HARNESSING DATA VISUALIZATION TO ADVANCE EQUITY IN CLINICAL SERVICES

AHRQ CHALLENGE PHASE 2 FINAL REPORT
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I. INTRODUCTION

In 2023, there were 13,960 new cases of cervical cancer and 4,310 deaths attributable to cervical cancer in the United States.[1] Despite declining rates of cervical cancer incidence and mortality in the United States in the previous 50 years, disparities persist for certain groups of people. Disparities in cervical cancer incidence and mortality exist by age, race and ethnicity,[2] sexual orientation and gender identity,[3-6] socioeconomic status (SES),[7-9] and insurance status.[7,10] While disparities have multiple causes, underscreening is likely a large contributor as the United States does not have an organized national cervical cancer screening program and patients do not have equitable access to preventive health services. Nationally in 2021, 27.6% of women eligible (those aged 21 to 65 years) were not up to date with their cervical cancer screening.[11] Patients seen at federally qualified health centers (FQHC) are even less likely to be up to date with their screening. A recent study[12] reported 49.0% of FQHC patients nationally had not been screened for cervical cancer in 2020. Further, studies have indicated patients with behavioral health conditions including serious mental illness[13] and substance use disorders[14] are less likely to be up to date with their cervical cancer screening. With the patients most at-risk also being those who are least likely to receive preventive services, patient-centered strategies are needed to increase uptake of relevant screenings. Increasing outreach to these at-risk patient groups may increase cervical cancer screening rates. Recently, the Food and Drug Administration (FDA) has approved two self-administered human papillomavirus (HPV) tests for in-clinic use[15]; offering a self-administered HPV test to patients is a potential method to increase cervical cancer screening. If patients are reluctant to have a clinician collect a cervical HPV sample during a pelvic examination, they may be open to instead collecting a vaginal sample on their own. Many studies have been conducted that support an increase in cervical cancer screening when patients are offered a self-administered HPV test.[16-19] This has been demonstrated in primary care populations eligible for screening[16-19] and also in patients who are under screened for cervical cancer (i.e., non-attenders or non-participants).[20-23]

The Kaiser Permanente Center for Health Research (KPCHR) team collaborated with Cascadia Health, Oregon's largest community-based behavioral health and substance use treatment center, to develop an interactive data visualization tool for cervical cancer screening using Tableau Desktop (version 2023.3.2). As a Certified Community Behavioral Health Center and an FQHC, Cascadia Health serves as a safety net for Oregonians, including those facing addiction and mental health challenges. In 2023,[24] they provided health care to over 4,000 patients across four main health centers. Their patients are primarily aged 18 to 64 years with most identifying as non-Hispanic White. Further, a significant portion of their patients live below the federal poverty line, receive Medicaid, and reside in public housing. Their preventive health screening rates in 2023 were lower than national averages, with a cervical cancer screening rate of 37%.[24]

The data visualization tool was designed to help Cascadia Health track their progress in increasing cervical cancer screening rates, focusing on identifying patient groups needing further outreach. Additionally, the tool will be especially beneficial for tracking the implementation of a recently launched pilot project allowing patients to self-administer HPV tests in the clinic. Our collaboration addresses disparities in cervical cancer morbidity and mortality by enhancing screening outreach and improving health outcomes for patients with lower socioeconomic status and mental health comorbidities.

II. DATA VISUALIZATION DEVELOPMENT

In consultation with clinic staff at Cascadia Health, KPCHR developed a list of variables that could be informative for a data visualization targeting cervical cancer screening. The list was modified as needed based on discussions with and feedback from several team members at Cascadia Health. Cascadia Health staff then worked with their Business Intelligence (BI) team to obtain the variables of interest, and a final dataset was developed (**Table 1**). The BI team generated a Structured Query

Language (SQL) query to pull data from their relational database for patients who were eligible for cervical cancer screening (i.e., persons with a cervix, aged 21-65 years). Deidentified data was sent to KPCHR as a flattened file in Excel. A few variables of interest were not easily obtainable from Cascadia Health's database, such as follow-up colposcopy results because patients are referred to gynecologists outside of the Cascadia Health system for colposcopies. Therefore, the data visualization was limited to the initial screening test, such as an HPV test, Papanicolaou (Pap) test, or both (i.e., co-testing).

