Implementing the 4 Pillars Practice Transformation Program at a Primary Care Practice

by

Yong Nam Jeon

Under Supervision of

Ngozi Osuagwu

Second Reader

Doris Titus-Glover

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Correspondence concerning this project should be addressed to Yong Nam Jeon, School of Nursing, University of Maryland, Baltimore. Email: yjeon@umaryland.edu

Abstract

Problem: Delayed pneumococcal and influenza vaccinations are a concern at a solo primary care office for patients 65 and older, highlighted by national data showing high mortality rates from influenza and pneumonia in this age group. In this solo primary care provider's office, the 2022 vaccination rates were 85% for the pneumococcal vaccine and 51% for the influenza vaccine among patients 65 and older. The main root cause of this issue is the limited time availability, as identified by the provider operating the solo practice. **Purpose:** This Quality Improvement (QI) project aimed to increase vaccination rates using the 4 Pillars Practice Transformation Program, focusing on strategies like Convenience, Patient Communication, Enhanced Vaccination System, and Motivation. **Methods:** Over a 15-week period, comprising 1 week of education and 14 weeks of implementation, evaluation, and data collection, the project focused on stakeholder education, staff motivation, distribution of educational materials, and immunization screenings during patient visits. Influenza vaccines were administered on-site, and referrals for pneumococcal vaccines were directed to a designated pharmacy. **Results:** The influenza vaccination rate increased from 51% to 60.5%. The rate was 70.6% up to Week 11, after which it declined due to vaccine exhaustion. Of 278 eligible patients, 224 were screened (80.6%). Among pneumococcal vaccine candidates, 38 patients were eligible; 25 accepted referrals, while 13 declined. The patient age range was 65-87, with a median of 69.5. **Conclusions:** The project notably improved vaccination rates in a solo primary care setting, achieving significant progress despite challenges like survey revision and vaccine exhaustion. The multifaceted approach led to substantial improvements in both screening and vaccination rates. This success offers valuable insights into public health practices, highlighting the potential to enhance vaccination rates and reduce vaccine-preventable diseases among elderly populations, thereby contributing to improved public health outcomes. **Keywords:** Elderly Vaccination, Primary Care, Quality Improvement, 4 Pillars Practice Transformation Program, Influenza Vaccine, Pneumococcal Vaccine, Immunization Rates, Public Health, Solo Practice Management.

Implementing the 4 Pillars Practice Transformation Program at a Primary Care Practice

Delayed pneumococcal and influenza vaccinations among elderly patients aged 65 years and older is an identified problem at the project site, a solo primary care physician office. Among the population aged 65 years of age and above, Centers for Disease Control and Prevention (CDC) (2020) reported a high mortality rate among elderly patients due to influenza and pneumonia, emphasizing the importance of vaccination in this population, and the mortality rate increased with age in both men and women. Vaccination against influenza and pneumonia significantly reduces pneumonia and influenza related hospitalizations (Heo et al., 2018). Therefore, a 100% vaccination rate is critical to reduce the risks of mortality and morbidity among this population.

In this solo primary care provider's office, the vaccination rates in this population show 85% for pneumococcal vaccine and 51% for influenza vaccine in 2022. The root causes of the problem have been identified by the provider operating the solo practice, as the lack of an alert system to recommend vaccinations, no ongoing feedback to staff regarding vaccination adherence, and immunization screening limited to annual physical exams, all of which are related to the limited time availability of the provider (see Figure 1).

The purpose of this project was to implement and assess the effectiveness of the 4 Pillars Practice Transformation (4 Pillars) Program in enhancing vaccination rates among elderly patients by addressing the root causes identified at the project site and reducing vaccine-preventable diseases such as flu and pneumococcal disease. The main process goal was to provide patient education materials and ensure 100% immunization screening for influenza and pneumococcal vaccines during every patient visit. The main outcome goal was to increase vaccination rates of pneumococcal and influenza vaccines among elderly patients of this solo

practice by 5 to 10%. The practice change implemented was a comprehensive, systematic approach to vaccination, integrating patient education, staff training, and regular immunization screenings beyond annual check-ups, thus optimizing every patient visit as an opportunity for vaccine assessment and administration.

Available Knowledge

The available knowledge, following an extensive appraisal and synthesis of evidence, substantiated the practice change executed in the project aimed at elevating vaccination rates among elderly patients at a solo primary care practice. The evidence supporting the 4 Pillars Program, which was adopted for this project, encompasses a range of evaluations demonstrating its success in various primary care environments (see Table 1). Significant studies by Zimmerman et al. (2017), Hawk et al. (2017), Nowalk et al. (2016), and Moehling et al. (2017), have affirmed the program's effectiveness in boosting vaccination uptake, particularly among elderly patients, offering level 1, quality A evidence of the program's significant impact when implementing multiple strategies. The synthesis also identifies additional studies that strongly affirm the efficacy of influenza and pneumococcal vaccines (see Table 2).

The synthesis firmly established the effectiveness of tailored, multi-faceted interventions in improving vaccination rates within targeted populations, especially among the elderly in primary care settings. The four pillars of the Practice Transformation Program including Convenience and Easy Access, Patient Education, Enhanced Vaccination System, and Motivation were well-matched with the needs identified at the project site.

In addition to the effectiveness of the 4 Pillars Program, the studies universally highlighted the critical role of context-specific adaptations in boosting vaccination rates. They

agreed that interventions must be deeply integrated with local healthcare practices and patient demographics to be most effective. For example, Zimmerman et al. (2017) emphasized the need for community-specific strategies, while Hawk et al. (2017) focused on the role of leadership and organizational flexibility in implementation success.

However, the studies differed in their prioritization of the four pillars based on setting characteristics. Some studies prioritized "Convenience and Easy Access" in urban settings with better healthcare infrastructure, while others found "Patient Education" more critical in rural or underserved areas where misinformation or lack of awareness was prevalent. These variances underscore the necessity of tailoring the 4 Pillars to fit the unique constraints and opportunities of each healthcare environment.

Customizing the program to the specific setting of the solo practice, particularly by addressing issues like limited staff feedback and the constraint of immunization screenings to annual physical exams, resonated with evidence suggesting that context-specific modifications are vital for intervention success.

The evidence strongly supports the project's strategies, notably the distribution of patient education materials and the optimization of every patient interaction for immunization screening. Studies such as Hawk et al. (2017) and Zimmerman et al. (2017) underscore the effectiveness of engaging healthcare staff and patients consistently at every touchpoint. Hawk et al. (2017) highlighted the critical role of personalized communication, while Zimmerman et al. (2017) demonstrated significant increases in vaccination rates when each patient visit was utilized as an opportunity for health promotion. Moehling et al. (2017) further corroborated these findings, showing that comprehensive education strategies that inform both patients and staff about the benefits and availability of vaccines can notably enhance vaccination uptake. These studies

collectively affirm that maximizing patient interactions for education and screening is a best practice in primary care settings, effectively increasing vaccination coverage.

Rationale

The intervention was expected to be effective based on the foundational principles of the PARiHS (Promoting Action on Research Implementation in Health Services) Framework, as elucidated by Bergström et al. (2020). This framework, essential in guiding the implementation of evidence-based practices in healthcare settings, revolves around three pivotal concepts: Evidence, Context, and Facilitation.

