Narrowing the Digital Divide: A Framework for Creating Telehealth Equity Dashboards

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Submitted to: Interactive Journal of Medical Research
on: February 27, 2024

Table of Contents

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Abstract

Telehealth presents the potential to improve access to care, but also to widen the digital divide contributing to healthcare disparities due to lacking standardized approaches to measure and display telehealth disparities. We outline a strategic framework for health systems to develop and optimally utilize a telehealth equity dashboard through a three-phased approach.

(JMIR Preprints 27/02/2024:57435)
DOI: https://doi.org/10.2196/preprints.57435

Original Manuscript

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The COVID-19 pandemic catalyzed a surge in telehealth adoption. [1, 2] However, disparities in access to and adoption of digital healthcare persist among Black, Hispanic, public-insured, low-income, and rural populations. [3, 4] This "digital divide" risks worsening health disparities in these populations. [5] As such, Crawford et al created the Digital Health Equity Framework (DHEF) to guide the equitable design and implementation of future digital health interventions. The DHEF takes into consideration how individuals' sociocultural and economic contexts influence intermediate factors, such as environmental stressors and health behaviors, which then drive the digital determinants of health (e.g. acceptability of or access to digital health, digital health literacy, etc.) at the root of these disparities. [6]

While health systems can use the DHEF to implement equity-minded telehealth strategies, understanding and bolstering the quality of the digital infrastructure within the communities they care for are critical steps to ensuring equitable access to telehealth. [7] Unfortunately, digital analytics are still lacking to understand utilization patterns for those underserved by technology infrastructure. Dashboards that showcase key performance indicators in real-time have become valuable tools to track healthcare access, understand disparities, and apply interventions. Yet, there are no consensus guidelines for the creation of telehealth-specific equity dashboards, which can apply the nuanced considerations for telehealth equity outlined through the DHEF to existing standards for data monitoring.

To standardize such dashboards, the Supporting Pediatric Research on Outcomes and Utilization of Telehealth (SPROUT)-CTSA Network formed the Telehealth Equity Workgroup. Evidence on best practices for the collection and use of equity-related data continues to evolve. Based on review of the existing literature and the operational experience of clinicians, informaticists, and researchers in this workgroup, we aim to describe a strategic framework for adult- and pediatrics-serving health systems to execute telehealth equity dashboards through three phases – Define, Design, and Deploy (Figure 1). Additionally, we offer a checklist for framework navigation (Table 1) to motivate more critical monitoring and evaluation of health systems' current telehealth practices and ultimately identify service delivery gaps.