Table 1. Patient and clinic data obtained from Cascadia Health

Variables
Health system (Cascadia, other)
Health center location
Provider
Unique patient identifier
Screening status (Screened, unscreened)
Method of screening (in-clinic co-testing, in-clinic primary HPV, self-administered primary HPV)
Date of screening test order
Date of screening test result
Result of screening test (HPV detected/not detected, abnormal cells detected/not detected)
Number of clinic encounters in the previous year
Number of clinic encounters in the previous month
Gender identity
Ethnicity
Race
Age
Family size
Family income
Insurance status
Insurance type
Living arrangement (e.g., living in shelter, living with others)
Employment status
HIV diagnosis
Smoking history
HPV vaccination status
Mental health condition diagnosis
Substance use disorder

KPCHR imported the Excel file from Cascadia Health BI into Stata to clean any fields as needed and ensure the data were usable for Tableau. The most recent screening HPV or Pap test was used to inform the visualization. Extended genotyping tests or follow-up HPV tests due to a prior positive screen were excluded. When a patient had both a Pap and HPV test, the test type was relabeled as co-testing; a positive result from either the Pap (abnormal cells) or HPV test (detected) indicated a positive co-testing result.

KPCHR exported the Excel file from Stata and linked it to a Tableau workbook. Minimal adjustments were made to the data in Tableau, primarily to create groups for certain fields (e.g., mental health diagnoses) or to split some fields (e.g., zip code from a full address). Each variable was explored in a separate figure or visualization to determine the format that would convey the results most effectively. For example, as patient ethnicity had eight categories, a donut chart displaying ethnicity would be difficult to interpret, so a bar chart was selected. The preliminary dashboard (**Figure 1**) shared with Cascadia Health staff included the following components: a tree map displaying the proportion of patients up to date or not up to date with cervical cancer screening; a bar chart showing the number of patients who selected each category of gender identity (i.e., female, male, non-binary/genderqueer, questioning, transgender female, transgender male, two spirit, other, or unknown/refused); a bar chart with the number of patients in each category of ethnicity (i.e., Non-Hispanic or Latino/a; Mexican, Mexican American, or Chicano/a; Hispanic or Latino/a; Puerto Rican; Cuban; Multiple Hispanic, Latino/a, or Spanish origins; Another Hispanic, Latino/a, or Spanish Origin; or unknown/refused); four donut charts displaying the proportion of patients with human immunodeficiency virus (HIV) diagnosis (i.e., HIV diagnosis, no HIV diagnosis, unknown), HPV vaccination (i.e., HPV vaccination, no HPV vaccination, unknown), screening test used (i.e., Pap test only, HPV test or co-testing, no test), and the HPV or Pap Test Result (i.e., screen negative, screen positive, or no test); a bubble chart showing the number of patients with mental health or substance use diagnoses; a histogram of patient age; a map showing the

location of the health center; and a variation of a box and whisker plot showing the distribution of the number of last year and last month visits.

The following patient characteristics were additionally used as filters for the dashboard: screening status, gender identity, ethnicity, and mental health or substance use diagnoses. For illustrative purposes, **Figure 2** displays the data visualization filtered for patients who were not up to date with their cervical cancer screening and who selected their ethnicity as Mexican, Mexican American, or Chicano/a. Of the 36 patients who were not up to date and of Mexican ethnicity, the visualization shows that most identified as female, six had a co-existing mental health or substance use diagnosis, and their ages spanned the full range eligible for cervical cancer screening (although most were aged under 50 years). Most importantly, the data visualization also tells us that most of these patients (35 of 36) had a clinical encounter with Cascadia Health in the previous year. These clinical encounters are opportunities for Cascadia Health to offer cervical cancer screening, particularly self-administered HPV screening.

