

Telemedicine in cardiology

Agnieszka Kujawska^{1,2}, Daria Bieniek^{2,3}, Marcin Kozuchowski⁴, Ewa Dzienniak⁵,
Mateusz Domeracki⁶

1. Department of Physiology, Collegium Medicum in Bydgoszcz Nicolaus Copernicus University in Torun, Poland

2. Faculty of Health Sciences, Department and Clinic of Geriatrics, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Toruń, Poland

3. Nicolaus Copernicus Specialist City Hospital in Toruń, 17/19 Batorego Street, 87100 Toruń, Poland

4. Department of Hygiene, Epidemiology and Ergonomics, Division of Ergonomics and Exercise Physiology, Faculty of Health Sciences, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Toruń, Poland

5. Finance and Accounting, WSB University in Toruń, Poland

6. Faculty of Mechanical Engineering, UTP University of Sciences and Technology in Bydgoszcz, Poland

Abstract

Introduction

Telemedicine is becoming regularly used in rural part of some of developed countries. Moreover, it could be applied to improve diagnosis and emergency care in adults as well as in neonatal care.

Material and methods

Articles in the EBSCO database have been analyzed using keywords: telemedicine, cardiology. The available literature is subjectively selected. Then, the newest version of every paper was searched for.

Results

Results of researches with applications of telemedicine in cardiology in emergency, chronic conditions. Moreover, potential costs and benefits were described.

Conclusions

Telemedicine could be useful for patients, their families, clinicians and regional healthcare systems. The rapidly changing healthcare climate includes an increasing focus on cost reduction, quality improvement and results, patient-centered care and technology solutions, all of which are well served by the optimal use of telemedicine.

Key words: remote; care

Introduction

After decades of development of IT systems and telemedicine applications dedicated to hospitals and healthcare professionals, medical IT has focused on taking into account new requirements in the field of e-Health, especially in the field of home care, self-care and cyber medicine [1]. Nowadays, telemedicine is becoming regularly used in rural part of Norway [2]. Moreover, telemedicine in cardiology could be applied to improve diagnosis and emergency care in adults as well as in neonatal care. Therefore, its potential utility would be described in the above review.

Material and methods

Articles in the EBSCO database have been analyzed using keywords: Telemedicine, cardiology. The available literature is subjectively selected. Then, the newest version of every paper was searched for.

Results

3.1 Telemedicine in diagnosis in cardiology

Conclusion noted in the northeast Brazil is that access to an echocardiography apparatus with remote cardiologist supervision improves the detection of congenital heart disease by neonatologists. Virtual outpatient clinics was shown to facilitate clinical management and the use of internet with simple security controls allows for more efficient resource allocation [3]. The current time transmission of neonatal echocardiograms from hospitals via a 3-line digital integrated service network was shown to be accurate and has the potential to improve patient care, improve echocardiogram quality, help sonographic education and have a positive impact on referral patterns and time management without increased rate of echocardiography usage. Echocardiographic transmission of infants from environmental hospitals through 3 lines of digital integrated services network is accurate and has the potential to improve patient care, improve echogram quality, help with sonographic education and have a positive effect on time management without increasing the overuse of echocardiography equipment [4].

In particular, the use of telemedicine has proved to be very useful in the diagnosis and treatment of critically ill patients, as well as in stable outpatient settings, newborns, infants and children, when distance or time creates challenges or inaccessibility for pediatric cardiac care [4, 5, 6].

Telemedicine should be carefully integrated into clinical practices and partner institutions in a well-defined and effective manner, because of numerous potential benefits with improvement of access to care, and reducing mortality rate [7].

Authors of research on use of a telemedicine the diagnosis of neonatal congenital heart defects noted that the images transmitted were indeed of high quality to allow confirmation of the exclusion of severe congenital heart failure. In the case of complex congenital heart disease, telemedicine could lead an opportunity for early diagnosis and initiation of

appropriate treatment in patients with and avoided the need for transmission in those with exclusion of diagnosis [8].

3.2 Telemedicine in emergency care in cardiology

Telemedicine application could be useful in ECG screening of patients with acute myocardial infarction in prehospital stage of management. Moreover, telecare systems was proposed as handy in postinfarction patients in re-hospitalization and rehabilitation phases. ECG telemedicine applied in nursing homes would rule out the possibility of false alarms which would lead to transporting patients to hospital without need [9]. Moreover, other Authors showed that initial experience in the use of unrefined telemedicine transmission of angiograms of candidates for cardiac surgery seems to be a promising tool for remote centers [10].

