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Opportunities and Challenges of Telemedicine in Respiratory Therapy

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Abstract

Respiratory therapy is a specialized area of healthcare that focuses on the assessment, treatment, management, and prevention of respiratory and associated disorders. The delivery of respiratory therapy services, like other healthcare services, has traditionally been done face-to-face. However, the recent advancement in telecommunications technology has opened new avenues for delivering healthcare services remotely, including respiratory therapy. The purpose of this essay is to discuss the opportunities and challenges of telemedicine in respiratory therapy, a specialized area of healthcare. In this essay, the key dynamics of telemedicine in respiratory therapy are explored, focusing on the opportunities and challenges faced in this specialized area of healthcare. The discussion begins with an overview of telemedicine in respiratory therapy, followed by a description of the opportunities and challenges. The essay concludes with the implication of the study, highlighting the significance of understanding the opportunities and challenges of telemedicine in respiratory therapy to develop strategies that promote the effective use of telemedicine in this field (Simeone et al., 2022).

Telemedicine refers to the use of telecommunications technology to deliver healthcare services remotely. Prior to the COVID-19 pandemic, telemedicine was largely underutilized in the provision of respiratory therapy services, despite its benefits. However, the pandemic served as a wake-up call, emphasizing the need to better understand the opportunities and challenges of telemedicine in respiratory therapy. Telemedicine can take on different forms, but in general, it can be classified as either monitoring or consultation. Monitoring telemedicine involves using technology to monitor patients' clinical parameters remotely, while consultation telemedicine refers to remote encounters between

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patients and healthcare providers (Kvinta, 2019). Telerehabilitation refers to rehabilitation services mediated through telecommunications technology rather than occurring in person. For telemedicine to be effectively used in respiratory therapy services, it is important to understand its opportunities and challenges from the perspective of respiratory therapy.

Keywords-telemedicine, respiratory therapy, remote monitoring, patient care

Telemedicine refers to the transfer of clinical data through electronic media or telecommunications methodology. The central aim of telemedicine is to provide clinical care to individuals who would be unable, unwilling, or otherwise disadvantaged in receiving such care. Telemedicine systems encompass a large number of components, including clinical data storage databases, clinical video-conferencing systems, and mechanisms for the remote collection of a variety of clinical data. Telemedicine systems allow for observations and treatment of patients outside of the traditional clinical setting (Simeone et al., 2022). Telemedicine seeks to extend the reach of clinical services to both clinical providers and patients in locations where such services would otherwise not be available, and similarly provide services remotely, such as from the home of the patient, to provide services to patients less capable of travel, disabled individuals, or those in areas of great geographic or urban density disadvantage.

Respiratory therapists (RTs) play a fundamental role in the prevention, diagnosis, treatment, and rehabilitation of individuals with respiratory or cardiac issues. RTs administer prescribed medications, therapeutic modalities, and recommend changes and modifications to the care plan of patients based on the review of physical assessments, diagnostic tests, and clinical data trends. The treatment of respiratory diseases often includes a rehabilitation component intended to restore functional capability, particularly but not exclusively in patients treated for acute respiratory failure from pneumonia, chronic obstructive pulmonary disease (COPD), or other causes. During a traditional rehabilitative therapy session, an RT performs a number of tasks which may include but are not limited to assessment of respiratory functional capability, adjustment of prescribed therapeutics, monitoring of vital signs, assuring the patient adherence to therapeutic procedure, and providing education or counseling with respect to the care of the respiratory condition.

1. Introduction

Respiratory-related morbidity and mortality is increasingly becoming a major public health concern worldwide. The burden of respiratory diseases is disproportionately borne by low-