Firstly, the evidence aspect of PARiHS emphasizes the use of well-founded, empirical research to inform healthcare practices. In the context of this project, the evidence concerning the efficacy of influenza and pneumococcal vaccinations in reducing disease incidence and mortality among the elderly provided a solid basis for the intervention. Secondly, the context within which the intervention was executed played a critical role in its anticipated success. The specific environment of the solo primary care practice, with its unique challenges and opportunities, was considered conducive to the intervention's goals, given the priority placed on preventing and managing vaccine-preventable illnesses among this population. Lastly, the facilitation, as a core component of the PARiHS framework, refers to the strategies and processes employed to enable the adoption of evidence-based practices. In this project, facilitation strategies were integral and included patient education, immunization screening at every visit, and the coordination of referrals to a designated pharmacy for vaccinations.

In summary, the PARiHS framework provided a comprehensive theoretical basis for the project, guiding the integration of solid evidence, an understanding of the specific context, and

effective facilitation strategies to enhance vaccination rates among the elderly population in the solo primary care practice (see Figure 2).

Methods

Context

In the context of a solo primary care setting, various elements such as culture, climate, and resources significantly influenced the success of vaccination interventions among elderly patients. Cultural factors impacted attitudes and willingness to receive vaccinations, with some patients displaying hesitancy rooted in historical mistrust towards healthcare systems. Barriers like health literacy levels, access to healthcare, communication challenges, and personal beliefs about vaccines were pivotal in shaping their responsiveness to vaccination efforts. The perceptions of staff and patients towards vaccination, influenced by the project site's climate, also played a crucial role in the intervention's success. Additionally, the limited availability of the provider, who operated the solo practice, presented a significant resource constraint. Addressing this constraint by delegating tasks to other staff members and optimizing immunization screening processes increased the intervention's feasibility and effectiveness. Furthermore, the limited methods for patient education, the absence of alert systems, and the infrequency of immunization screening outside of annual exams posed additional challenges in effectively reaching the elderly population within this setting (see Figure 3).

Intervention

The implementation team consisted of the primary care physician, administrator, and support staff. Bingham strategies and tactics (Bingham, 2021) were utilized to achieve the project aims: accountability, buy-in, collaboration/communication, data, and education (see Table

3). The intervention began with educational training in Week 1, followed by a focus on monitoring and reinforcing strategies through regular communication and stakeholder re-evaluation during Week 5. In Week 15, the intervention impact was assessed through final data collection. The approach included staff training, motivational initiatives, patient education, and consistent immunization screening, alongside the on-site provision of the influenza vaccine. Since the project site did not administer pneumococcal vaccines, patients were referred to a designated pharmacy that accepts walk-ins for vaccination, thus facilitating ease of access (see Figure 4). While the original plan included alert message systems, the actual intervention shifted focus to more practical, on-the-ground strategies appropriate for the practice's setting. This included conducting immunization screenings at every patient visit, distributing patient education materials, and administering the Behavioral Risk Factor Surveillance System (BRFSS) 2009 Section 16: Immunization survey during the check-in process.

Measurement

To ensure inclusivity, all patients aged 65 and older were considered eligible participants, with no participant excluded during the intervention process. The effectiveness of the intervention was gauged using the Weekly Screening Rate and a modified approach for pneumococcal vaccination measurement, adapted due to the EMR system's inability to generate specific data for patients aged 65 and above in 2024. The pneumococcal vaccination assessment was thus focused on tracking referrals acceptance and declination. The BRFSS 2009 Section 16: Immunization survey (BRFSS screening tool), endorsed by the CDC (2017), facilitated patient-level data collection, with responses entered into the University of Maryland, Baltimore REDCap as an EDC (electronic data capture) tool for the Post Implementation Log (see Appendix A, B,

C). BRFSS forms were scanned into the EMR and securely destroyed after patient check-out, ensuring data integrity and patient privacy.

Ethical Considerations

Non-human Subject's Research determination from the Human Research Protections Office (HRPO) of the UMSOM Institutional Review Board (IRB) was obtained prior to project implementation (see Appendix D). This step was crucial in ensuring that the privacy and confidentiality of any potential human subjects were rigorously protected. Additionally, to address any potential ethical concerns, measures were put in place to safeguard the privacy of patients and maintain data confidentiality throughout the project.

To maintain ethical standards and protect patient privacy, all patient interactions, including surveys and vaccine administrations, were conducted in private examination rooms to ensure the utmost confidentiality. Staff members were also educated on privacy regulations and the expectations associated with data collection, reinforcing their commitment to patient privacy throughout the project's duration.

Results

During the 15-week project, significant updates were made to the structure and processes, resulting in improved vaccination rates among elderly patients. Notably, Week 5 marked the implementation of strategic revisions, including enhanced staff education and the introduction of new survey tools such as the Weekly Screening Rate. These adjustments also involved refining the questionnaire in the Post Implementation Log to improve data accuracy and patient engagement. These comprehensive changes laid the groundwork for sustained improvements observed in subsequent weeks.

The influenza vaccination supply encountered a significant challenge, nearing depletion by Week 11, which limited the number of vaccinations that could be administered in the subsequent weeks. Nevertheless, out of 278 eligible patients, 224 were screened for immunization, yielding an 80.6% screening rate. This rate represents a notable improvement, increasing from 71.7% during the first five weeks to 86.7% from Week 6 to Week 14, which underscores the success of our intensified screening efforts during the project (see Appendix E).

Of the 139 patients eligible for the influenza vaccine, the vaccination rate over the 14 weeks stood at 60.5%, with a peak rate of 70.6% observed from Week 1 to Week 11 before the vaccine supply dwindled (see Appendix E). On the pneumococcal vaccine front, out of 38 eligible patients, 25 accepted referrals to a pharmacy for vaccination, showcasing a proactive response to the external referral system.

These results, especially the acceptance and decline rates for pneumococcal vaccine referrals within the patient age range of 65-87 years (median age 69.5), shed light on patient willingness and access to vaccination services. Notably, 68% of patients aged 65-69 accepted the pneumococcal vaccination referral, whereas a significant 85% of older patients, aged 70-87, declined it. This trend indicates that the likelihood of declining the vaccine increases with age, a pattern that could inform future vaccination strategies. Additionally, the clear link between the strategic interventions, such as survey revisions, enhanced screening, and refined referral processes, and the vaccination outcomes emphasizes the impact of these strategies within the contextual elements of vaccine availability and patient demographics.

Unexpectedly, the depletion of the influenza vaccine supply by Week 11 presented a significant obstacle, impacting the overall vaccination rate. Yet, this challenge also acted as a catalyst for refining the screening process and optimizing the utilization of the remaining vaccine

doses. The fluctuations in vaccination rates, driven by the interplay between vaccine availability and the enhancements in screening procedures, highlight the dynamic nature of executing public health interventions in real-world settings.

The data analysis revealed a direct correlation between the implemented tactics and improved vaccination rates, despite the unforeseen hurdle of vaccine supply. The project's ability to adapt to these challenges and maintain high screening rates demonstrates the resilience and effectiveness of the chosen strategies within the specified context.