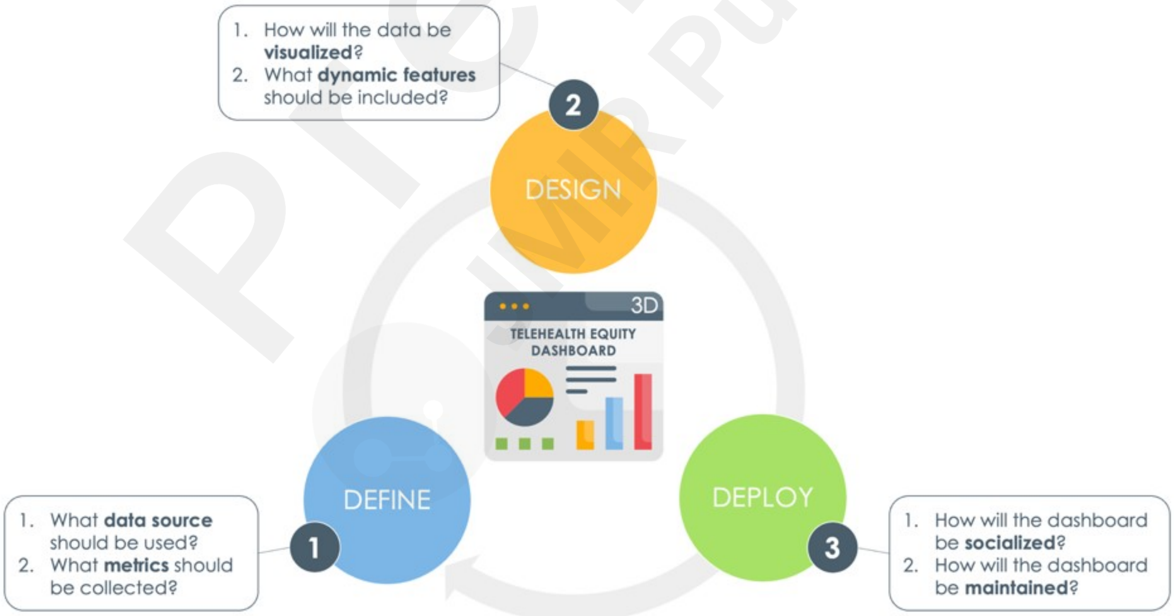

Figure 1. Telehealth Equity Dashboard Framework

Engaging Interested Parties

Before beginning to create a telehealth equity dashboard, health systems must identify all interested parties to balance diverse perspectives and priorities. This should include all potential dashboard users such as clinical staff, investigators, and administrators as well as dashboard experts and patient advocates. Early engagement facilitates institutional buy-in to both the development and use of a dashboard. Additionally, as there is notable variation in data privacy regulations based on patient age, type of medical problem, local health system policy, and federal laws, early involvement of senior leadership can help ensure dashboards are implemented appropriately. Once identified, interested parties must be continuously engaged throughout all phases of the framework process to ensure these dashboards are developed with the intended users in mind.

Phase I: Define

First, health systems should consider what data sources to leverage. Data source mapping is one useful technique to identify usable sources for dashboard development. This inventory process involves cataloging all available sources and describing potentially relevant data to allow teams to consider the feasibility, reliability, and quality of these sources. [8]

Poor data quality can have negative downstream impacts, as inaccurate or incomplete data can mask disparities. [9] First, patient and caregiver demographics can often be conflated in pediatric and elderly care settings. Additionally, previous research found that non-White patients were less likely to have the correct race in their health records and were often mislabeled as White, skewing disparities. [10]

Several strategies can mitigate the limitations of missing or inaccurate data. [11] Imputation or Bayesian modeling techniques can help bolster existing data by addressing missingness with inferred values. For example, imputing race and ethnicity identified greater disparities in COVID-19 compared to only excluding missing data. [12] Health systems can also enhance existing data by linking their databases to external sources to conduct area-based monitoring. [13] To illustrate, health systems could integrate regional-level population data from national datasets (e.g. the National Survey of Children's Health or the American Community Survey for United States health systems) with internal patient data by census tract. Inequities can then be tracked between geographic regions to further support patients from medically underserved areas.

Unfortunately, these methods fail to address the root of data inaccuracy. Improvement of data collection processes is the best long-term solution. Staff training, patient education, and options for self-reporting outside of clinical encounters are key for improved collection. [9] Greater transparency regarding the purpose of data collection and improved framing of questions to reduce discomfort in sharing sensitive data could also increase self-reporting. [10]

Once data sources are established, health systems can select metrics from the domains of the SPROUT Telehealth Evaluation and Measurement (STEM) Framework [14], including health outcomes (i.e, disease-specific measures), health delivery (i.e., quality and cost), individual experience (i.e., patient experience data), and key performance indicators (i.e., implementation measures), as well as equity stratifiers (i.e., environmental/patient attributes). Additionally, defining each metric's performance target is critical. Targets can be based on peer organizations' performance, past institutional achievements, national/state/county-wide standards, and public policy goals.

Phase II: Design

Next, health systems should carefully consider the design of their dashboards, as literature demonstrates how data aggregation and visualization influence the ability to detect disparities. Common broad racial/ethnic categories such as Black or Hispanic obscure within-group differences that can have significant clinical implications. [15] For example, when Asian is grouped with Native Hawaiian and Other Pacific Islanders, such aggregated statistics conceal meaningful differences between subpopulations. [16] Thus, it is important to present data as disaggregated by equity stratifiers as possible, acknowledging that some level of aggregation is necessary given data quality limitations. A recent proposal for revised federal government standards for race/ethnicity classification may guide new best practices. [17]

We recommend, at a minimum, comparing data from medically underserved populations tailored to each health system with an aggregated "catch-all" category. Health systems may consider including a reference which is often the total population, or the group with the largest population, the most favorable health outcomes, or the greatest socioeconomic advantage. [18] However, there are risks of identifying a "reference" group. Selecting White, for example, as the "reference" population may inherently imply "non-reference" populations require assimilation or acculturation or are generally "abnormal."

