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Implementing Remote Patient Monitoring of Physical Activity in Clinical Practice

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Abstract

Purpose: Remote patient monitoring (RPM) is a tool for patients to share data collected outside of office visits. RPM uses technology and the digital transmission of data to inform clinician decision-making in patient care. Using RPM to track routine physical activity is feasible to operationalize, given contemporary consumer-grade devices that can sync to the electronic health record. Objective monitoring through RPM can be more reliable than patient self-reporting for physical activity.

Design and Methods: This article reports on four pilot studies that highlight the utility and practicality of RPM for physical activity monitoring in outpatient clinical care. Settings include endocrinology, cardiology, neurology, and pulmonology settings.

Results: The four pilot use cases discussed demonstrate how RPM is utilized to monitor physical activity, a shift that has broad implications for prediction, prevention, diagnosis, and management of chronic disease and rehabilitation progress.

Clinical Relevance: If RPM for physical activity is to be expanded, it will be important to consider that certain populations may face challenges when accessing digital health services.

Conclusion: RPM technology provides an opportunity for clinicians to obtain objective feedback for monitoring progress of patients in rehabilitation settings. Nurses working in rehabilitation settings may need to provide additional patient education and support to improve uptake.

Keywords: Rehabilitation; remote patient monitoring; physical activity; technology.

Given the discrete nature and brevity of most telehealth and in-person office visits, remote patient monitoring (RPM) is an electronic tool for patients to share data collected outside of office visits. RPM uses technology and the digital transmission of data to inform clinical decision-making and improve patient care (Kruklitis et al., 2022). Accessing reliable remote data may become an important aspect of self-directed preventive medicine and promote shared physician–patient decision-making (Greiwe & Nyenhuis, 2020). For example, RPM for physical activity (RPM-PA) can facilitate postoperative rehabilitation outside of the clinical setting for the most common orthopedic surgical procedures, hip and knee replacements, and improve clinical care and outcomes for this population (Mehta et al., 2020).

Tracking routine physical activity is possible to operationalize, given contemporary consumer-grade devices. Furthermore, objective monitoring can be more reliable than self-reporting for physical activity (Schuna et al., 2013). Over 20% of U.S. adults already wear a fitness tracker or smart watch (Vogels, n.d.), and the majority (82%) report willingness to share their wearable data with clinicians (Rising et al., 2021). Hence, RPM-PA is feasible to implement in a multitude of clinical settings. Furthermore, when healthcare clinicians are able to access and interpret RPM-PA data, the insights gained offer robust discussion points for patient education (Greiwe & Nyenhuis, 2020).

In this article, we report on a series of clinical use cases that highlight the utility and practicality of RPM-PA monitoring in the outpatient care setting. Patients with four different disease states are described, highlighting the diverse uses of RPM-PA.

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Methods

RPM-PA is discussed as it relates to endocrinology, cardiology, pulmonology, and neurology. Full details of each of the study's methods are found in the following section. In the first three cases, RPM-PA was used in conjunction with a novel physical activity screening tool, the physical activity vital sign (PAVS), that serves as an aid to substantiate the data recordings. The PAVS is a valid physical activity screen that consists of three questions to assess physical activity duration (minutes and days per week) and intensity (Ball et al., 2016; Sallis et al., 2016). The PAVS has been integrated into the electronic health record (EHR) for use in ambulatory clinical settings. Therefore, clinicians are able to access self-assessed physical activity, in addition to RPM-PA data flows, to inform their physical activity counseling. In the third case (pulmonology), adolescents in a cystic fibrosis clinic are currently being assessed with the PAVS, followed by physical activity counseling and RPM-PA. Lastly, RPM-PA was used in an outpatient neurology clinic to assess feasibility in patients with stroke and traumatic brain injury. The institutional review board at NYU Langone Health (endocrinology, cardiology, pulmonology pilots) and the Kessler Foundation (neurology pilot) reviewed and approved the studies discussed. Adult participants aged 18 years and above provided written informed consent. For children 14 years old and above in the Cystic Fibrosis Center, parents provided written informed consent, and children provided written assent. Table 1 summarizes the four pilot studies. Full reports of these pilot studies have not yet been published or are in review.