Discussion

The project successfully achieved its goal of enhancing vaccination rates among elderly patients through the application of the 4 Pillars Practice Program and Bingham strategies. Key interventions such as immunization screening, patient education, and the implementation of the BRFSS screening tool were instrumental in this achievement. Notably, there was an increase in influenza vaccination rates from 51% to 60.5% over 14 weeks, with a specific period of improvement observed from Week 1 to Week 11, where the vaccination rate peaked at 70.6%, although it was later impacted by vaccine supply constraints.

Financially, while a detailed cost/benefit analysis and return on investment (ROI) calculation extend beyond the project's scope, preliminary indications suggest that the increased vaccination rates could lead to long-term healthcare savings by reducing the incidence and associated costs of vaccine-preventable diseases among the elderly. The sustainability of the project's outcomes hinges on the continued application of these strategies, with potential for further refinement and expansion to enhance their effectiveness and adaptability to other settings.

Comparing the project's results with other publications reveals consistency with documented successes in improving vaccination rates among elderly groups. However, the project encounters differences in anticipated and observed outcomes, notably due to the unforeseen vaccine supply shortage, impacting the overall vaccination rate after Week 11. This highlights the external dependencies that can influence project outcomes.

The project has highlighted age-related patterns in vaccine referral acceptance that offer deeper insights into patient behaviors and may guide the development of future vaccination strategies. Our analysis reveals distinct differences in acceptance rates between younger and older segments within the elderly population, with a notable decrease in willingness to accept pneumococcal vaccine referrals as age increases. This trend underscores the necessity for tailored communication and intervention strategies to effectively address the varying levels of vaccine hesitancy across age groups.

Internal validity may have been influenced by factors such as the single setting's limited generalizability, potential biases in self-reported data, and the short duration of the project, which restricts the assessment of long-term impacts. Efforts to mitigate these limitations included rigorous data collection and analysis procedures, adaptation of interventions to the context, and regular monitoring and adjustment of strategies in response to emerging challenges and feedback.

The project demonstrates the effectiveness of tailored, evidence-based interventions in improving vaccination rates among elderly populations in a solo primary care setting. While achieving notable success, it also offers valuable lessons on the need for flexibility, continuous monitoring, and adaptation to enhance the robustness and applicability of similar initiatives in broader contexts.

Conclusion

The project presents a valuable contribution to healthcare by demonstrating a practical and effective strategy to improve vaccination rates in a primary care setting. It integrates the 4 Pillars Practice Transformation Program with Bingham strategies, providing a replicable model that enhances healthcare delivery, quality, safety, and patient outcomes, particularly for the elderly population. This approach directly supports the project's potential ROI. By increasing vaccination rates, the initiative not only helps prevent vaccine-preventable diseases among the elderly but also potentially reduces mortality risks associated with these diseases. While a detailed cost analysis is beyond the project's scope, preliminary data suggests that higher vaccination rates could significantly reduce healthcare expenditures by minimizing the incidence of serious complications and hospitalizations. Although not quantified directly, the prevention of severe disease manifestations indirectly indicates a positive impact on the survival rates of the elderly, aligning with broader goals to enhance life quality and extend the healthy years of seniors, thereby underscoring the economic viability and societal benefits of the project.

The sustainability and scalability of this project are among its significant strengths. The adaptable strategies implemented provide a solid foundation for applying similar interventions across diverse healthcare settings, suggesting that with continuous training and monitoring, these methods can be sustained and adapted to enhance public health impact. For practice implications, the project underscores the importance of routine screening, patient education, and strategic use of technology in vaccination campaigns. It advocates for a holistic and multifaceted approach to public health interventions, integral to future quality improvement (QI) initiatives, emphasizing the necessity to address vaccine hesitancy, optimize screening processes, and ensure efficient vaccine administration to improve vaccination rates.

Looking ahead, the project sets a precedent for future QI initiatives, encouraging further research in diverse settings and over extended periods. It highlights the importance of addressing limitations through robust data collection and expansion to multi-site studies to ensure the generalizability and applicability of the findings. Continuous adaptation and evaluation will be crucial in refining the intervention, ensuring it remains responsive to patient needs and healthcare trends, and maximizing its contribution to healthcare quality and patient safety.

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Table 1

Evidence Review Table

Citation: Zimmerman, R. K., Brown, A. E., Pavlik, V. N., Moehling, K. K., Raviotta, J. M., Lin, C. J., Zhang, S., Hawk, M., Kyle, S., Patel, S., Ahmed, F., & Nowalk, M. P. (2017). Using the 4 Pillars Practice Transformation Program to increase pneumococcal immunizations for older adults: A cluster randomized trial. *Journal of the American Geriatrics Society, 65*(1), 114-122. https://doi.org/10.1111/jgs.14451

Level: I

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The purpose of this study was to test the effectiveness of a step-by step, evidence-based guide, the 4 Pillars Practice Transformation Program, to increase adult pneumococcal vaccination.	Research: Prospective, randomized controlled cluster trial	**Sampling Technique:** Cluster sampling **Eligible Participants:** Seeking 10-15% absolute increase in vaccination rate and a minimum practice size of 100 patients, EMR use: EpicCare, Epic, Vernona, WI **Setting:** Primary care family medicine and internal medicine practices in Pittsburg and Houston **Excluded:** Patients aged <65 **Accepted:** Primary care practices (n=24) in total of individuals aged 65 and older (n=18,107) **Control:** n=11 in Year 1 and n=12 in Year 2 **Intervention:** n=13 in Year 1 and n=12 in Year 2 **Power analysis:** 80%	**Control Protocol:** No intervention group and in Year 2 controls were crossed over into active intervention **Intervention Protocol:** 4 Pillars Program in Year 1 and became maintenance group in Year 2: Pillar 1—convenient vaccination services; Pillar 2—communication with patients about the importance of immunization and the availability of vaccines; Pillar 3—enhanced office systems to facilitate immunization; Pillar 4—motivation through an office immunization champion **Treatment Fidelity:** Practices have been shown to improve implementation of	**Dependent Variable:** Delaying EMR data, age, and vaccination coverage DV Measure: Pneumococcal vaccination rates (PPSV and PCV)	**Statistical Results:** By the end of Year 2, 79% of practices (19/24) had PPSV rates at or above 70%, and 58% of practices (14/24) had PPSV rates at or above 80%. **Conclusions:** In a RCCT, the intervention and control groups increased PPSV vaccination in adults aged 65 and older. In a pre-post study, small to medium-sized private primary care practices using the 4 Pillars Practice Transformation Program improved PPSV and PCV uptake significantly more than similar practices that were in the maintenance phase of the study.

		power with an alpha of .05. Achieved. **Group Homogeneity:** Intervention/Control homogeneous based on demographic characteristics (date of birth, sex, race or ethnicity, health insurance coverage), office visits (dates), and vaccinations (vaccines given and dates)	interventions when they are well supported through a facilitator such as an immunization champion and specifically to increase pneumococcal vaccination using clinician education and financial incentives.		