3.3 Benefits and costs of telemedicine in cardiology

Videoconferencing consultations on pediatric cardiology allow two remote centers to respond to healthcare needs (making therapeutic decisions and providing information to families), often avoiding long and expensive travel. They also allow remote medical teams to exchange medical information in a friendly manner and respond to the needs of lifelong learning, which are necessary in medicine, especially in a field as specialized as pediatric and congenital cardiology [11]. **In description of 63 cases, the need for transfer to avoid diagnosis was avoided [8]. Therefore, there are potentially significant financial savings for the referred hospital.** For a pediatric cardiologist, the concerns about being involved in telemedicine diagnosis are that one can skip a serious problem and get false assurance. The medical aspects of patient liability after this re-consultation are still unclear.

Earlier diagnosis and initiation of appropriate treatment that can be achieved by telemedicine should reduce morbidity and mortality, but no controlled studies assessing this benefit have been published so far. Another significant benefit is that unnecessary transfers are avoided. In series of 61 studies [12] three ventricular septal abnormalities and one-moderate pulmonary stenosis were detected. 28 major changes were accurately diagnosed. In the series described by Finlayet et al. [13] 26 patients diagnosed by telemedicine echocardiography. No significant anomalies were found. Sobczyk et al. shared his experience of remote diagnosis in 47 patients from previously recorded transthoracic images [14]; 24 tests were normal. Accurately diagnosed changes included patent ductus arteriosus was noted in 8 cases, ventricular septal defect in six cases and one case of ventricular septal defect with interrupted aortic arch. **An incorrect clinical decision has been reported, resulting in a delay in the transfer of a patent ductus arteriosus patient requiring a commitment because of a non-convincing study submission.** Therefore, Authors concluded that diagnosis on the scanner should not be considered a definitive cardiological consultation [14].

Discussion

Telemedicine seems to have a significant impact on the quality of ECG interpretation, but so far there is no conclusive evidence that telemedicine affects the clinical results of myocardial infarction. The spreading of smartphones, tablets and other mobile electronic devices creates an opportunity to extend the standard of professional healthcare, especially in medical emergencies where urgent intervention can reduce mortality and improve quality of life [15]. Telemedicine could improve emergency medical services, helping to accelerate urgent patient transfers, streamline remote consultations, and strengthen supervision of paramedics and nurses. In Poland, cost of patients care in public hospitals due to the heart failure is increasing in the last years, while no decrease of time spend in hospital was noted [16]. In 2016, 33 855 733 000 zł was spend on benefits for cardiac patients [16]. Taking this into account, using of

telemedicine could be used to decrease the overall cost spend on patients care and/or improving its effectiveness, what could presumably improve the overall patients ability to undertake paid job, eventually leading to even more cost reduction spend by public sector. However, further research is needed to regulate and standardize practice. Particular emphasis should be placed on better study design and larger sample size to improve the reliability of results and conclusions. A large part of the research was focused on devices mounted in ambulances. Wearing technology, such as head-mounted displays that allow rescuers to reach patients on site, can improve early pre-hospital diagnosis and should be examined. To further reduce response time, you should also consider incorporating smartphone technology into emergency systems, and thus facilitate patient or bystander incident reporting. Although technological advances will still outweigh their use in clinical practice, the inclusion of new technologies in medical practice is promising in improving care and improving clinical outcomes, and researchers must continue to assess the effectiveness of telemedicine to optimize communications technology-assisted care [15].

Conclusions

In conclusion, telemedicine could be useful for patients, their families, clinicians and regional healthcare systems. Further telemedicine research and established results in the future will help improve where, when and for whom the use of these technologies is most clinically and economically effective. The rapidly changing healthcare includes an increasing focus on cost reduction, quality improvement and results, patient-centered care and technology solutions, all of which are well served by the optimal use of telemedicine. Full realization of the potential of telemedicine in improving patient care and reducing healthcare costs is visible, but will require state and federal governments, as well as private and public entities, to develop regulations and policies that will allow reimbursement of telemedicine in traditional healthcare by state Medical committees cooperate to eliminate outdated practices limiting the practice of telemedicine in various states, and hospital organizations develop and accept universal references as replacement procedures. Evidence gathered in this document must now serve as a call to action for these groups to work closely with healthcare professionals to remove reimbursement, licensing and certification obstacles, and to enable telemedicine to be fully integrated into healthcare system.