Figure 1. Data visualization with all patient characteristics displayed

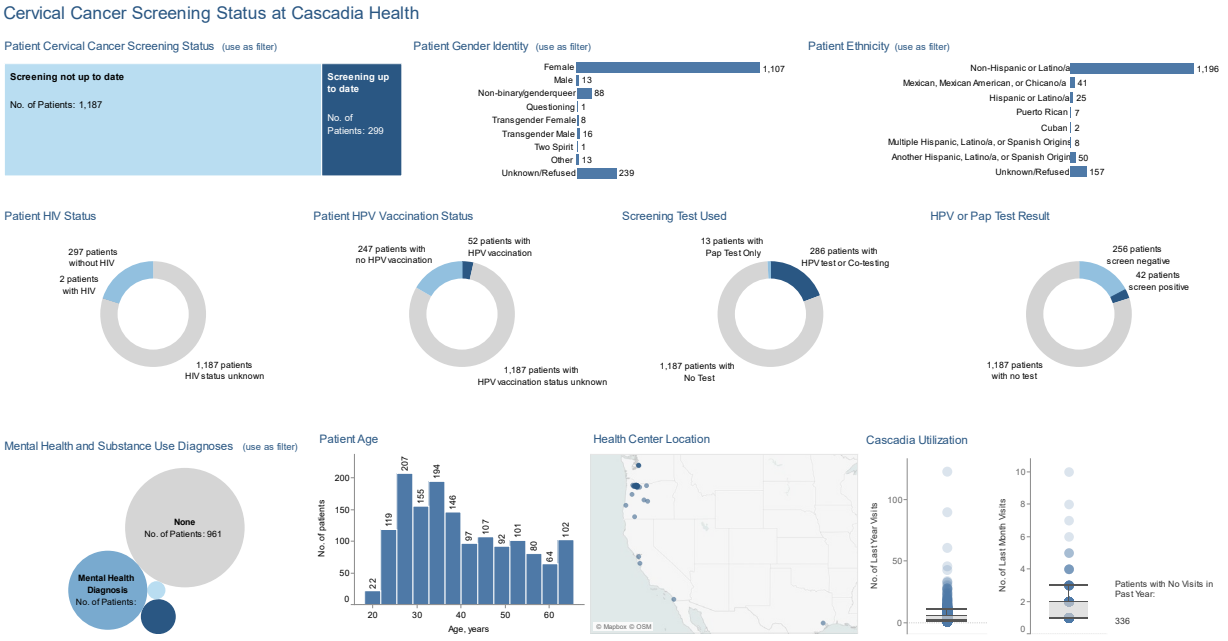
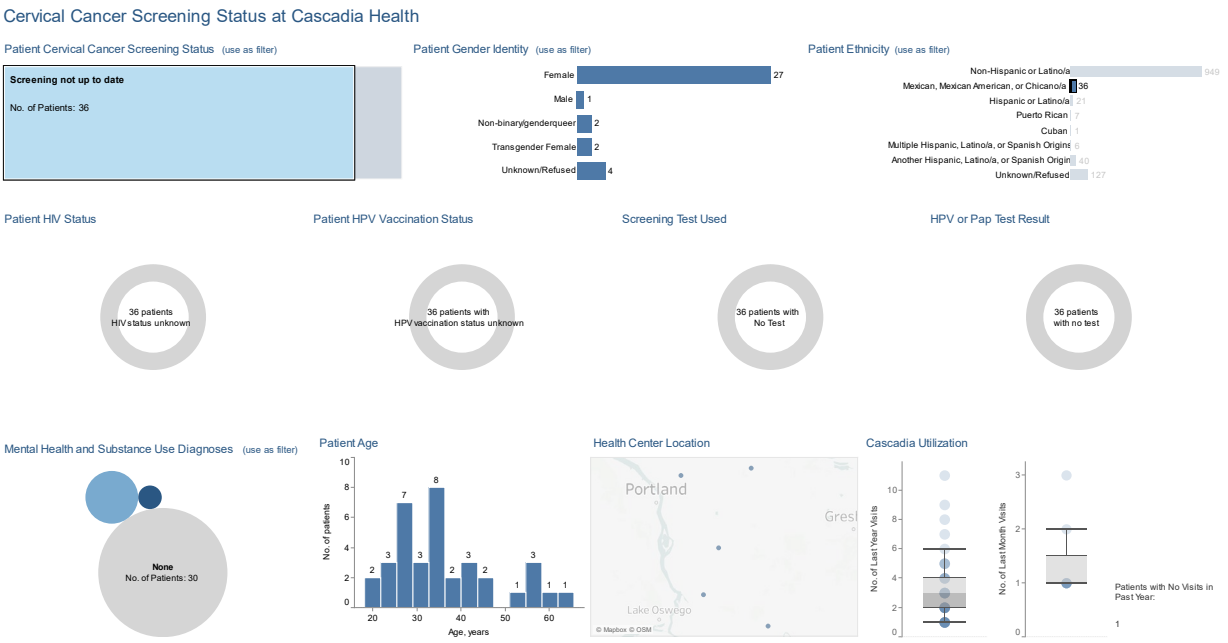