Power System Technology
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and middle-income nations that are ill-equipped to handle the looming crisis. As the global population grows older, respiratory diseases associated with aging, such as chronic obstructive pulmonary disease (COPD) and lung cancer, are rapidly escalating in prevalence. Exacerbated by the COVID-19 pandemic, the emergence of novel respiratory diseases has thrown a wrench in conventional health systems to address respiratory maladies, necessitating the urgent implementation of innovative health care delivery systems, especially for vulnerable populations at high risk of respiratory diseases (Simeone et al., 2022). Telemedicine, the remote provision of care utilizing audio, text, and visual telecommunication technologies, is at the forefront of evolving health care modalities in the post-pandemic world. It is an emerging paradigm in health care that intersects technology with health care to ensure patients receive access to care anytime and anywhere, enhancing the potential to improve patient outcomes. Respiratory therapy, a specialized discipline that focuses on the treatment and care of patients with respiratory diseases, has innumerable telemedicine opportunities and solutions that can be harnessed to dramatically improve the efficacy of care delivered to patients with respiratory diseases. However, like any other health care domain, telemedicine in respiratory therapy is not devoid of obstacles and challenges. This article aims to explore the opportunities and challenges of telemedicine in respiratory therapy. These insights are paramount in addressing the existing gaps in the current health care delivery system and ensuring vulnerable populations at risk from respiratory diseases have access to effective care. The COVID-19 pandemic is no doubt one of the most cataclysmic global events in the 21st century to date. COVID-19 has reshaped and redefined every aspect of society across the world, and health care is no exception. Telemedicine encounters skyrocketed during the COVID-19 pandemic, and interest in adopting telemedicine accelerated exponentially in health care systems across the world. Health systems are now contemplating the sustainability of telemedicine in the post-COVID-19 scenario and prioritizing its integration into routine care delivery systems. While telemedicine was previously limited to general medicine, infectious disease, and nutritional care, respiratory telemedicine was seldom practiced prior to the pandemic. In fact, there are numerous telemedicine opportunities in respiratory therapy that are largely uncharted. Respiratory telemedicine interventions, including remote monitoring of patients with respiratory diseases, telemedicine-based pharmaceuticals, telemedicine consultations, and direct observation therapy with video, have significantly improved treatment adherence and health outcomes in patients with chronic respiratory diseases, such as asthma and COPD. Nonetheless, the telemedicine paradigm is still evolving, and significant obstacles to telemedicine remain, including technology illiteracy among

Power System Technology
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patients, Internet connectivity issues, regulatory variances, reimbursement models, and concerns over the reliability and security of telecommunication technologies.

2. Telemedicine in Respiratory Therapy

Respiratory therapy is a branch of healthcare which specializes in the treatment of patients with cardiopulmonary disorders. Historically, patient assessment and management by respiratory therapists has required face-to-face consultations, but telemedicine offers the opportunity for patients to be assessed and managed without coming to the healthcare facility (Simeone et al., 2022). Telemedicine consists of using audio, text, and visual telecommunication technologies to deliver medical care remotely to patients and enhance communication between medical providers. Telemonitoring, or remote patient monitoring, involves utilizing telecommunications technology to record and transmit a patient's vital signs and symptoms to medical providers remotely. Telemedicine consultation refers to encounters between patients and medical providers that occur remotely over an audio-visual interface. Telerehabilitation involves rehabilitation services that are mediated over audio-visual interfaces. Telemedicine has the potential to transform medical care for many different diseases, but its impact on respiratory care is of particular importance as many respiratory conditions are chronic, requiring continuous medical care and often debilitating, resulting in a significant decline in quality of life.

There have been efforts to implement telemedicine in the assessment and management of patients with chronic respiratory conditions prior to the COVID-19 pandemic, many of which have demonstrated improved access and outcomes for patients. Furthermore, the shift to telemedicine is largely dependent on the ability of core allied health professionals to adapt to the telemedicine tools provided. For chronic respiratory diseases, the allied health professional at the center of care is the respiratory therapist. Prior to the COVID-19 pandemic, most respiratory therapy departments had not implemented telemedicine, but there were some exceptions where telemedicine was successfully employed. These departments served as an important foundation for other healthcare facilities to implement telemedicine respiratory therapy programs as the pandemic spread. Respiratory therapy departments that rapidly pivoted to telemedicine were able to utilize the lessons learned from these implementations. Telemedicine models have been developed by respiratory therapy departments in multiple healthcare settings, including the home, outpatient clinics, and acute care facilities. Starting with a discussion of different telemedicine models employed by respiratory therapy departments in various healthcare settings, the purpose has been to identify trends in telemedicine practice and highlight areas where telemedicine

Power System Technology
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could grow rapidly. Finally, a foundation is provided for a deeper discussion on specific aspects of telemedicine in respiratory therapy.