Additionally, designing dashboards with filter functionality across multiple metrics can provide more robust analytics and displays. Irrespective of the population that a health system serves, intersectionality, or the connection between personal identities, is another key attribute to dashboard design, allowing for a more in-depth look at identified disparities. Race as a stratifier on its own could be a proxy for other variables underlying why these disparities exist. However, through filter functionality, users might consider assessing telehealth equity across race with another key attribute such as social determinants of health or internet access. [18]

Designers should follow best practices for data visualization, [19] including maximizing data-ink ratios and selecting the appropriate software for desired displays. Commercial visualization tools can be found in Table 1. When choosing visualizations, it is essential to consider ease of interpretation and potential risks of misrepresentation. Tables explicitly lay out comprehensive information but can be difficult to digest. Interpretation can be supported through bolding or color-coding. Graphs can simplify data presentation and draw attention to specific insights, but this simplicity can be misleading. [18] It is essential to include missing data percentages to illustrate uncertainty and incorporate features to understand the context of the data for accurate interpretation. For instance, when interpreting a narrowed disparity, the availability of hover functionality to display numerators, denominators, and count breakdowns for each data point can help users understand the source of this change. In addition to reporting current statistics, the ability to view metrics over time permits detection of trends and post-intervention changes in disparities which is an essential dashboard function.

Once a preliminary design has been determined, teams can develop a draft dashboard. From this point forward, design and development should proceed concurrently. The draft dashboard should undergo pretesting with sample end-users which can subsequently inform alterations to the design. Keep in mind, multiple designs are likely needed to accommodate different audiences, from front-line staff implementing care and monitoring day-to-day activity to administrators interested in quarterly or annual trends.

Phase III: Deploy

Finally, intentional deployment of a telehealth equity dashboard is critical to increase utilization, inform and monitor operational and clinical interventions, preserve institutional buy-in, and create a data-driven culture to improve health equity.

Socialization, the process of organizations adjusting to, learning about, and buying-into a new initiative, is a key aspect of successful dashboard deployment. Socializing with leadership and clinical providers allows teams to create relationships for long-term reporting and inspires clinicians to use the dashboard in day-to-day operations. Normalizing the use of equity dashboards at all levels can stimulate sustained awareness and action to improve telehealth equity hence laying the foundation for a culture of accountability and quality data collection to address disparities in telehealth and beyond.

In this phase, it is also essential to identify a cadence of dashboard review and updates, given the likely differing preferences among users. For example, leadership may expect a quarterly update on high-level telehealth equity experience, while interpreter services may desire monthly check-ins to monitor progress on their practice changes. Socialization with regular review allows for opportunities for feedback, which studies have shown improve data quality. [20] By recognizing the appropriate set of interested parties, health systems can continue to enhance their dashboards with the right feedback from a broader and inclusive user group.

Once the dashboard has been deployed, data can be used and updated to advocate for new programs or workflows supporting medically underserved populations. The implementation of a dashboard is an ongoing, iterative process through each phase. For example, the telehealth equity dashboard may highlight a disparity that motivates the creation of a new intervention. The implementation of a new intervention may then require new metrics to be added to the existing dashboard or identify other ways to track performance. The dashboard development team may thus return to Phase I to reevaluate their sources and metrics. Additionally, periodic usability testing by end-users can allow for the identification of these key areas of improvement for subsequent iterations. This process, akin to the Plan-Do-Study-Act cycle in improvement science, can ensure the adaptability and continual advancement of a dashboard to meet the demands of a dynamic health system. [21]

Call to Action

Dashboards offer an avenue to improve data transparency. Data sharing, especially as it relates to equity, may be limited due to lack of incentives, fear of public scrutiny, or perceived opportunity costs if data is used for research by external parties. [22] However, this creates silos between and even within health systems. Data sharing has the potential to establish shared standards and cross-institutional efforts to improve health on the population-level. Therefore, as technology use in healthcare advances, we must pay close attention to what the data are telling us, be transparent with our progress and shortcomings, and push for change in our care models to ensure equitable quality of and access to care for all patients.

Conclusions

The pandemic laid bare the implications of the digital divide on health disparities. Nevertheless, telehealth continues to serve as a potential cost-effective care model and promising access point for patients with barriers to in-person services. As such, our strategic framework for developing a telehealth equity dashboard offers a valuable means to track utilization patterns and outcomes to provide evidence needed to support continued investment in an equitable telehealth offering. Telehealth equity dashboards present a promising means to build a culture of data transparency, equity-centered implementation, and continuous improvement to narrow the digital divide and improve access to care for all patients in this expanding world of digital healthcare.