Figure 2. Data visualization filtered by screening status and ethnicity



III. DATA VISUALIZATION IMPLEMENTATION AND EVALUATION

The initial draft of the visualization was disseminated to the Cascadia Health team via Tableau Public, an online visual analytics platform (https://public.tableau.com/app/profile/leslie.perdue2689/viz/EquityVisualization5_31_2024/CCScreeningStatusatCascadia). After providing an opportunity for the clinic staff to review and explore the tool, KPCHR conducted individual qualitative interviews to gather feedback on the visualization, including its implementation in the HPV self-administered testing pilot and its sustainability within the Cascadia Health system. Included were five Cascadia Health clinic staff and leadership team members: the primary care practice administrator, primary care practice supervisor, clinic panel manager, senior director of quality and population health, and medical director. Insights from these qualitative interviews helped guide the development of a framework to implement and evaluate the use of a data visualization tool for the HPV self-administered testing pilot. The following sections outline key components of this framework, structured to facilitate effective implementation and assessment:

1. **Expand Cervical Cancer Screening Options to Overcome Patient-Specific Barriers and Enhance Screening Accessibility**

The Cascadia Health patient population faces several barriers that make HPV self-administered testing particularly appealing. Many patients have inconsistent living situations or lack reliable phone access, complicating outreach efforts for traditional cervical cancer screenings. Therefore, offering HPV self-administered testing during any primary care or mental health visit has the potential to transform the screening landscape, as these encounters may be the only opportunity to conduct the test. Many individuals have also experienced trauma, such as sexual abuse or assault, making pelvic examinations distressing; self-administered testing provides a less invasive alternative that can help alleviate these emotional barriers, encouraging more individuals to participate in cervical cancer screening.

2. Empower Clinic Staff with Visual Analytics to Enhance Cervical Cancer Screening Outreach

The Cascadia Health staff were enthusiastic to have a visualization for the HPV self-administered testing pilot, given its potential to significantly improve cervical cancer screening rates among their patients. Overall, Cascadia Health staff expressed strong support for the visualization tool, recognizing its potential to assist team members in improving cervical cancer screening participation. Panel coordinators will be the primary users of the dashboard as they are responsible for patient outreach needs. The primary care supervisor will manage the panel coordinators and oversee outreach efforts on a clinic population level. For some outreach programs, clinic care coordinators may also provide assistance if needed.

3. Leverage Key Measures to Enhance Cervical Cancer Screening Outreach and Patient Support

Key measures for monitoring cervical cancer screening progress include screening status, age, location, clinic, language spoken, mental health and substance diagnoses, and HPV vaccine history. These variables will enable clinic staff to identify patient groups eligible for cervical cancer screening and facilitate the ordering of HPV self-administered tests as needed. Furthermore, specific variables, such as language-spoken and any comorbidities, will assist the care team in recognizing and addressing potential patient-level barriers. By offering HPV self-test instructions in the appropriate languages and providing tailored support, the clinic can ensure that patients receive the necessary resources to participate in cervical cancer screening effectively.

4. Implement Data Visualization to Drive Cervical Cancer Screening Initiatives Across Organizational Levels

There are three areas where a clinic could implement the data visualization as developed: 1) To show preventive services metrics and progress to leadership and funders, 2) To show preventive services metrics and progress to the clinic providers and staff executing population management projects, and 3) To use the preventive services metrics to target certain patient groups for outreach.

The first utilization scenario for this data visualization is for the medical director to use it to discuss clinical metrics with leadership and funders at Cascadia Health to prioritize populations for outreach and targeted interventions. While it is known that cancer screening rates are lower at FQHCs, and the leadership at Cascadia Health is aware of this, seeing visualizations of the same data is often more impactful and meaningful. Having this data visualization accessible on demand is useful for discussions where the content may be discussed ad hoc. Additionally, having a visualization tool that can be easily updated means the medical director does not need to spend time ahead of a meeting asking staff to determine cervical cancer screening rates.

The second implementation scenario is for the medical director to use the data visualization to discuss cervical cancer screening measures with Cascadia Health providers and staff that may use the tools for outreach and interventions. Like the first situation, images of the screening progress can be more powerful than messages to simply increase cervical cancer screening. Of particular interest to the medical director was the field displaying Cascadia Health utilization in the previous year, which indicated many patients were seen by Cascadia Health providers who could offer them a self-administered HPV test during patient encounters.

The third use scenario is for the panel managers to use the data visualization to monitor their progress in cervical cancer screening and to determine what groups they need to target for more outreach. This outreach could be for initiating cervical cancer screening, by either scheduling a clinic

appointment for a pelvic examination and HPV test, or adding a self-administered HPV test order to the patient's existing medical appointment.