2.1. Definition and Scope

Telemedicine is the remote diagnosis and treatment of patients using telecommunications technology. Telemonitoring and telemedicine consultation remote services (Simeone et al., 2022). Telemonitoring is when a patient has monitoring equipment at home that is connected to a health service through a phone or internet connection. The monitoring equipment is able to record things like vital signs and health statuses, which are transferred to a healthcare provider, who then considers the information and may alter the treatment as needed. On the other hand, a technician or health professional provides equipment for consultation in telemedicine scenarios, which patients use to connect with a physician to ask questions or receive treatment. During the consultation, audiovisual technology is used to allow providers to see, hear, and talk with the patient, transmitting data about the patient's condition. Telemedicine can also include "store and forward" services, where a patient presents data for diagnosis without a prior consultation (e.g., transmitting x-rays and other data to a physician). Generally, telemedicine services are categorized as "live" or "synchronous" services, where real-time connection takes place, and "asynchronous" services, where the connection is made at different times (e.g., storing and forwarding data). Telemedicine services can be considered in terms of the types of environments in which they take place. Services conducted at a different location than where a patient is treated are referred to as "telemedicine" in the broad sense (e.g., the provider is at a clinic and the patient is at home). However, telemedicine also originally encompassed services that take place in a patient's home, which was not the usual practice for many health services. In this narrower sense, telemedicine services have traditionally included clinical treatments for respiratory conditions, such as asthma. Expanding this context with consideration to practice other than traditional boundaries makes it necessary to address telemedicine services with patients involved in out-of-home environments. As such, the scope involves clarification of exactly what types of telemedicine services are being considered. In terms of telemonitoring and telemedicine consultation services, this scope includes considering patient health statuses that can be managed with telemedicine services, but beyond simply selecting a range of diagnosis codes, it is essential to clarify what types of health conditions are involved in remote monitoring and consultation. Considering these categories, respiratory conditions are a group that is primarily managed with telemedicine services. Throughout the text, telemedicine is viewed as the broader concept that includes both telemonitoring and telemedicine consultation services provided

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

by audio, text, and visual telecommunications technologies. This discussion focuses on the opportunities telemonitoring and telemedicine consultation services of remote technologies can create for the management of the patients' health in respiratory therapy, but challenges must also be addressed. In terms of opportunities, telemedicine services can enhance the reach of specialist care for robust health services to patients currently outside the service area, as well as to create opportunities for remote patients to access services that would otherwise require extensive travel. Because respiratory conditions disproportionately affect low-income communities, often located far from specialist care, telemedicine services could be particularly beneficial for these populations. Beyond patient care, telemedicine service availability may affect educational opportunities for patients, as well as implications for educational opportunities within respiratory therapy training programs. In short, these considerations frame respiratory telemedicine as audio, text, and visual telecommunications technologies used to deliver remote direct medical care to patients with various respiratory conditions. In addition to defining remote care, this telemedicine framework also includes conditions that can involve direct patient care services delivered via audio, text, and visual telecommunications technologies. In the context of respiratory conditions, the focus is primarily on various diagnoses that affect the lungs and airways, such as asthma and chronic obstructive pulmonary disease (COPD). However, consideration of the scope also involves an assessment of the types conditions or health statuses that can be managed with telemedicine services beyond the types of services delivered.

2.2. Benefits

Telemedicine has the potential to be a viable mechanism for delivering effective care in respiratory therapy. Due to its chronic nature, respiratory therapy relies heavily on regular patient monitoring and management by practitioners. Effective management can be challenging when patients are unable to access care. Telemedicine provides a solution to ensure patients have equitable access to respiratory care services. It has the ability to remotely assess, monitor, and manage patients' respiratory conditions through telecommunications technology. The feasibility and acceptability of telemedicine have been established in managing some chronic respiratory complications, such as asthma, chronic obstructive pulmonary disease (COPD), and cystic fibrosis (CF) (Simeone et al., 2022).

Without question, the greatest benefit telemedicine brings to respiratory therapy is increasing patients' accessibility to care. This is especially critical for those living in rural

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

areas or otherwise underserved communities. In its most basic form, telemedicine allows patients to access care via remote consultations with practitioners. For patients, this is often a much more efficient approach to healthcare delivery—one that minimizes travel time to and from appointments and limits disruptions to their daily lives. Evidence shows that telemedicine systems can improve access to care for patients who are homebound and unable to travel. Beyond simply mitigating access barriers, telemedicine systems also provide care to patients in areas that lack necessary health services. Most current telemedicine systems provide audio-visual telecommunications that allow real-time monitoring of patients' respiratory conditions. This enables practitioners to promptly intervene if a patient's condition begins to worsen.