Citation: Hawk, M., Nowalk, M. P., Moehling, K. K., Pavlik, V., Raviotta, J. M., Brown, A. E., Zimmerman, R. K., & Ricci, E. M. (2017). Using a mixed methods approach to examine practice characteristics associated with implementation of an adult immunization intervention using the 4 Pillars Practice Transformation Program. *The Journal for Healthcare Quality*, *39*(3), 153-167. https://doi.org/10.1097/JHQ.0000000000000071

Level: I

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The purpose of this study was to evaluate the intervention's implementation, using the 4 Pillars Program and increase adult vaccination rates in primary care practices.	Research: Prospective, randomized controlled cluster trial	**Sampling Technique:** Cluster Sampling **Eligible Participants:** At least one adult vaccination <50% and willingness to participate in the study to improve vaccination rates **Setting:** Primary care practices in Southwestern Pennsylvania and in Houston, Texas **Excluded:** Patients <=18 years old **Accepted:** 24 practices **Control:** 12 practices **Intervention:** 11 practices (One practice was not able to schedule an interview within the dedicated study period) **Power analysis:** Paired samples t-tests (alpha <.05). Achieved. **Group Homogeneity:** 4 practice characteristics; Quality Improvement History, Community and Practice Leadership, Immunization Champion Leadership	**Control Protocol:** No intervention group and in Year 2 controls were crossed over into active intervention **Intervention Protocol:** 4 Pillars Program in Year 1 and became maintenance group in Year 2 **Treatment Fidelity:** Four practice characteristics were identified from the thematic analysis of the interviews as being important to intervention implementation, namely, degree of quality improvement history, communication and practice leadership, Immunization Champion leadership effectiveness, and organizational flexibility.	**Dependent Variable:** 4 practice characteristics, practice type to gauge a practice's readiness for change DV Measure: Vaccination rates and RE-AIM Framework: Reach, Effectiveness, Adoption, Implementation, Maintenance	**Statistical Results:** High Implementer practices significantly increased average influenza uptake (3.0 percentage point difference; p = .038) and average Tdap vaccination rate (9.3 percentage point difference; p=.006) and Public/University practices significantly increased average Tdap vaccination rate (6.5 percentage point difference; p=.012), while Moderate and Low Implementer practices did not significantly improve rates for either vaccine. **Conclusions:** When designing future randomized cluster trials in primary care settings it may be useful to stratify practices not just by patient population and location, but also by practice type to gauge a practice's readiness for change. Practice characteristics such as

		Effectiveness, and Organizational Flexibility			experience with quality improvement or practice change research projects, leadership and communication style, organizational flexibility, as well as the potential effectiveness of the selected immunization champion may be critical factors in predicting success of the intervention.

Citation: Nowalk, M. P., Lin, C. J., Pavlik, V. N., Brown, A. E., Zhang, S., Moehling, K. K., Raviotta, J. M., South-Paul, J. E., Hawk, M., Ricci, E. M., Middleton, D. B., Patel, S. A., Ahmed, F., & Zimmerman, R. K. (2016). Using the 4 Pillars™ Practice Transformation Program to increase adult Tdap immunization in a randomized controlled cluster trial, *Elsevier, 34*(41), 5026-5033. https://doi.org/10.1016/j.vaccine.2016.07.053

Level: I

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The purpose of this study was to test the effectiveness of an intervention to increase adult Tdap vaccination that included the 4 Pillars Program, provider education, and one-on-one coaching of practice-based immunization champions.	Research: Prospective, randomized controlled cluster trial	**Sampling Technique:** Cluster Sampling **Eligible Participants:** >=18 years and >=1 time each year, >100 patients per practice **Setting:** Primary care practices in Pittsburgh and Houston **Excluded: <100 adult patients and >50% vaccination rates in participating practices** **Accepted:** 24 practices in total of 70,549 patients **Control:** 38,089 patients in Year 1 **Intervention:** 32,460 patients in Year 1 **Power analysis:** 80% power with an alpha of .05. Achieved. **Group Homogeneity:** Intervention/Control homogeneous based on demographic characteristics (date of birth, sex, race or ethnicity, health insurance coverage)	**Control Protocol:** No intervention group and in Year 2 controls were crossed over into active intervention **Intervention Protocol:** 4 Pillars Program in Year 1 and became maintenance group in Year 2: Pillar 1—convenient vaccination services; Pillar 2—communication with patients about the importance of immunization and the availability of vaccines; Pillar 3—enhanced office systems to facilitate immunization; Pillar 4—motivation through an office immunization champion **Treatment Fidelity:** Practices have been shown to improve implementation of interventions when they are well supported through a facilitator such as an immunization champion and	**Dependent Variable:** Delaying EMR data, age, and vaccination coverage **DV Measure:** Tdap vaccination rates	**Statistical Results:** At the end of the pre-post study comparing the Year 2 active intervention sites and the maintenance sites, individual site Tdap rates ranged from a low of 6.8% to a high of 79.5% **Conclusions:** Clinically and statistically significant improvements in Tdap vaccination rates were achieved in diverse primary care practices, including safety net clinics serving disadvantaged Hispanics, using an intervention that includes the 4 Pillars Practice Transformation Program and its online practice transformation dashboard.

			specifically to increase pneumococcal vaccination using clinician education and financial incentives.		

Citation: Hsiao, A., Hansen, J., Timbol, J., Lewis, N., Isturiz, R., Alexander-Parrish, R., McLaughlin, J. M., Gessner, B. D., & Klein, N. P. (2022). Incidence and estimated vaccine effectiveness against hospitalizations for all-cause pneumonia among older US adults who were vaccinated and not vaccinated with 13-Valent Pneumococcal Conjugate Vaccine. *JAMA Network, 5*(3), e221111. https://doi.org/10.1001/jamanetworkopen.2022.1111

Level: II

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The purpose of this study was to estimate the association between the incidence of hospitalized all-cause pneumonia and lower respiratory tract infections (LRTI) and PCV 13 vaccination among older adults.	Research: Retrospective, cohort study	**Sampling Technique:** Cross sectional sampling **Eligible Participants:** Patients born after 1936 with no known history of PPV23 or PCV13 receipt before age 65 **Setting:** Kaiser Permanente Northern California **Excluded:** Individuals who received PPV23 or PCV 13 before age 65 years and born before 1936 **Accepted:** 192,061 patients **Control:** 56,453 patients without vaccination **Intervention:** 135,608 patients with PCV13 vaccination **Power analysis:** Vaccination Effectiveness as (1-RR) X100%, significance defined as P<0.05. Achieved. **Group Homogeneity:** Intervention/Control homogeneous based on	**Control Protocol:** PCV13 unvaccinated **Intervention Protocol:** PCV13 vaccinated **Treatment Fidelity:** Related risk of first pneumonia or LRTI hospitalization of vaccinated and unvaccinated individuals was estimated using Poisson regressions adjusted for sex, race, ethnicity, age, influenza vaccine receipt, PPV23 receipt since age 65, pneumonia risk factors, health care use, and season.	**Dependent Variable:** PCV13 vaccinated and unvaccinated, ICD-9 and ICD-10 codes **DV Measure:** Vaccine Effectiveness (VE)	**Statistical Results:** PCV13 was associated with an adjusted VE of 10.0% (95% CI, 2.4-17.0; P = .01) against hospitalized pneumonia and 9.4% (95% CI, 2.1-16.1; P = .01) against hospitalized LRTI. **Conclusions:** PCV13 vaccination of adults aged 65 years or older was associated with significant reductions in hospitalizations for all-cause pneumonia and LRTI.