5. Coordinate Targeted Patient Outreach and In-Clinic Distribution to Accelerate Cervical Cancer Screening Uptake

Panel coordinators conduct phone outreach to patients who are due or overdue for cervical cancer screenings, ensuring that individuals receive timely reminders and support for their health needs. Care coordinators may also assist in these outreach efforts as needed, enhancing the initiative's overall effectiveness. For self-administered HPV tests, these will be provided in-clinic and distributed by providers or medical assistants, with orders written by panel managers to streamline the process and ensure that patients have access to the self-administered tests during their visits. This coordinated approach aims to improve screening rates and facilitate patient participation in cervical cancer prevention.

6. Monitor and Evaluate Cervical Cancer Screening Progress through Routine Data Updates

Panel managers will track outreach and screening progress, which is crucial for the successful implementation of the HPV self-administered testing pilot. To support this initiative, the dashboard will be updated every one to three months to accurately reflect current screening rates. As the SQL query is already developed, updating the data export requires only minimal data updates by the Cascadia Health BI team. These updates will necessitate periodic reports from the BI team, ensuring that the data remains relevant and actionable. This systematic approach to progress tracking and data visualization will enable the clinic to make informed decisions and continuously improve its cervical cancer screening campaign.

IV. LESSONS LEARNED

The collaboration with KPCHR and Cascadia Health has provided valuable insights into the unique challenges community clinics face when implementing new programs and tools. First, lack of clinic resources can impact the implementation and utilization of data visualization tools. Staffing issues, such as high turnover and insufficient personnel, complicate efforts to maintain timely and consistent progress. Compliance delays, such as obtaining necessary agreements for data transfer, can impede project timelines. Second, data management presents another set of challenges. Issues were encountered with data cleaning and missing data, which can both hinder the accuracy and effectiveness of the visualizations. Future research should address resource constraints and enhance data collection and management capabilities to ensure successful implementation and sustainability of data visualization tools in community clinic settings.

V. FUTURE PLANS

Cascadia Health's sustainability plan focuses on staffing and funding, and long-term engagement. First, Cascadia Health will fund four panel coordinator positions to ensure adequate outreach capacity. Second, ongoing training and support for users of the visualization will be provided to maximize the tool's effectiveness and maintain adherence to patient outreach protocols.

Looking ahead, identified patients from the visualization tool could also be connected to their follow-up care for cervical cancer screening (e.g., triage cytology, colposcopy) through Cascadia Health's partnerships with community-based organizations providing social and health services. The clinic staff could identify opportunities to tailor further cervical cancer screening interventions based on the data visualizations. Cascadia Health is also motivated to expand the use of data visualization tools to enhance other preventive services, specifically targeting colorectal cancer screening, including fecal testing and follow-up colonoscopies after abnormal fecal testing, as well as breast cancer screening through

mammography. Further, it may be most efficient to create one interactive data visualization that tracks all cancer screenings (particularly, colorectal cancer and breast cancer screenings). Accessing available data at the claims level could also be instrumental in demonstrating the tool's effectiveness in improving patient outcomes across a broader spectrum of health care services. Further research could help solidify the data visualization tool's applicability, ensuring long-term sustainability and relevance in optimizing patient care.

VI. SECTION 508 COMPLIANCE

This final report adequately addresses the required Section 508 accessibility standards. It was reviewed against the accessibility conformance checklists provided by the U.S. Department of Health and Human Services and run through the accessibility checker provided by the software program.

VII. CONCLUSION

In conclusion, this collaboration to develop and implement a data visualization tool for cervical cancer screening with Cascadia Health is set to significantly enhance outreach efforts and improve patient outcomes. This initiative aligns with Cascadia's commitment to address health disparities. The interactive dashboard, powered by Tableau and electronic health record (EHR) data, will enable the identification of specific patient groups requiring targeted screening interventions while presenting information in a user-friendly visual format. This tool will assist with population management and clinical care improvement, offering opportunities for enhancement at various levels – providers can inform individual patient care decisions, staff can leverage it for population-level outreach and intervention planning, and administrators can track screening rates and overall program effectiveness. By following a structured implementation framework that includes clinic staff engagement, integration with existing workflows, and regular evaluation, Cascadia Health aims to maximize the tool's impact. This data-driven

approach to cervical cancer screening represents an important step towards more effective, targeted, and equitable screening for Cascadia's patient population, ultimately contributing to improved health outcomes and reduced disparities in cancer care.

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