2.3. Challenges

Even as telemedicine has expanded rapidly, there are many challenges involved with its use. The most commonly cited barrier to receiving telemedicine services is technology disparity (Simeone et al., 2022). Many patients need access to the devices needed to access telehealth. Some patients might own the necessary devices but not have stable internet that would allow for effective telemedicine use. Even if a patient has access to devices and internet, digital literacy can be a barrier. Older patients are more likely to have chronic conditions, but they are also less likely to be familiar with using technology. Patients with low health literacy would also struggle with telemedicine that requires technology skills, because these patients already have difficulties understanding health information.

In addition to the structural barriers patients may face, there are clinical challenges to using telemedicine. The most important aspect of respiratory therapy is assessment, but patients are usually not seen in person. Without direct access to the patient, some assessments may not be possible. For instance, without in-person evaluations, listening to breath sounds is impossible. When telemedicine is utilized in respiratory therapy, steps may need to be taken to ensure that the respiratory therapist is able to make accurate assessments. Many telehealth platforms do not meet the minimum technical requirements for privacy and data security, which is essential for any health service. Even platforms that are well known and widely used have been deemed unacceptable for healthcare services. These compliance issues are necessary to consider when looking into telemedicine interventions. The practice of telemedicine involves a wide range of challenges regarding the law and regulations. For instance, what states a provider can practice in, and what requirements must be met before providing care in a specific state can vary dramatically. Many states need telemedicine to meet the same standard of care as in-person practice. Often laws and regulations differ

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

from one region to another. This can make it difficult to adjust to telemedicine practice in a new area. Training on telemedicine techniques for healthcare providers is necessary when implementing new practices. If the telemortuary procedure involves new technologies, training may also be directed towards the technologies themselves.

3. Technological Aspects

Telemedicine has exhibited rapid advancements throughout the COVID-19 pandemic (Simeone et al., 2022). For telemedicine to be successfully integrated into respiratory therapy practice, it is essential to have an understanding of the technologies involved. Telemedicine relies on basic technological components: a reliable digital infrastructure, ideally using high-speed internet, software programs used for virtual consultations, and cloud-based solutions for storing data. The digital infrastructure must meet bandwidth requirements to support the desired number of simultaneous audio-visual connections. Audio-visual connection software solutions can be as simple as FaceTime or Skype, but these may not meet the data privacy needs of certain healthcare systems. Thus, video connection software designed specifically for healthcare systems is preferred; for instance, is being used to provide free-of-charge telemedicine solutions for non-profit organizations. Also crucial for telemedicine practice are cloud-based solutions allowing patient data to be stored on a cloud and enabling healthcare providers access from any connected computer. By uploading patient data to the cloud, it becomes accessible to multiple users, promoting collaboration among healthcare providers in complex cases.

Innovative technologies have been developed, particularly within the past two decades, for patient monitoring and assessment, which can now be utilized for telemedicine. Additionally, wearable devices have been created to monitor multiple physiological parameters, including electrocardiogram (ECG) measurements from chest-worn devices. Monitoring devices often come with software providing healthcare professionals with data visualization and analysis tools. Some software solutions analyze data autonomously and generate reports for healthcare providers. Furthermore, simple technologies can be employed for telemedicine; for example, a device for remotely assessing pulmonary function using a cell phone microphone was developed. The assessment results undergo an automated quality check, and if they pass, an email is sent to healthcare providers along with the test results. (Su et al., 2024)(Lukas et al., 2020)

User-friendly interfaces supported by patient education are vital for patients to engage with and successfully use technological devices. Overall, technology is not merely a tool but the

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

foundation of telemedicine practice. Acknowledging the role of technology and continuing investments in this area is essential for telemedicine practice to thrive.