		demographic covariates included sex, race, ethnicity, and age			

Citation: Wateska, A. R., Nowalk, M. P., Zimmerman, R. K., Smith, K. J., & Lin, C. J. (2018). Cost-effectiveness of increasing vaccination in high-risk adults aged 18-64 years: A model-based decision analysis, *BMC Infectious Diseases, 18*(52). https://doi.org/10.1186/s12879-018-2967-2

Level: III

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The purpose of this study was to show 4 Pillars Program increases uptake of pneumococcal polysaccharide vaccine, influenza vaccine, and tetanus-diphtheria-acellular pertussis vaccine by 5-10% among adults with high-risk medical conditions, but its cost-effectiveness is unknown.	Research: Non-experimental study	**Sampling Technique:** Cluster sampling **Eligible Participants:** Patients with vaccination in high-risk adults aged 18-64 years **Setting:** Primary care practices **Excluded:** Age >=65 **Accepted:** 71,072 patients **Control:** 36,253 patients without the program **Intervention:** 34,819 patients with the program **Power analysis:** Not indicated. **Group Homogeneity:** Not indicated.	**Control Protocol:** With No 4 Pillars Program **Intervention Protocol:** With 4 Pillars Program **Treatment Fidelity:** Vaccination rates and intervention costs were derived from a randomized controlled cluster trial in diverse practices in 2 U.S. cities. A decision tree model estimated the cost-effectiveness of implementing the 4 Pillars Program in primary care practices compared to no program for a population of adults 18–64 years of age at high risk of illness complications over a 10-year time horizon.	**Dependent Variable:** 3rd Party Payer Perspective, 4 Pillars Program, No 4 Pillars Program **DV Measure:** Cost Per Person, 4 Pillars Program cost	**Statistical Results:** From a third-party payer perspective, which considers direct medical costs, the 4 Pillars Program cost $28,301 per quality-adjusted life year gained; from a societal perspective, which adds direct nonmedical and indirect costs, the program was cost saving and more effective than no intervention. **Conclusions:** The 4 Pillars Practice Transformation Program is a cost-effective or cost-saving strategy, depending on the perspective taken, for averting vaccine preventable diseases in adults aged less than 65 years with medical conditions that place them at higher risk for influenza complications.

Citation: Loong, D., Amiri, M., Saunders, H., Mishra, S., Radhakrishnan, A., Rodrigues, M., Yeung, M. W., Muller, M. P., Straus, S. E., Tricco, A. C., & Isaranuwatchai, W. (2022). Systematic review on the cost-effectiveness of seasonal influenza vaccines in older adults. *Value Health, 25*(8), 1439-1458. https://doi.org/10.1016/j.jval.2022.03.011

Level: II

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The purpose of this study was to assess the relative cost-effectiveness of all influenza vaccine options for older adults.	Research: Systematic review of quasi-experimental studies with meta-analysis	**Sampling Technique:** Convenience sampling **Eligible Participants:** Older adults aged >=65 years or general population studies with stratified data and results for older adults, All influenza vaccines approved for use in the target population in Canada/United States, Other approved vaccines, cost-effectiveness, cost-utility, or cost-benefit analyses **Setting:** Inpatient and outpatient settings in Canada, UK, and USA **Excluded:** Citation excluded based on title/abstract (n=1948) **Accepted:** Study reports included in review (n=27) **Control:** Comparator (TIV) **Intervention:** TIV-AD, QIV, TIV-HD **Power analysis:** Not indicated. **Group Homogeneity:**	**Control Protocol:** Use of TIV **Intervention Protocol:** Use of TIV-AD, QIV, TIV-HD **Treatment Fidelity:** The majority of studies (n = 24) had well-defined research questions and a clear description of the interventions. Most studies (n = 21) also reported incremental analyses, methods, and results of sensitivity analyses, and study.	**Dependent Variable:** Protection against influenza **DV Measure:** Quality-adjusted life-years (QALYs)	**Statistical Results:** The evidence suggests QIV, TIV-HD, and TIV-ADJ are cost-effective against TIV for a WTP threshold of $50 000 per quality-adjusted life-year **Conclusions:** Future studies should include new and existing vaccine options for broad age ranges and use more robust methodologies—such as real-world evaluations or modeling studies accounting for methodological, structural, and parameter uncertainty.

		Only 14 studies provided enough demographic information to assess whether the study populations were similar to the targeted adult populations of Canadian jurisdictions.			

Citation: Zimmerman, R. K., Moehling, K. K., Lin, C. J., Zhang, S., Raviotta, J. M., Reis, E. C., Humiston, S. G., & Nowalk, M. P. (2017). Improving adolescent HPV vaccination in a randomized controlled cluster trial using the 4 Pillars Practice Transformation Program. *Vaccine, 35*(1), 109-117. https://doi.org/10.1016/j.vaccine.2016.11.018

Level: I

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The purpose of this study was to evaluate an intervention using the 4 Pillars Practice Transformation Program to increase HPV, MCV, and Tdap uptake among adolescents in primary care practices.	Research: Prospective, randomized controlled cluster trial	**Sampling Technique:** Cluster Sampling **Eligible Participants:** Practices with at least 50 patients 11-17 years old with estimated vaccination rates less than national goals **Setting:** Primary care practices **Excluded:** Patients age 18 and above **Accepted:** 22 practices **Control:** 11 control sites **Intervention:** 9 intervention sites (2 sites dropped out) **Power analysis:** 80 % power with an alpha of 0.05 and a probability of vaccination in the control group to be 40% and in the intervention group to be 50% and an intracluster correlation (ICC) of 0.20. Achieved. **Group Homogeneity:** Intervention/Control homogeneous based on demographic characteristics: age (11–	**Control Protocol:** Control sites were informed by the research team that their intervention would take place the following year and were not contacted again until the end of the active study period when the primary contact for each practice was asked to complete a survey about strategies being used to promote adolescent vaccination. **Intervention Protocol:** Each site identified a Champion who was responsible for logging into the 4 Pillars™ Program website to register the practice, select strategies and access practice improvement resources. Other roles for the Champion included promoting implementation of chosen strategies, working to motivate the staff and participating in	**Dependent Variable:** Use of 4 Pillars Practice Transformation Program and implementation of >10 strategies from 4 Pillars Program **DV Measure:** HPV series initiation among adolescents	**Statistical Results:** Average baseline HPV initiation rates were 52.5% for intervention and 61.8% for control groups. After 9 months, the intervention sites increased HPV initiation 10.2 PP compared with 7.3 PP in control sites (P<0.001); HPV series completion rates did not differ between groups. **Conclusions:** Using >10 strategies from the 4 Pillars™ Practice Transformation Program is effective for increasing HPV series initiation among adolescents.

		13 years old and 14–17 years old), sex, race (white, non-white), and health insurance type (commercial vs. public, other).	biweekly telephone coaching with a research liaison. **Treatment Fidelity:** De-identified demographic, office visit and vaccination data were derived from EMR data extractions performed by the UPMC Center for Assistance in Research using the eRecord. Champions or a member of the office's leadership team in both the Intervention and Control sites completed a survey to report what strategies their practices were employing to improve adolescent vaccination rates at the end of the active study period.		