Results

Endocrinology

In a pediatric diabetes center, RPM-PA plus PAVS was pilot tested in a sample of young adults (n = 15), aged 18–25 years, with Type 1 diabetes. After clinicians assessed self-reported physical activity and counseled those who reported low levels, patients were offered a 12-week RPM-PA trial through use of a Fitbit Zip. Daily steps were imported directly to the EHR through the patient portal. During Week 1, mean step count was 37,932 ± 17,058/week. At the end of the monitoring period, the mean steps were similar, 36,677 ± 18,120/week. However, there was a noted discrepancy between self-reported physical activity and Fitbit-recorded step counts, with self-reported physical activity recorded as greater than Fitbit-recorded steps at both timepoints, reinforcing the need for objective measures of physical activity to confirm physical activity levels. Although not a primary outcome of this study, participants' hemoglobin A1c remained essentially unchanged from 8.1 ± 1.6 (65 mmol/mol) at baseline to 8.1 ± 1.5 (65 mmol/mol) at 12 weeks.

Cardiology

In a preventive cardiology clinic, the PAVS was coupled with RPM-PA. When patients, aged 18 years and older, with cardiovascular disease (CVD) or CVD risk factors reported low levels of physical activity, a clinical decision support tool was triggered to alert the providers of the need for physical activity counseling. This clinical decision support tool was a best practice advisory (BPA), which included a note in the patient's chart and an after-visit summary to indicate that they were counseled on physical activity. The use of the BPA, that is, signing the BPA, was variable during the year-long pilot (ranging from 2% in Month 10 to 65% in Month 2), these triggers demonstrated the potential to significantly augment care when adopted appropriately. Patients who reported low levels of physical activity were invited to enroll in a trial of RPM-PA with a Fitbit Charge 4 for 12 weeks. Only four out of the 59 participants

Table 1 Remote Patient Monitoring (RPM) Pilot Studies[a] Summary

Clinical Area	Year	Population	Recruitment Site	Sample Size	Study Aim	Activity Monitor
Endocrinology	2019	Age 18–25 years with Type 1 diabetes	Pediatric diabetes clinic	15	PA assessment and counseling with 12 weeks of RPM	Fitbit Zip
Cardiology	2022	Age 18+ years CVD risk	Preventive cardiology clinic	59	PA assessment and counseling with 12 weeks of RPM	Fitbit Charge 4
Pulmonology	2022	Age 14+ years with cystic fibrosis	Cystic fibrosis center	20	PA assessment and counseling with 6 months of RPM	Apple Watch
Neurology	2022	Adults with stroke and TBI	Outpatient rehabilitation setting	10	Evaluate the feasibility, usability, accuracy, and challenges of RPM	ActiGraph GT9X Link

Note. PA = physical activity; CVD = cardiovascular disease; TBI = traumatic brain injury.
[a] Results not yet published or in review.

(7%) were lost to follow-up, which was lower than the 20% accounted for in the a priori sample size calculations. The participants who did not complete the follow-up visit included two who were ill at the time of their follow-up appointment, one that could not be contacted, and one that withdrew from the study. However, the 93% retention over 12 weeks demonstrated patients' overall willingness to engage with RPM-PA.

Pulmonology

An active study in a Cystic Fibrosis Center incorporates both the PAVS and RPM-PA through the utilization of Apple watches. Adolescents, aged 14 years and older, with cystic fibrosis (n = 20) are being assessed with the PAVS at baseline and provided tailored exercise prescriptions. Each participant is given an Apple Watch to wear for 6 months. At 3- and 6-month follow-up, the impact of the exercise counseling on functional capacity (6-minute walk test), quality of life (revised Cystic Fibrosis Questionnaire; Solé et al., 2018), and lung function (pulmonary function test) are assessed. Exercise prescriptions will be adjusted at each visit to adjust step goals. The objective of this study was to assess whether wearable technology and RPM-PA makes it easier for providers to assess adherence to exercise recommendations, track progress toward physical activity goals, and standardize monitoring of physical activity in this population. Specifically, it will evaluate the efficacy of physical activity assessment and promotion using wearable technology on exercise adoption in this younger patient population.

