felt these helped with ostomy management and all felt comfortable with a virtual format.
Limitations	Not formally studied, have not addressed the issue of billing	Sample size was small and recruited from a single facility, limiting the generalizability of findings. Limited scope did not allow exploring into issues with technology
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care	Using virtual care Consumer perspectives
Notes	Virtual care solving recruitment issues	Video conferencing for follow-up visits
Author	Tong, X.	Yen, C.
Date	2016	2011
Title	Usability Comparisons of Head-Mounted vs. Stereoscopic Desktop Displays in a Virtual Reality Environment with Pain Patients	Effects of Virtual Reality-Augmented Balance Training on Sensory Organization and Attentional Demand for Postural Control in People with Parkinson Disease: A Randomized Controlled Trial...including Invited Commentary with Author Response
Publication	Studies in Health Technology & Informatics	Physical Therapy
Method	Repeated-measured experiment	Longitudinal, randomized controlled trial
Setting	Clinical setting	Intervention was conducted in the clinic, assessment was performed in a research lab
Subjects	20 chronic pain patients	42 people with PD

Table A2. *Cont.*

Author	Tong, X.	Yen, C.
Results	Participants experienced higher levels of simulator sickness with Oculus Rift HMD. Results may help clinicians and researchers to choose the most appropriate VR displays for chronic pain patients and to enhance VR displays for long-term pain management interventions	Both VR and CB training improved sensory integration for postural control in people with PD. Attentional demand for postural control was not changed after either VR or CB training.
Limitations	Did not measure the use of either display over longer periods of time, or with repeated frequency	Functional significance of the improvement in equilibrium scores in the SOTs was not known, and the sample size was small
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care	Using virtual care
Notes	VR tools and selecting the best VR tool on the market for pain management	VR as a tool for augmented training for PD patients
Author	Papadopoulos, L.	Dyer, E.
Date	2013	2018
Title	Design and evaluation of a simulation for pediatric dentistry in virtual worlds	Using virtual reality in medical education to teach empathy
Publication	Journal of Medical Internet Research	Journal of Medical Library Association
Method	Child virtual patient used. Evaluation of simulation completed	VR immersion training
Setting	Pediatric dentistry	University of New England library
Subjects	103 dental students	Health professions students
Results	69% of the simulation group expressed their preference for using this module as an additional teaching tool	Successfully introduced an innovative new teaching modality to the medical physician assistant, physical therapy and nursing curricula. VR enhanced students' understanding of age-related health problems and increased their empathy for older adults with vision and hearing loss or Alzheimer's disease.
Limitations	Did not include measures of changes in students' skills on behavior management.	Staff time and pace issues.
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care for education	Virtual tools for education
Notes	Virtual education for dental students	VR for educating empathy in medical students
Author	Salminen, H.	Tong, V.T
Date	2014	2012
Title	Virtual patients in primary care: Developing a reusable model that fosters reflective practice and clinical reasoning	Smoking Cessation for Pregnancy and Beyond: A Virtual Clinic
Publication	Journal of Medical Internet Research	Journal of Women's Health
Method	Content analysis of student's opinions on a virtual patient	Interactive patient simulations
Setting	Medical curriculum at Karolinska Institute, Sweden	Dartmouth College interactive Media Laboratory, ACOG and Centers for Disease Control and Prevention
Subjects	10 primary care physicians and 14 medical students	Healthcare professionals
Results	Good acceptance by students, supporting self-directed learning and reflective thinking	Web-based training programs can help providers enhance their skills in helping pregnant women quit smoking and remain smoke-free post-partum
Limitations	n/a	n/a
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care for education	Education at a distance
Notes	Virtual patients for educating medical students	Patient simulations for education

Table A2. *Cont.*

Author	Shumaher Frutuoso, I.	Naverlo, S.
Date	2019	2016
Title	Creation of a Virtual Learning Environment in Intensive Care	Patient Perceptions of a Virtual Health Room Installation in Rural Sweden
Publication	Journal of Nursing UFPE	Rural & Remote Health
Method	Mixed, descriptive, cross-sectional study	Evaluation of patient perceptions through survey (patient activation measure)
Setting	Intensive Care Unit	Center for Rural Medicine
Subjects	70 professionals from the nursing team	19 users of the virtual health room
Results	Virtual learning environment is important for continuing education	Older patients were less likely to value the contribution of VHR. No relationships between level of education and distance traveled and perceptions of VHR
Limitations	Lack of published materials related to virtual learning environments in hospitals, which may intimidate creation initiatives in the nursing area	Limited regarding depth of information relative to sample size
Themes (edu, using, intro, consumer/doc pers)?	Using virtual care for education	Consumer perspectives
Notes	Nursing education	Virtual Health Room
Author	**Mammen, J.**	**Pflugeisen, B.**
Date	2017	2017
Title	Patient and Physician Perceptions of Virtual Visits for Parkinson's Disease: A Qualitative Study	Patient Satisfaction with Virtual Obstetric Care
Publication	Telemed J E Health	Maternal & Child Health Journal
Method	Qualitative survey	Four-domain satisfaction questionnaire, Dillman method. Chi-square tests, t-tests, logistic regression, ANOVA models
Setting	Home	Antenatal visits
Subjects	Parkinson's disease patients and treating physicians	378 participants using virtual care, 795 using traditional care for obstetric services
Results	Patients and providers mostly favor telemedicine, which higher satisfaction in patients compared to providers	Overall satisfaction was significantly higher in the virtual care cohort. Virtual care model was selected by significantly more women who already have children than those experiencing pregnancy for the first time
Limitations	Experiences of subjects varied depending on their comfort level or issues encountered with technology	Implicit bias present in retrospective, voluntary response survey studies and low response rates.
Themes (edu, using, intro, consumer/doc pers)?	Consumer perspectives	Consumer perspectives
Notes		Virtual care for obstetric services

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