3.1. Remote Monitoring Devices

Remote monitoring devices are widely applicable in telemedicine, especially in telemonitoring. They enable continuous monitoring of health parameters relevant to a chronic disease or medical condition (Tomašić et al., 2018). The most relevant parameters are tracked by suitable sensors fixed to the monitored subjects. Health data are usually preprocessed by hardware, and the results are transmitted to a telemonitoring centre where they are further processed, stored, and visualized (Tomasic et al., 2018). Health data are also usually accompanied by a low-bandwidth monitoring or audiovisual link. Besides the respiratory rate, temperature, and oxygen saturation, several recent monitoring technologies have been developed, which are compact, low-cost, and reliable, facilitating their integration into wearable devices. Wearable technology features a miniature sensor with a processing unit embedded into a piece of wearable equipment worn by the monitored subject. Wearable technology provides real-time data transmission to a telemonitoring centre via a mobile phone or standalone base station. The monitored subjects have access to their data and can be alerted in case of extreme values. Hence these devices can be used to enhance self-management and empower patients to take a proactive role in their care. Additionally, some health parameters can trigger a timely alert based on monitored data, enabling the prevention of acute health crises. Health data are typically postprocessed and displayed at the telemonitoring centre and possibly at the healthcare professionals' sites. The success of remote monitoring largely depends on patients' ability to use the devices correctly. Patients must be educated on the use of monitoring devices and be explicitly shown how the data and alerts are interpreted and what actions are to be taken.

3.2. Teleconsultation Platforms

Teleconsultation platforms represent the technological backbone for the implementation of remote virtual therapy sessions in respiratory therapy. These platforms allow patients and healthcare providers to effectively engage in virtual therapy sessions with a range of features supporting text, audio, and video interactions. Ideally, teleconsultation platforms should have easy-to-use interfaces to ensure accessibility for all patients, including the elderly and those having physical and cognitive disabilities. Teleconsultation platforms vary widely in functions and the level of security measures in place. Some platforms conform to HIPAA regulations for data privacy, whereas public platforms may be more susceptible to data breaches but can still be maneuvered in a privacy-compliant way

Power System Technology
ISSN:1000-3673
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(Simeone et al., 2022). Other platforms have been designed specifically for healthcare teleconsultation and come with an integrated healthcare provider workflow, which includes videoconferencing, chat features, and electronic health records. All these platforms are web-based and do not require the installation of additional software by patients, which is crucial as the COVID-19 pandemic has a disproportionate impact on older populations who are generally less digitally literate. Teleconsultation platforms can allow healthcare providers to get in touch with patients to offer ongoing care continuity or for new specialist referrals. Patients diagnosed with chronic obstructive pulmonary disease (COPD) or asthma can especially benefit from teleconsultation options that facilitate their access to much-needed medical care in a timely manner and minimize the risk of exacerbation. With the heightened focus on protecting patient privacy in the health services sector, teleconsultation has become a medium under stricter regulations to facilitate provider-patient interactions for monitoring a range of health conditions. As such, robust teleconsultation platforms are essential for patient care enhancement in respiratory therapy.

4. Regulatory and Legal Considerations

As telemedicine services expand in respiratory therapy, healthcare providers must navigate a regulatory and legal landscape that shapes how these services are delivered. Local and national regulations governing patient privacy and data security should be prioritized for compliance. Interestingly, telehealth policies are evolving concerning reimbursement and licensure for healthcare providers. Currently, many states have declared a public health emergency, which has temporarily relaxed some constraints on telehealth services. However, understanding these nuances is essential as regulations shift back to their previous frameworks after the emergency period ends, or some may expand permanently (Cason & A. Brannon, 2011).

Interstate practice poses a complex issue. Most states employ a “home state” model, meaning providers must abide by the regulations in the state where the patient is located. Thus, as state lines are crossed, providers encounter an assortment of regulations; one state may allow telemedicine across state lines, while another may not. Healthcare professionals should stay apprised of states’ individual compliance requirements as telemedicine services expand into new territories. At a minimum, practitioners should actively focus on addressing compliance issues in consultation with legal counsel. Care should also be taken to uphold ethical practices when treating patients remotely. For example, informed consent for treatment should be obtained just as it would in an in-person setting, and appropriate documentation of consent should be kept. A review of legislation found efforts to support

Power System Technology
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and expand telemedicine services, particularly concerning the care of patients in their homes. In summary, while regulatory challenges abound, recognizing these challenges and addressing them at the outset should aid in successfully implementing telemedicine practices in respiratory therapy. (Mehrotra et al.2022)

5. the roles of pharmacists in telemedicine:

In the realm of telemedicine, pharmacists play pivotal roles that extend beyond traditional pharmacy settings. As virtual healthcare continues to evolve, pharmacists are increasingly assuming multifaceted responsibilities that contribute significantly to patient care and outcomes.