Neurology

In an outpatient rehabilitation setting, a pilot study was recently conducted in 10 adults with stroke and traumatic brain injury in the chronic phase (>1 year postinjury) to evaluate the feasibility, usability, accuracy, and patient-reported challenges of RPM-PA. Patients were asked to wear ActiGraph GT9X Link monitors on their wrist, waist, and ankle simultaneously for 4 weeks, video-record (chest-mounted GoPro Hero 7) everyday activity in the community whenever possible, and provide weekly feedback. Accuracy of step counts at each wear location for the activity monitors was evaluated using video recordings from the community. Preliminary data analysis showed that patients with stroke and traumatic brain injury took, on average, 3,689 ± 1,779 steps every day and spent most of the day being sedentary. Patients also reported more concerns with the wrist-worn monitor compared to the waist- and ankle-worn monitors.

Discussion

The four pilot use cases highlight how RPM is increasingly being used to monitor physical activity for a multitude of use cases and patients from clinical specialties across healthcare systems. This is a shift that has broad implications for prediction, prevention, diagnosis, and management of chronic disease. RPM-PA allows clinicians to track physical activity outside of the clinical setting, which may correlate with disease-specific outcomes (Block et al., 2016). For example, in a systematic review of 36 studies, increased levels of physical activity were associated with a lower risk of CVD incidence and mortality (Wahid et al., 2016). Physical activity interventions of 6 months duration or longer appear to improve exercise capacity in individuals with cystic fibrosis, although more high-quality studies are needed to fully understand the benefits of physical activity in this population (Radtke et al., 2022). It also provides clinicians accessible data that may be used to direct patients' physical activity goals to more closely reflect disease-specific physical activity guidelines. Early experience supports robust engagement with RPM tools—an encouraging step toward routine monitoring of physical activity.

Benefits of RPM-PA

Physical activity data from wearables may be used to monitor disease onset, track adherence to prescribed therapeutic exercises, and predict prognostic outcomes in high-risk chronic disease populations, both in and out of the hospital. Consideration of physical activity levels as a part of routine clinical care is meaningful, as physical activity optimization has demonstrated impact on cardiovascular event rate, risk of developing diabetes or metabolic syndrome, and all-cause mortality (Kraus et al., 2018, 2019; Saint-Maurice et al., 2020). Physical activity levels are also associated with chronic disease risk factors such as blood pressure and cholesterol (Grundy et al., 2019; Whelton et al., 2018).

With RPM-PA, clinicians are able to more closely monitor populations' adherence to physical activity guidelines and accurately track step count fluctuations. RPM-PA has also been shown to predict hospitalization in certain populations (Stehlik et al., 2020). Hence, close monitoring of physical activity trends can be used to trigger clinician alerts for at-risk patients. Ultimately, inferences drawn from these continuous data flows afford richer dialogue between patient and provider. Integration of RPM-PA into mainstream practice has the potential to significantly augment the healthcare system's handle on chronic disease. The use of wearable devices, such as RPM-PA, can provide monitoring and feedback, while potentially improving cost-effectiveness by offering continuous therapy throughout the day, thus enhancing the effects of rehabilitation (Bravo & Muñoz, 2022).

Considerations for the Use of RPM-PA in Different Populations

If the use of RPM-PA is to be expanded, it is important to consider that certain populations may face additional challenges when accessing digital health services. Older adults, populations in rural areas, and minorities with low socioeconomic status and/or limited health literacy or English proficiency more frequently encounter these barriers (Nouri et al., 2019, 2020; SF.gov, n.d.). Around 18% of Americans are older than 65 years. Within this subgroup, only 55%–60% own a smartphone, and 60% are able to find a website to complete a form (Nouri et al., 2020; Pew Research Center, n.d.-a, n.d.-b; SF.gov, n.d.). Therefore, the older adult may struggle with day-to-day use of RPM devices. Moreover, 10% of the U.S. population lives in poverty. This subpopulation has decreased rates of both smartphone ownership (71%) and basic digital literacy (53%) and may struggle to employ RPM strategies that rely on smart phone connectivity (Nouri et al., 2020; Pew Research Center, n.d.-a, n.d.-b; SF.gov, n.d.). Considering these two at-risk populations in aggregate, Nouri et al. noted that around one in every four Americans may not have the necessary digital literacy to engage with digital health innovations, such as RPM (Nouri et al., 2020). As RPM becomes more widely accepted into clinical practice, clinicians must remain cognizant of its impact on healthcare disparities. Nurses may need to provide additional education and continued support to some patients to promote successful engagement of these remote technologies.