Table 2

Evidence Synthesis

Project Title: Reducing Vaccine Preventable Diseases with 4 Pillars Practice Transformation Program			
JHNEBP Model Level	**Total Number of Sources**	**Author and Quality Rating of each study**	**Synthesis of Findings**
Level 1 Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis	4 RCCTs (Zimmerman et al; Hawk et al; Nowalk et al; Moehling et al)	Zimmerman et al A Hawk et al A Nowalk et al A Moehling et al A	Four studies found that the 4 Pillars Practice Transformation Program improved vaccination uptake significantly. Hawk et al. (2017) found it may be useful to stratify practices by practice type to gauge a practice's readiness for change. Moehling et al. (2017) found using >10 strategies from the 4 Pillars Practice Transformation Program is more effective for increasing vaccination.
Level II Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	1 cohort study (Hsiao et al) and 1 systematic review of quasi-experimental studies with meta-analyses (Loong et al)	Hsiao et al A Loong et al B	Hsiao et al. (2022) focused on reducing vaccine preventable diseases such as pneumonia and lower respiratory tract infections. Loong et al. (2022) found cost-effectiveness of QIV, TIV-HD, and TIV-ADJ.
Level III Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or systematic review of qualitative studies with or without meta-synthesis	1 non-experimental study (Wateska et al)	Wateska et al C	Wateska et al. (2018) found the 4 Pillars Practice Transformation Program is a cost-effective or cost-saving strategy, depending on the perspective taken, for averting vaccine preventable diseases in adults aged less than 65 years with medical conditions that place them at higher risk for influenza complications.
Overall Quality Rating w/rational and Recommendation: A			
Recommendations Based on Evidence Synthesis: Strong, compelling evidence, consistent results: solid indication for a practice change. The 4 Pillars Transformation Program has strong evidences with 4 RCCTs for increasing vaccination rates in primary care practice. Revising 4 Pillars Transformation Program reflecting the site type and using >10 strategies from the 4 Pillars Program should be recommended.			

Table 3

Bingham ABCDE Strategies and Tactics

Action to Achieve Goals
Accountability 1. Define clear roles and responsibilities for promoting vaccination. Identify who will be responsible for assigning support staff to this task and tracking progress towards goals. 2. Define clear roles and responsibilities for referring patients to nearby clinics. Identify who will be responsible for providing information about nearby clinics and communicating this information to patients.
Buy-In 1. Work to incentivize the implementation of improving the vaccination rate in the practice including: lunch party when the practice achieves the project structure, process, and outcome goals.
Collaboration/Communication 1. Involve staff members in the development process, such as by soliciting their feedback on the process algorithm. Communicate the algorithm to all staff members who will be involved in educating patients on recommended vaccinations. 2. Work with staff members and providers to identify eligible patients and communicate the importance of vaccinations to them. Use multiple channels, such as posters, flyers, and patient education materials, to reach patients.
Data 1. Develop a system for tracking vaccination rates and identify any barriers to achieving high rates. Use this data to make improvements to the vaccination process over time.
Education 1. Provide training and education to staff members on the process during the implementation period and where to refer the patients for vaccination and obtain the education material

Figure 1

Fishbone Diagram

Problem Statement: Delayed pneumococcal and influenza vaccinations in the elderly

Outcome: Increase uptake of pneumococcal and influenza vaccines in the elderly

Setting and internal data: Primary care practice (solo practice) and 85% rates for pneumococcal vaccination and 51% for influenza vaccination among the elderly in 2022