Bibliography

1. Smith, R. (1997). The future of healthcare systems: Information technology and consumerism will transform health care worldwide. *BMJ*;314:1495
2. Rinde, E., Nordrum, I., & Nymo, B. J. (1993). Telemedicine in rural Norway.
3. da Silva Mattos, S., Hazin, S. M. V., Regis, C. T., de Araújo, J. S. S., de Lira Albuquerque, F. C., Moser, L. R. D. N., ... & Gomes, R. G. S. (2015). A telemedicine network for remote paediatric cardiology services in north-east Brazil. *Bulletin of the World Health Organization*, 93(12), 881.
4. Sable, C. A., Cummings, S. D., Pearson, G. D., Schratz, L. M., Cross, R. C., Quivers, E. S., ... & Martin, G. R. (2002). Impact of telemedicine on the practice of pediatric cardiology in community hospitals. *Pediatrics*, 109(1), e3-e3.
5. Webb, C. L., Waugh, C. L., Grigsby, J., Busenbark, D., Berdusis, K., Sahn, D. J., ... & American Society of Echocardiography Telemedicine Collaborators' Group. (2013). Impact of telemedicine on hospital transport, length of stay, and medical outcomes in infants with

suspected heart disease: a multicenter study. *Journal of the American Society of Echocardiography*, 26(9), 1090-1098.

6. Dowie, R., Mistry, H., Rigby, M., Young, T. A., Weatherburn, G., Rowlinson, G., & Franklin, R. C. (2009). A paediatric telecardiology service for district hospitals in south-east England: an observational study. *Archives of disease in childhood*, 94(4), 273-277.

7. Committee on Quality of Health Care in America, Institute of Medicine. (2001). Crossing the quality chasm: a new health system for the 21st century.

8. Mulholland, H. C., Casey, F., Brown, D., Corrigan, N., Quinn, M., McCord, B., ... & Craig, B. G. (1999). Application of a low cost telemedicine link to the diagnosis of neonatal congenital heart defects by remote consultation. *Heart*, 82(2), 217-221.

9. Koor, S., Nieberl, K., Fugedi, K., & Kail, E. (2001, September). Telemedicine ECG-telemetry with Bluetooth technology. In *Computers in Cardiology 2001. Vol. 28 (Cat. No. 01CH37287)* (pp. 585-588). IEEE.

10. Bonvini, R. F., Caoduro, L., Menafoglio, A., Calanca, L., Von Segesser, L., & Gallino, A. (2002). Telemedicine for cardiac surgery candidates. *European journal of cardio-thoracic surgery*, 22(3), 377-380.

11. Geoffroy, O., Acar, P., Caillet, D., Edmar, A., Crepin, D., Salvodelli, M., ... & Paranon, S. (2008). Videoconference pediatric and congenital cardiology consultations: a new application in telemedicine. *Archives of cardiovascular diseases*, 101(2), 89-93.

12. Casey, F., Brown, D., Corrigan, N., Craig, B. G., Quinn, M., McCord, B., ... & Mulholland, H. C. (1998). Value of a low-cost telemedicine link in the remote echocardiographic diagnosis of congenital heart defects. *Journal of Telemedicine and Telecare*, 4(1_suppl), 46-48.

13. Finley, J. P., Sharratt, G. P., Nanton, M. A., Chen, R. P., Bryan, P., Wolstenholme, J., & MacDonald, C. (1997). Paediatric echocardiography by telemedicine-nine years' experience. *Journal of Telemedicine and Telecare*, 3(4), 200-204.

14. Sobczyk, W. L., Solinger, R. E., Rees, A. H., & Elbl, F. (1993). Transtelephonic echocardiography: successful use in a tertiary pediatric referral center. *The Journal of pediatrics*, 122(6), S84-S88.

15. Amadi-Obi, A., Gilligan, P., Owens, N., & O'Donnell, C. (2014). Telemedicine in pre-hospital care: a review of telemedicine applications in the pre-hospital environment. *International journal of emergency medicine*, 7(1), 29.

16. Łyszczarz, B., Śliwczyński, A., Gierczyński, J., Nojszewska, E., Karczewicz, E., & Szynek, A. (2017). Ocena kosztów niewydolności serca w Polsce z perspektywy gospodarki państwa. *Instytut Innowacyjna Gospodarka*.