In addition to RPM's impact on health disparities, device-specific limitations of RPM-PA include step data variations in certain populations. People with slow or nonstereotypical gait patterns, as well as obese individuals, may diverge from established RPM-PA norms (Brodie et al., 2018). Furthermore, the lack of standardization across wearable devices creates bottlenecks when attempting to report findings in a uniform manner. Nevertheless, given the low correlations between self-report and objective measures of physical activity (Prince et al., 2008), as noted previously, RPM-PA can provide an objective measure of physical activity data that is accessible for clinicians yet requires minimal effort for patients. However, adherence to the activity tracker is an important consideration, and reminders may need to be in place to assure patients are wearing the device at least a minimum percent of time needed to provide valid data (Orstad et al., 2021).

Given that adequate physical activity conveys benefits in many chronic health conditions (e.g., CVD, diabetes, and cancer; 2018 Physical Activity Guidelines Advisory Committee, 2018), RPM-PA can play an important role in assessing progress toward optimal physical activity goals. For example, recently discharged patients with heart failure can be monitored to assess adherence to a self-care regimen (Sohn et al., 2020). The use of RPM-PA can also play a role in monitoring treatment outcomes in postoperative orthopedic patients, a population who appears willing to engage in this type of home monitoring (Kurtz et al., 2022). Given the interest in reducing the hospital length of stay (Kirubarajan et al., 2021) and the potential economic burden of hospitalization on some patients and families (Kilgore et al., 2017), the use of RPM, in general, can play an important role.

Relevant Policy

The past few years have welcomed a large influx of remote monitoring endorsements. Starting in 2018, the Centers for Medicare & Medicaid Services began reimbursing for the RPM, and by 2019, RPM-specific Current Procedural Terminology (CPT®) codes were established (PYA, 2019). The shift toward remote monitoring gained further support with the Centers for Medicare & Medicaid Services' release of the 2022 Fee Schedule to include remote therapeutic monitoring (RTM) codes (Medicare Program; CY 2022 Payment Policies Under the Physician Fee Schedule and Other Changes to Part B Payment Policies; Medicare Shared Savings Program Requirements; Provider Enrollment Regulation Updates; and Provider and Supplier Prepayment and Post-Payment Medical Review Requirements, 2021). Whereas RPM recognizes tracking of physiological data like heart rate and blood pressure, RTM allows clinicians to tap into nonphysiological data such as patients' pain levels, adherence to treatment plans, and, importantly, their musculoskeletal activity. RTM-specific Current Procedural Terminology (CPT®) codes create substantial groundwork to incentivize clinicians to utilize RPM-PA, as many of the codes are specifically approved for monitoring musculoskeletal status. Unlike RPM, clinicians outside the physician scope, physician's assistants and advanced nurse practitioners, can utilize RTM—giving practitioners like physical and occupational therapists the opportunity to join other clinicians in monitoring important patient outcomes. With new policies like these, the dialogue surrounding remote monitoring continues to be enhanced, allowing for richer interaction between patient and provider. RPM-PA may provide accurate, engaging, and accessible solutions that patients and providers have been searching for to overcome issues of treatment adherence, as demonstrated by the previously discussed case studies.

Practice Implications

There are several factors to consider prior to implementing RPM in clinical practice. To start, collaborating with others who have prior experience may facilitate the start-up process. Institutional resources, including information technology experts, may aid efforts related to EHR integration, adoption of best practice alerts, and or screens/surveys that complement RPM data. Lastly, all efforts should be intentional about diversity and inclusion efforts that prioritize underrepresented minorities with a particular focus on social determinants of health. Strategies that target the digital divide and device barriers may support tangible gains toward more inclusive and diverse engagement in remote care.

Limitations

In this article, we describe four current uses of RPM-PA in outpatient clinical settings. However, there are additional use cases we have not described (e.g., outpatient orthopedics). Three of these studies took place in one large academic medical center. Smaller or more rural hospitals may not have the same resources or EHRs to support RPM. However, this article highlights four unique cases, while including additional information on considerations for different populations, and relevant policy and practice implications, all of which may provide valuable guidance to hospital systems looking to initiate RPM in their outpatient clinical settings.