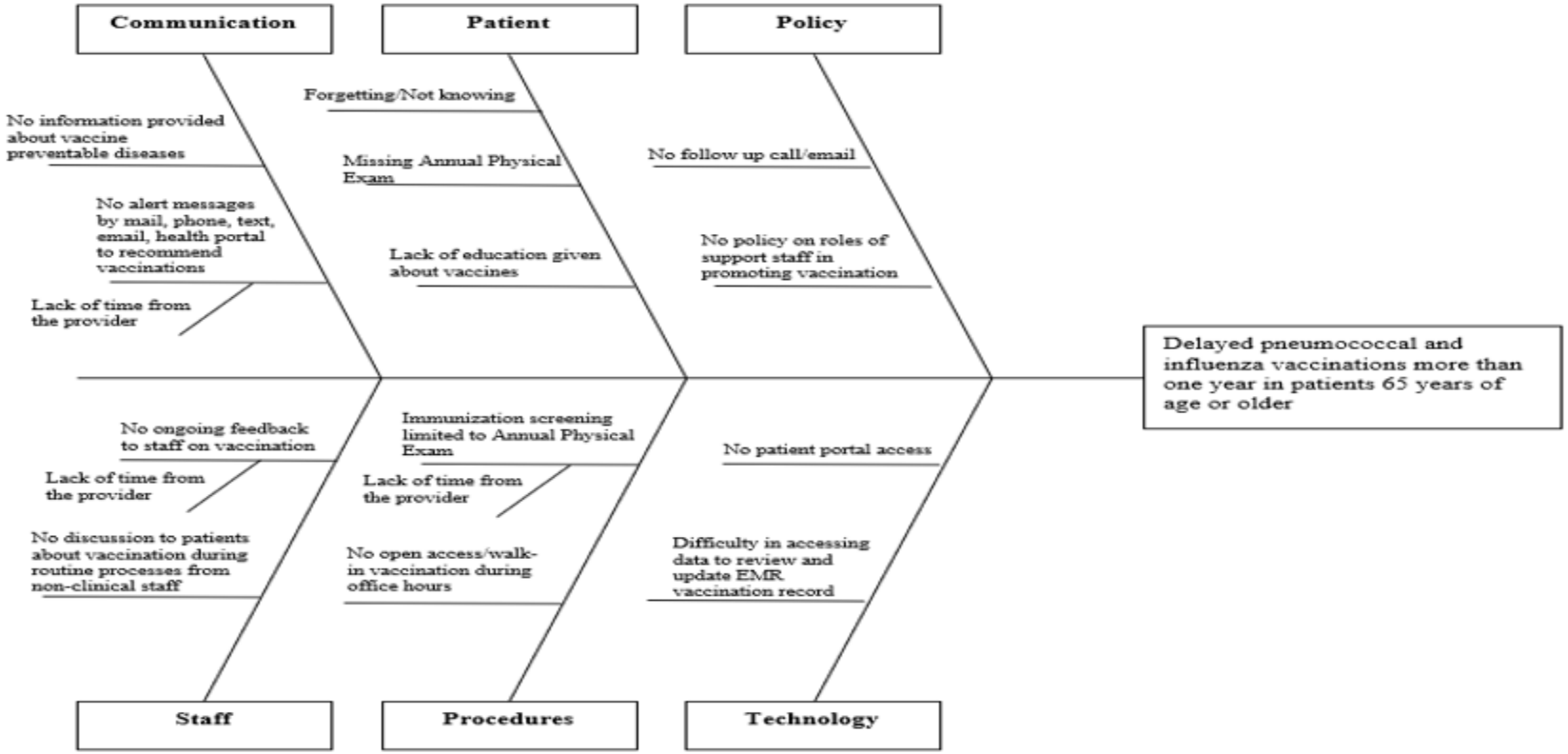


Figure 2

PARiHS Framework

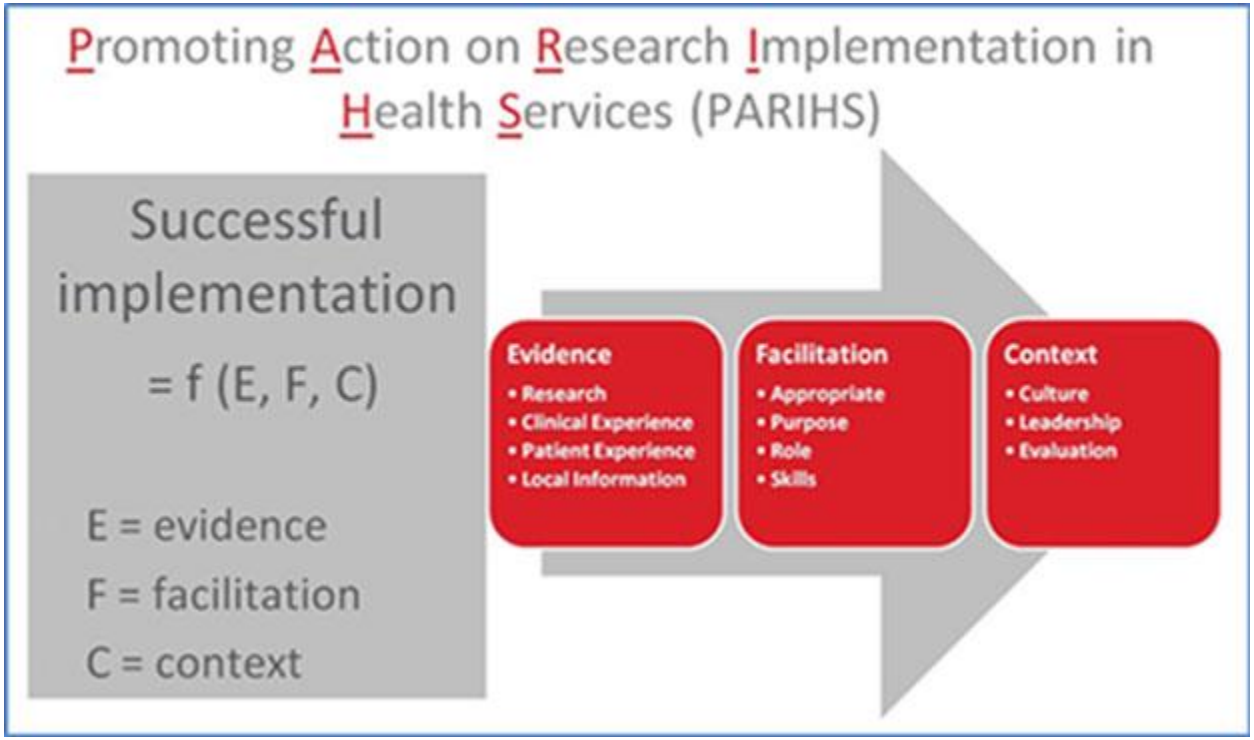


Figure 3

Previous Process Map

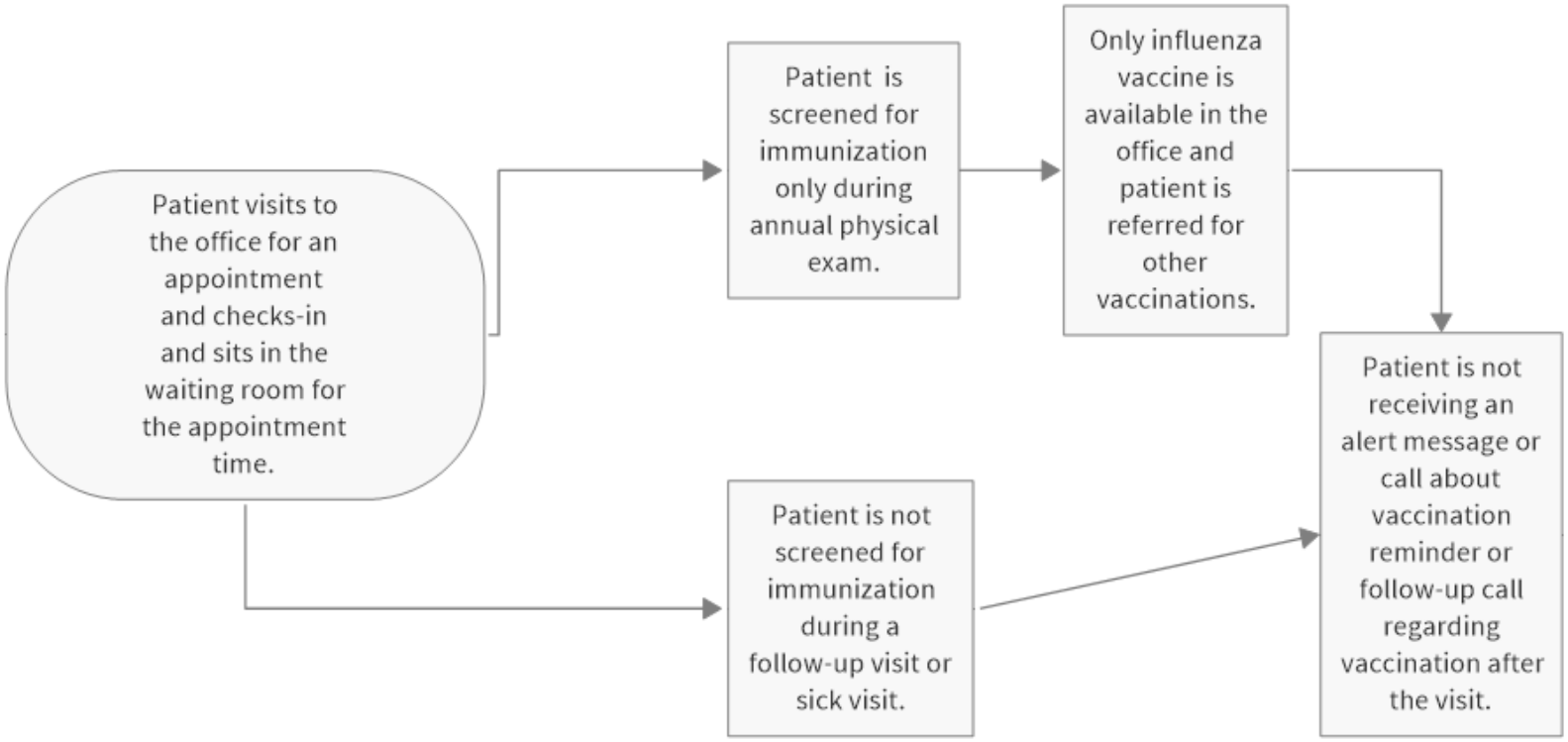
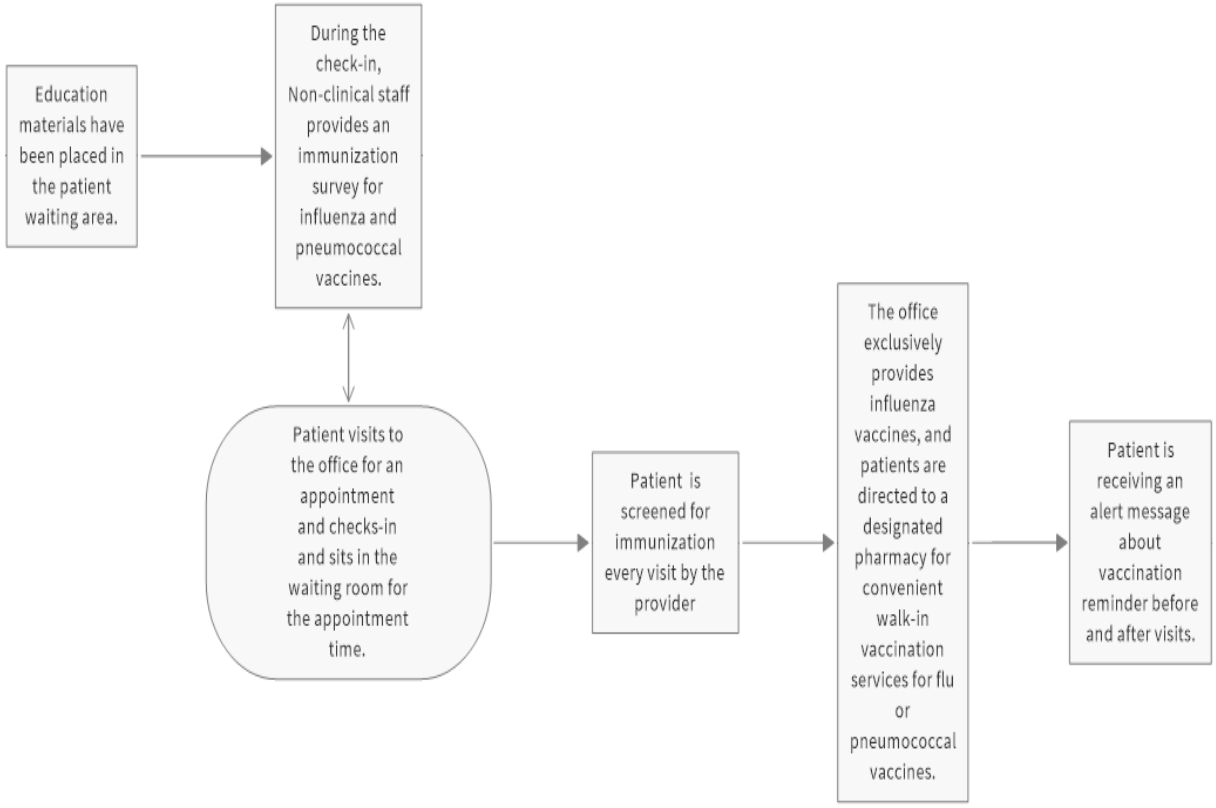