Table 1. Telehealth Equity Dashboard Checklist

Phase I: Define	
Step 1: Identify data sources and collect accurate data on equity stratifiers	
Internal Sources: ☐ Electronic Medical Record ☐ Patient Experience Surveys	External Sources: ☐ National Census Databases ☐ National and Regional Community Surveys ☐ News, Industry Papers
Step 2: Choose metrics based on STEM framework [14]	
Health Outcomes: ☐ Individual or population-level disease specific measures (e.g., HbA1c, BMI percentile, depression screening results, Vanderbilt score, mortality)	Health Delivery: ☐ Access (e.g., interpreter use, portal use) ☐ Effectiveness (e.g., guideline adherence) ☐ Quality (e.g., diagnostic accuracy, % harm) ☐ Cost (e.g., healthcare utilization)
Individual Experience: ☐ Satisfaction (e.g., promoter score) ☐ Usability (e.g., technical quality) ☐ Burden reduction (e.g. saved workdays) ☐ Adaptability	Key Performance Indicators: ☐ No-show rates ☐ Wait times ☐ Patient volume ☐ Percent virtual visits
Equity Stratifiers: ☐ Common demographics (e.g., age, gender identity, sex, race, ethnicity, zip code, census tract) ☐ Advanced demographics (e.g., language preference, insurance, disability status, complexity) ☐ Technology access (e.g., device access, device type, stable internet, technology literacy) ☐ Social determinants of health (e.g., economic stability, neighborhood metrics of disadvantage)	
Phase II: Design	
Step 1: Create dynamic features	
Recommended Features: ☐ Comparison Groups ☐ Variable Filter/Aggregation Functionality ☐ Hover Functionality to see Counts, Percents, Numerators, and Denominators	☐ Table Displays for Detailed Views ☐ Graphical Displays for Trends ☐ Time Range Filtering ☐ Data Missingness Reporting
Step 2: Select visualization tools	
Visualization Tools: ☐ Epic® ☐ HealtheIntent® ☐ Power BI® ☐ QlikView®	☐ Qlik Sense® ☐ R® ☐ Tableau® ☐ Other
Phase III: Deploy	
Step 1: Socialize dashboard	
Recommended Steps: ☐ Share with interested parties (leadership, administrative, operations, clinical, patients) ☐ Integrate feedback	
Step 2: Maintain data	
Recommended Steps: ☐ Establish cadence for dashboard tracking and review with each user group ☐ Establish cadence for data updates, reporting, and reassessment of performance metrics/goals	

Acknowledgments

Funding Statement: Dr. Michael Luke's effort contributing to this manuscript was in part funded by the NICHD Grant #T32HD060550. Dr. John Chuo, Christina Coleman, and the SPROUT-CTSA Network Health Equity Topic Working Group Dashboards Taskforce's effort contributing to this manuscript was in part funded by NIH/ NCATS SPROUT-CTSA Collaborative Telehealth Network Grant #U01TR002626. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

Data Availability: Not Applicable

Conflicts of Interest: The authors have no relevant conflicts of interest to disclose.

Author Contributions:
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Dr. Sansanee Craig: Conceptualization, Writing - Review and Editing
Dr. Suzinne Pak-Gorstein: Conceptualization, Writing –Review and Editing
Dr. S. Margaret Wright: Conceptualization, Writing - Review and Editing
Marlíse Arellano: Conceptualization, Writing - Original Draft, Investigation, Writing - Review and Editing
Jessica Zhang: Conceptualization, Writing - Review and Editing
Dr. John Chuo: Writing - Review and Editing
Dr. Philip Scribano: Conceptualization, Supervision, Project Administration, Writing - Review and Editing

AI Dislosure: No generative AI was used in any portion of the manuscript writing.