Conclusion

RPM technology provides a unique opportunity for clinicians to obtain real-time feedback for chronic disease monitoring. Though physical activity has been historically self-reported, RPM provides more objectivity and potential impact, creating actionable data for both patients and clinicians. Although the field is full of opportunity, much work is needed to create formal guidance, policies, and programs that will allow equitable access for all populations, in addition to strengthening technological limitations, common to all new innovation. Future research is needed to augment data acquisition approaches, signal processing algorithms, and clinical evidence, with a focus on implementation science. Patient-generated health data, such as RPM-PA, has the potential to provide a more comprehensive view of a patient's health status, allowing clinicians to provide more precise and tailored patient care (Abdolkhani et al., 2019). Nurses working in hospital or rehabilitation settings will need to become familiar with these technologies not only to instruct patients but also to access and interpret the physical activity data syncing to the EHR.

Conflict of Interest

The authors declare no conflict of interest.

Key Practice Points

- Remote patient monitoring is an accessible and feasible technology for rehabilitation settings.
- Remote patient monitoring for physical activity can complement existing clinical care.
- Remote patient monitoring provides clinicians with data outside of a clinic visit.
- Remote patient monitoring can allow for additional patient–provider interactions.

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REFERENCES

2018 Physical Activity Guidelines Advisory Committee (2018). *Physical activity guidelines advisory committee scientific report*. U.S. Department of Health and Human Services. https://health.gov/our-work/nutrition-physical-activity/physical-activity-guidelines/current-guidelines.

Abdolkhani, R., Gray, K., Borda, A., & DeSouza, R. (2019). Patient-generated health data management and quality challenges in remote patient monitoring. *JAMIA Open*, *2*(4), 471–478. 10.1093/jamiaopen/ooz036.

Ball, T. J., Joy, E. A., Gren, L. H., Cunningham, R., & Shaw, J. M. (2016). Predictive validity of an adult physical activity "vital sign" recorded in electronic health records. *Journal of Physical Activity & Health*, *13*(4), 403–408. 10.1123/jpah.2015-0210.

Block, V. A. J., Pitsch, E., Tahir, P., Cree, B. A. C., Allen, D. D., & Gelfand, J. M. (2016). Remote physical activity monitoring in neurological disease: A systematic review. *PLOS ONE*, *11*(4), e0154335. 10.1371/journal.pone.0154335.

Bravo, V. P., & Muñoz, J. A. (2022). Wearables and their applications for the rehabilitation of elderly people. *Medical & Biological Engineering & Computing*, *60*(5), 1239–1252. 10.1007/s11517-022-02544-w.

Brodie, M. A., Pliner, E. M., Ho, A., Li, K., Chen, Z., Gandevia, S. C., & Lord, S. R. (2018). Big data vs accurate data in health research: Large-scale physical activity monitoring, smartphones, wearable devices and risk of unconscious bias. *Medical Hypotheses*, *119*, 32–36. 10.1016/j.mehy.2018.07.015.

Greiwe, J., & Nyenhuis, S. M. (2020). Wearable technology and how this can be implemented into clinical practice. *Current Allergy and Asthma Reports*, *20*(8), 36. 10.1007/s11882-020-00927-3.

Grundy, S. M., Stone, N. J., Bailey, A. L., Beam, C., Birtcher, K. K., Blumenthal, R. S., Braun, L. T., de Ferranti, S., Faiella-Tommasino, J., Forman, D. E., Goldberg, R., Heidenreich, P. A., Hlatky, M. A., Jones, D. W., Lloyd-Jones, D., Lopez-Pajares, N., Ndumele, C. E., Orringer, C. E., Peralta, C. A., … Yeboah, J. (2019). 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA guideline on the management of blood cholesterol: A report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*, *139*(25), e1082–e1143. 10.1161/CIR.0000000000000625.

Kilgore, M., Patel, H. K., Kielhorn, A., Maya, J. F., & Sharma, P. (2017). Economic burden of hospitalizations of Medicare beneficiaries with heart failure. *Risk Management and Healthcare Policy*, *10*, 63–70. 10.2147/RMHP.S130341.