In telemedicine, pharmacists act as crucial members of healthcare teams, offering expertise in medication management, drug interactions, and patient counseling. Through remote consultations, pharmacists can conduct medication reviews, provide dosage adjustments, and offer recommendations tailored to individual patient needs, ensuring optimal therapeutic outcomes.

Moreover, pharmacists play a vital role in promoting medication adherence and educating patients on proper medication usage through telehealth platforms. By leveraging technology, pharmacists can enhance patient understanding, address concerns, and empower individuals to take ownership of their health.

Additionally, pharmacists in telemedicine collaborate with healthcare providers to optimize treatment plans, monitor patient progress, and intervene when necessary to prevent adverse drug reactions or complications. By facilitating seamless communication and information exchange, pharmacists help streamline care delivery and improve patient safety in virtual healthcare settings.

In essence, the integration of pharmacists into telemedicine highlights their indispensable contributions to comprehensive patient care. Through their expertise, dedication, and commitment to promoting health and wellness, pharmacists continue to shape the landscape of telemedicine, fostering a future where quality healthcare is accessible and personalized regardless of physical barriers.

6. Future Directions and Conclusion

Telemedicine for respiratory therapy has been catapulted from the fringe of clinical applications to the forefront by COVID-19. Inspired by it or aided by necessity, healthcare

Power System Technology
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providers and institutions have rapidly adopted telemedicine into routine practice across just about every discipline in medicine. Public policy from government agencies has supported these initiatives and fostered a newfound investment in technology by healthcare institutions, all with the intention of limiting in-person encounters. Many of these changes have been long-sought opportunities turned into reality almost overnight — some leading to more sustainable telemedicine capabilities in the future than before the pandemic and some being temporary fixes that will recede back to antiquity. Overall, a lot of lessons were learned, both positive and negative, during this dramatic shift in how healthcare is delivered (Simeone et al., 2022).

Telemedicine has the potential to grow practice in other ways, too. The increased exposure to telemedicine could lead to more people changing locales in practice, using telemedicine to maintain practice in a town where providers are adequate but possibly live elsewhere. As regulatory barriers are eased, technology deemed necessary for live audio-visual telemedicine encounters should be considered essential equipment for respiratory therapy departments or applicable rehabilitation programs in the post-pandemic world. With the right technology in place, departments in larger institutions can immediately provide support and guidance when needed. This is especially true for rural “critical-access” or low-volume facilities where a second set of eyes and opinions can be crucial. (Kho et al., 2020)

Looking at the future of telemedicine, there are several thoughts to consider. How far could telemedicine be pushed as standard practice? The pandemic has shown that telemedicine is unintentionally mandated and rushes into practice, usually uncovering holes in practice and technology that need filling beforehand. Therefore, advocacy from all stakeholders is needed to ensure telemedicine is perceived as an important aspect of care delivery and that policies that aid expansion are pushed through. Another change to consider post-pandemic is the need for education and training on telemedicine or telehealth practices. Before the pandemic, primarily only those with a keen interest and initiative were educated about telemedicine. With the shift to telemedicine, there were reports of “accidental” telehealth providers learning about it as they went, with technology processes failing at times and encounters not having a similar educational experience as in-person ones. To continue evolving telemedicine, education on the technologies and processes involved in delivering care via telemedicine should be a course in respiratory therapy programs. Such education should provide the foundations of technology limitations and considerations, encounter

Power System Technology
ISSN:1000-3673
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design, and necessary preparations for a successful telemedicine encounter. (Jumreornvong et al., 2020)

Lastly, directly prompted by a pandemic, preconceived notions about telemedicine may fade, and it will revert back largely to how it was before. The general conclusion during the dramatic shift to telemedicine was that it was better than nothing. Still, patient encounters were naively thought to be attended live audio-visual telemedicine via a laptop or tablet and simply pan the camera around the room because of telemedicine's simplicity. Instead, many factors affect the usability and acceptability of telemedicine, such as how the technology and environment are designed, how preparation and training are undertaken, and how providers become familiar with the technology. With restrictions lessening, now is a crucial time to provide constructive criticism on what worked and what did not, with various perspectives from clinicians, educators, and even administrative departments having to take a larger role in telemedicine's success. (Sheshadri et al.2022)

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