References

1. Roy J, Levy DR, Senathirajah Y. Defining Telehealth for Research, Implementation, and Equity. J Med Internet Res. 2022 2022/4/13;24(4):e35037. doi: 10.2196/35037.
2. Curfman A, McSwain SD, Chuo J, Yeager-McSwain B, Schinasi DA, Marcin J, et al. Pediatric Telehealth in the COVID-19 Pandemic Era and Beyond. Pediatrics. 2021 Sep;148(3). PMID: 34215677. doi: 10.1542/peds.2020-047795.
3. Drake C, Lian T, Cameron B, Medynskaya K, Bosworth HB, Shah K. Understanding Telemedicine's "New Normal": Variations in Telemedicine Use by Specialty Line and Patient Demographics. Telemed J E Health. 2022 Jan;28(1):51-9. PMID: 33769092. doi: 10.1089/tmj.2021.0041.
4. Patel SP, Sun E, Reinhardt A, Geevarghese S, He S, Gazmararian JA. Social Determinants of Digital Health Adoption: Pilot Cross-sectional Survey. JMIR Form Res. 2022 2022/12/6;6(12):e39647. doi: 10.2196/39647.
5. Anil Kumar Vaidhyam S, Huang K-T. Social Determinants of Health and Patients' Technology Acceptance of Telehealth During the COVID-19 Pandemic: Pilot Survey. JMIR Hum Factors. 2023 2023/11/7;10:e47982. doi: 10.2196/47982.
6. Crawford A, Serhal E. Digital Health Equity and COVID-19: The Innovation Curve Cannot Reinforce the Social Gradient of Health. J Med Internet Res. 2020 2020/6/2;22(6):e19361. doi: 10.2196/19361.
7. Gustavson AM, Lewinski AA, Fitzsimmons-Craft EE, Coronado GD, Linke SE, O'Malley DM, et al. Strategies to Bridge Equitable Implementation of Telehealth. Interact J Med Res. 2023 2023/5/15;12:e40358. doi: 10.2196/40358.
8. Hosseinpoor AR, Bergen N, Schlotheuber A. Promoting health equity: WHO health inequality monitoring at global and national levels. Glob Health Action. 2015;8:29034. PMID: 26387506. doi: 10.3402/gha.v8.29034.
9. Wilkins CH, Friedman EC, Churchwell AL, Slayton JM, Jones P, Pulley JM, et al. A Systems Approach to Addressing Covid-19 Health Inequities. NEJM Catalyst. 2021;2(1). doi: doi:10.1056/CAT.20.0374.
10. Blagev DP, Barton N, Grissom CK, McKee KE, Harrison AM. On the Journey Toward Health Equity: Data, Culture Change, and the First Step. NEJM Catalyst. 2021;2(7). doi: doi:10.1056/CAT.21.0118.

11. Bilheimer LT, Klein RJ. Data and measurement issues in the analysis of health disparities. Health Serv Res. 2010 Oct;45(5 Pt 2):1489-507. PMID: 21054368. doi: 10.1111/j.1475-6773.2010.01143.x.
12. Labgold K, Hamid S, Shah S, Gandhi NR, Chamberlain A, Khan F, et al. Measuring the missing: greater racial and ethnic disparities in COVID-19 burden after accounting for missing race/ethnicity data. medRxiv. 2020 Oct 2. PMID: 33024980. doi: 10.1101/2020.09.30.20203315.
13. Hosseinpoor AR, Bergen N. Area-based units of analysis for strengthening health inequality monitoring. Bull World Health Organ. 2016 Nov 1;94(11):856-8. PMID: 27821889. doi: 10.2471/blt.15.165266.
14. Chuo J, Macy ML, Lorch SA. Strategies for Evaluating Telehealth. Pediatrics. 2020;146(5). doi: 10.1542/peds.2020-1781.
15. Kauh TJ, Read JG, Scheitler AJ. The Critical Role of Racial/Ethnic Data Disaggregation for Health Equity. Popul Res Policy Rev. 2021;40(1):1-7. PMID: 33437108. doi: 10.1007/s11113-020-09631-6.
16. Shimkhada R, Scheitler AJ, Ponce NA. Capturing Racial/Ethnic Diversity in Population-Based Surveys: Data Disaggregation of Health Data for Asian American, Native Hawaiian, and Pacific Islanders (AANHPIs). Population Research and Policy Review. 2021 2021/02/01;40(1):81-102. doi: 10.1007/s11113-020-09634-3.
17. Revesz RL. Initial Proposals For Updating OMB's Race and Ethnicity Statistical Standards. Federal Register: January 27, 2023.
18. Penman-Aguilar A, Talih M, Moonesinghe R, Huang D. Response to Scanlan Concerning: Measurement of Health Disparities, Health Inequities, and Social Determinants of Health to Support the Advancement of Health Equity. J Public Health Manag Pract. 2016 Nov-Dec;22(6):614-5. PMID: 27682733. doi: 10.1097/phh.0000000000000494.
19. Midway SR. Principles of Effective Data Visualization. Patterns. 2020 2020/12/11/;1(9):100141. doi: https://doi.org/10.1016/j.patter.2020.100141.
20. Taggart J, Liaw ST, Yu H. Structured data quality reports to improve EHR data quality. Int J Med Inform. 2015 Dec;84(12):1094-8. PMID: 26480872. doi: 10.1016/j.ijmedinf.2015.09.008.
21. Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D, Reed JE. Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. BMJ Qual Saf. 2014 Apr;23(4):290-8. PMID: 24025320. doi: 10.1136/bmjqs-2013-001862.
22. van Panhuis WG, Paul P, Emerson C, Grefenstette J, Wilder R, Herbst AJ, et al. A systematic review of barriers to data sharing in public health. BMC Public Health. 2014 2014/11/05;14(1):1144. doi: 10.1186/1471-2458-14-1144.

Supplementary Files

Figures

Telehealth equity dashboard framework.