Kirubarajan, A., Shin, S., Fralick, M., Kwan, J., Lapointe-Shaw, L., Liu, J., Tang, T., Weinerman, A., Razak, F., & Verma, A. (2021). Morning discharges and patient length of stay in inpatient general internal medicine. *Journal of Hospital Medicine*, *16*(6), 333–338. 10.12788/jhm.3605.

Kraus, W. E., Janz, K. F., Powell, K. E., Campbell, W. W., Jakicic, J. M., Troiano, R. P., Sprow, K., Torres, A., & Piercy, K. L., 2018 Physical Activity Guidelines Advisory Committee* (2019). Daily step counts for measuring physical activity exposure and its relation to health. *Medicine and Science in Sports and Exercise*, *51*(6), 1206–1212. 10.1249/MSS.0000000000001932.

Kraus, W. E., Yates, T., Tuomilehto, J., Sun, J.-L., Thomas, L., McMurray, J. J. V., Bethel, M. A., & Holman, R. R. (2018). Relationship between baseline physical activity assessed by pedometer count and new-onset diabetes in the NAVIGATOR trial. *BMJ Open Diabetes Research & Care*, *6*(1), e000523. 10.1136/bmjdrc-2018-000523.

Kruklitis, R., Miller, M., Valeriano, L., Shine, S., Opstbaum, N., & Chestnut, V. (2022). Applications of remote patient monitoring. *Primary Care: Clinics in Office Practice*, *49*(4), 543–555. 10.1016/j.pop.2022.05.005.

Kurtz, S. M., Higgs, G. B., Chen, Z., Koshut, W. J., Tarazi, J. M., Sherman, A. E., McLean, S. G., & Mont, M. A. (2022). Patient perceptions of wearable and smartphone technologies for remote outcome monitoring in total knee arthroplasties. *The Journal of Knee Surgery*, *36*, 1253–1258. 10.1055/s-0042-1755378.

Medicare Program; CY 2022 Payment Policies Under the Physician Fee Schedule and Other Changes to Part B Payment Policies; Medicare Shared Savings Program Requirements; Provider Enrollment Regulation Updates; and Provider and Supplier Prepayment and Post-Payment Medical Review Requirements. (2021). Federal Register. https://www.federalregister.gov/documents/2021/11/19/2021-23972/medicare-program-cy-2022-payment-policies-under-the-physician-fee-schedule-and-other-changes-to-part

Mehta, S. J., Hume, E., Troxel, A. B., Reitz, C., Norton, L., Lacko, H., McDonald, C., Freeman, J., Marcus, N., Volpp, K. G., & Asch, D. A. (2020). Effect of remote monitoring on discharge to home, return to activity, and rehospitalization after hip and knee arthroplasty: A randomized clinical trial. *JAMA Network Open*, *3*(12), e2028328. 10.1001/jamanetworkopen.2020.28328.

Nouri, S., Avila-Garcia, P., Cemballi, A. G., Sarkar, U., Aguilera, A., & Lyles, C. R. (2019). Assessing mobile phone digital literacy and engagement in user-centered design in a diverse, safety-net population: Mixed methods study. *JMIR mHealth and uHealth*, *7*(8), e14250. 10.2196/14250.

Nouri, S., Khoong, E. C., Lyles, C. R., & Karliner, L. (2020). Addressing equity in telemedicine for chronic disease management during the COVID-19 pandemic. *NEJM Catalyst Innovations in Care Delivery*. 10.1056/CAT.20.0123.

Orstad, S. L., Gerchow, L., Patel, N. R., Reddy, M., Hernandez, C., Wilson, D. K., & Jay, M. (2021). Defining valid activity monitor data: A multimethod analysis of weight-loss intervention participants' barriers to wear and first 100 days of physical activity. *Informatics (MDPI)*, *8*(2), 39. 10.3390/informatics8020039.

Pew Research Center. (n.d.-a). *Internet/broadband fact sheet*. Retrieved November 29, 2022, from https://www.pewresearch.org/internet/fact-sheet/internet-broadband/

Pew Research Center. (n.d.-b). *Mobile fact sheet*. Retrieved November 29, 2022, from https://www.pewresearch.org/internet/fact-sheet/mobile/

Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Connor Gorber, S., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: A systematic review. *The International Journal of Behavioral Nutrition and Physical Activity*, *5*, 56. 10.1186/1479-5868-5-56.