Figure 4

Desired Process Map



Appendix A

BRFSS 2009 Section 16: Immunization

Brfss 2009 Section 16 Immunization

Record ID	_____
16.1 A flu shot is an influenza vaccine injected into your arm. During the past 12 months, have you had a flu shot?	◯ Yes ◯ No ◯ Don't know / Not sure ◯ Refused
16.2 During what month and year did you receive your most recent flu shot?	◯ Choose to enter Month / Year ◯ Don't know / Not sure ◯ Refused
Month (example: for January enter 01)	_____
Year (example: 1999, 2006)	_____
16.3 During the past 12 months, have you had a flu vaccine that was sprayed in your nose? The flu vaccine sprayed in the nose is also called FluMist(TM).	◯ Yes ◯ No ◯ Don't know / Not sure ◯ Refused
16.4 During what month and year did you receive your most recent flu vaccine that was sprayed in your nose?	◯ Choose to enter Month / Year ◯ Don't know / Not sure ◯ Refused
Month (example:for February enter 02)	_____
Year (example: 1997, 2004)	_____
16.5 A pneumonia shot or pneumococcal vaccine is usually given only once or twice in a person's lifetime and is different from the flu shot. Have you ever had a pneumonia shot?	◯ Yes ◯ No ◯ Don't know / Not sure ◯ Refused

Appendix B

Post Implementation Log

Post Implementation Log

Please complete the survey below.

Thank you!

Date	_____
Gender	◯ Male ◯ Female
Age	_____
Was the patient screened for influenza and pneumococcal vaccines today?	◯ Yes ◯ No
Was the patient eligible for the influenza vaccine?	◯ Yes ◯ No
Was the patient eligible for the pneumococcal vaccine?	◯ Yes ◯ No
Did the patient receive the influenza vaccine today?	◯ Yes ◯ No
Did the patient receive a referral for the pneumococcal vaccine to the walk-in pharmacy?	◯ Yes ◯ No

Appendix C

Weekly Screening Rate

Weekly Screening Rate

Please complete the survey below.

Thank you!

1) Week _____

2) Total number of age-eligible patients _____

3) Total number of screened patients _____

4) Screening rate (%) _____ (%)

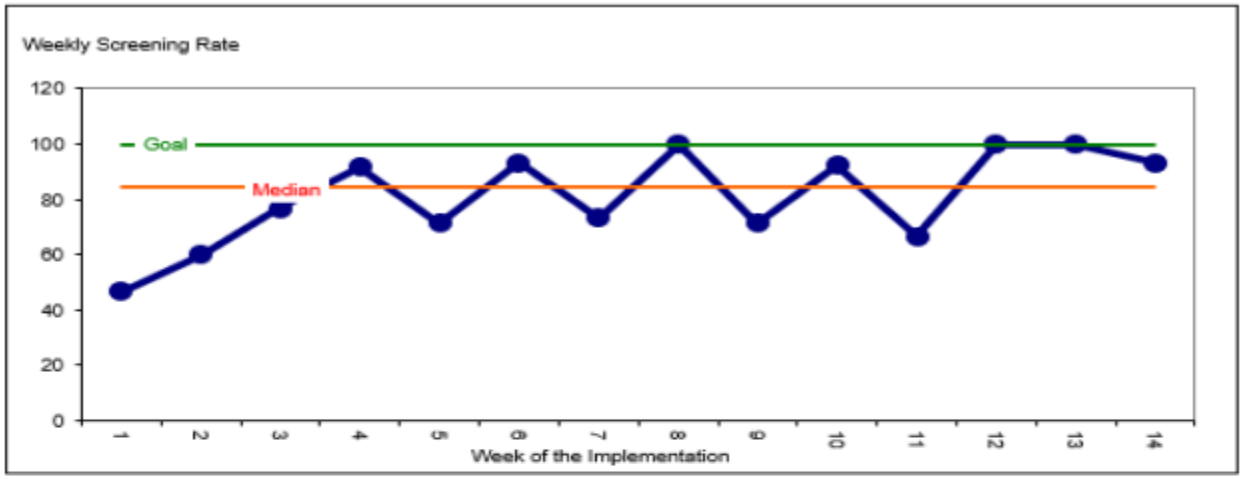
Appendix D

List of Site Ethics Procedures

- Institutional Review Board (IRB) approval: The project site should follow the IRB procedures and guidelines for the protection of human subjects, including privacy protections.
- Conflict of Interest Disclosure: All project site staff members involved in the QI project should disclose any actual or potential conflicts of interest that could affect the integrity of the project. This information should be documented and reviewed by the IRB.
- Data Security and Privacy: The project site should ensure that all data is collected, stored, and analyzed securely and confidentially.

Appendix E

Run Chart



We utilized the University of Maryland, Baltimore REDCap as an EDC (electronic data capture) tool.