PYA. (2019). *Providing and billing Medicare for remote patient monitoring*. http://www.pyapc.com/wp-content/uploads/2019/10/Providing-and-Billing-Medicare-for-Remote-Patient-Monitoring-PYA.pdf

Radtke, T., Smith, S., Nevitt, S. J., Hebestreit, H., & Kriemler, S. (2022). Physical activity and exercise training in cystic fibrosis. *The Cochrane Database of Systematic Reviews*, *8*(8), CD002768. 10.1002/14651858.CD002768.pub5.

Rising, C. J., Gaysynsky, A., Blake, K. D., Jensen, R. E., & Oh, A. (2021). Willingness to share data from wearable health and activity trackers: Analysis of the 2019 health information National Trends Survey data. *JMIR mHealth and uHealth*, *9*(12), e29190. 10.2196/29190.

Saint-Maurice, P. F., Troiano, R. P., Bassett, D. R., Jr., Graubard, B. I., Carlson, S. A., Shiroma, E. J., Fulton, J. E., & Matthews, C. E. (2020). Association of daily step count and step intensity with mortality among U.S. adults. *JAMA*, *323*(12), 1151–1160. 10.1001/jama.2020.1382.

Sallis, R. E., Baggish, A. L., Franklin, B. A., & Whitehead, J. R. (2016). The call for a physical activity vital sign in clinical practice. *The American Journal of Medicine*, *129*, 903–905. 10.1016/j.amjmed.2016.05.005.

Schuna, J. M., Jr., Johnson, W. D., & Tudor-Locke, C. (2013). Adult self-reported and objectively monitored physical activity and sedentary behavior: NHANES 2005–2006. *International Journal of Behavioral Nutrition and Physical Activity*, *10*, 126. 10.1186/1479-5868-10-126.

SF.gov. (n.d.). *San Francisco digital equity*. Retrieved November 29, 2022, from https://sf.gov/san-francisco-digital-equity

Sohn, A., Speier, W., Lan, E., Aoki, K., Fonarow, G. C., Ong, M. K., & Arnold, C. W. (2020). Integrating remote monitoring into heart failure patients' care regimen: A pilot study. *PLOS ONE*, *15*(11), e0242210. 10.1371/journal.pone.0242210.

Solé, A., Olveira, C., Pérez, I., Hervás, D., Valentine, V., Baca Yepez, A. N., Olveira, G., & Quittner, A. L. (2018). Development and electronic validation of the revised cystic fibrosis questionnaire (CFQ-R teen/adult): New tool for monitoring psychosocial health in CF. *Journal of Cystic Fibrosis*, *17*(5), 672–679. 10.1016/j.jcf.2017.10.015.

Stehlik, J., Schmalfuss, C., Bozkurt, B., Nativi-Nicolau, J., Wohlfahrt, P., Wegerich, S., Rose, K., Ray, R., Schofield, R., Deswal, A., Sekaric, J., Anand, S., Richards, D., Hanson, H., Pipke, M., & Pham, M. (2020). Continuous wearable monitoring analytics predict heart failure hospitalization: The LINK-HF Multicenter Study. *Circulation: Heart Failure*, *13*(3), e006513. 10.1161/CIRCHEARTFAILURE.119.006513.

Vogels, E. A. (n.d.). *About one-in-five Americans use a smart watch or fitness tracker*. Retrieved August 25, 2022, from https://www.pewresearch.org/fact-tank/2020/01/09/about-one-in-five-americans-use-a-smart-watch-or-fitness-tracker/

Wahid, A., Manek, N., Nichols, M., Kelly, P., Foster, C., Webster, P., Kaur, A., Friedemann Smith, C., Wilkins, E., Rayner, M., Roberts, N., & Scarborough, P. (2016). Quantifying the association between physical activity and cardiovascular disease and diabetes: A systematic review and meta-analysis. *Journal of the American Heart Association: Cardiovascular and Cerebrovascular Disease*, *5*(9), e002495. 10.1161/JAHA.115.002495.

Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Jr., Collins, K. J., Dennison Himmelfarb, C., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D. W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Jr., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., Williams, K. A., Sr., … Wright, J. T., Jr. (2018). 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: Executive summary: A report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines. *Circulation*, *138*(17), e426–e483. 10.1161/CIR.0000000000000597.

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