

EVALUATING COMMUNICATION METHODS AND THEIR IMPACT ON
VACCINATION RATES IN EARLY CHILDHOOD

by

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ABSTRACT

Yearly vaccination against seasonal influenza is the most effective prevention against an illness with especially dangerous implications for young children. The Center for Disease Control and Prevention (CDC) recommends two doses of influenza vaccine in the first eligible flu season for young children under the age of two. Communication of reminders for the second dose can be an integral aspect of improving rates at which young children receive the recommended two doses of influenza vaccine. Not all methods of communication are as effective, and the understanding and evaluation of each respective method provides the healthcare professional with information about how to best reach their families/caregivers with important information. The purpose of this paper is to evaluate these methods as they pertain to not only influenza vaccination rates, but also other routinely recommended early childhood vaccines.

While technological advances have brought about many new and innovative ways to communicate with families, the literature suggests that reminder telephone calls remain the most effective method to communicate regarding vaccines which are due. New research is also emerging on this topic and will likely further guide the way in which healthcare providers communicate with their patients and families/caregivers.

Sustainable improvement in uptake of vaccine rates are specific to the type of vaccine. Trends specific to the seasonal influenza vaccine will also be evaluated through the course of this paper to identify and evaluate additional interventions which may be necessary to achieve sustained improvement to protect the youngest members of our population.

EVALUATING COMMUNICATION METHODS AND THEIR IMPACT ON VACCINATION RATES IN EARLY CHILDHOOD

Introduction

Accessible healthcare is critical to ensuring that children receive vaccines against preventable illnesses that can have major health implications, cause permanent harm or even death for the youngest, most vulnerable members of the population. In 2019 the World Health Organization (WHO) identified their top threats to global health (who.int, 2019). Among these threats were inadequate primary care systems, global influenza pandemic and vaccine hesitancy. All three of these threats have a significant link to accessible healthcare. Improving access to primary care impacts the health of the population.

Identifying effective methods of communication between health care professionals and patients/caregivers is essential. Specifically, the need to identify effective methods to reach caregivers with reminders regarding routine and seasonal immunizations. This action is especially critical for infants and young children receiving the influenza vaccine for the first time. The recommendation by the Center for Disease Control and Prevention (CDC) is that children under two whom have not received two flu vaccines before receive a second dose of the vaccine at least four weeks after their first dose (cdc.gov, 2019). Evaluating how various methods of communication with caregivers links to improved adherence of vaccination according to the CDC guidelines will be the focus of this paper.

Problem Statement

Influenza vaccination rates continue to be lower than most other routine recommended childhood immunizations, despite a goal of 70% set by Healthy People 2020. (healthypeople.gov., 2020). Most recent data from the 2016-2017 flu season showed 49.7% influenza vaccination rates nationwide. The current influenza vaccination rate at a pediatric primary care clinic in the western United States that serv as the setting of this project was 58% in the 2018-2019 flu season. Comparatively, the rates for DTaP and HiB according to CDC recommendation for young children were 82.5% and 80.9% respectively (healthypeople.gov, 2020). Local rates for these same immunizations were in 85%-87% range at last report. The recommendation for a second dose of influenza vaccine in the first eligible season (generally for young children between 6 and 23 months of age) calls for innovative communication methods on the part of the health care profession to ensure adequate protection from influenza.

Background

The recommendation for young children to receive a second dose of influenza vaccine in their first eligible season is important as it would protect our youngest and most vulnerable members of the population from the risks associated with influenza illness. Recent data regarding the rates at which eligible children were receiving the recommended two doses of influenza vaccine suggest that less than half of those who are initially given a dose of influenza vaccine subsequently receive a second dose in the same season (Nekrasova, et al., 2020). This trend may suggest a gap in the way that reminders

are communicated to parents when a second dose of influenza vaccine is indicated for their child. Reminder recall programs can be effective ways to communicate when a vaccine may be due (Frascella, et al., 2020) but as the methods of communication continue to evolve, healthcare professionals must also consider what is the preferred method of communication for their target population.

Purpose

The purpose of this project is to evaluate methods of communicating with parents regarding a second dose of influenza vaccine and the impact on rates at which eligible patients in the pediatric primary care setting receive the recommended second dose. Utilization of a standard telephone based intervention while evaluating preferred methods and the impact on uptake will both be discussed throughout the course of the project. Through evaluating different methods of communication and establishing preferred methods for individual families the pediatric primary care team aims to reach as many patients who are eligible for their second dose of influenza vaccine and establish uptake in overall immunization rates.

Significance

The impact of influenza related illness on the health of young children is profound; the virus often results in pneumonia and other respiratory illnesses accounting for more hospital admissions and outpatient visits than any other type of illness (healthypeople.gov, 2020). Every year influenza illness results in roughly 200,000 hospitalizations and 36,000 deaths nationwide (cdc.gov, 2019). Promotion of timely

vaccination against influenza for the youngest and most vulnerable members of the population is a high priority of public health agencies. Healthy People 2020 set lofty goals for improved influenza vaccination rates, with 70% as the goal listed in the report and most recent data suggesting rates of 49.7% for the 2016-2017 flu season (healthypeople.gov, 2020). Pediatric primary care practices have the ability to impact the low rates of immunization according to recommendation from the CDC. As technology advances the way in which healthcare professionals are able to reach their patients and families will evolve. For the success of an intervention multiple methods needs to be evaluated for preference and effectiveness along with fiscal feasibility and necessary resources for implementation. Using a one size fits all method of communication may not be the most effective, as previous studies suggest using a customizable approach to reminder recall programs (Nowalk, et al., 2016).

Receiving the influenza vaccine is an important public health intervention for pediatric patients, as vaccination against influenza remains the most effective measure available for preventing infection and minimizing severity of symptoms if infection occurs. Reported data as of January 18, 2020 showed that influenza illness and related complications caused 54 pediatric deaths so far during the current flu season with 143 and 188 pediatric deaths in each of the previous seasons respectively (cdc.gov, 2020).

Definitions

The premise of the project is to evaluate various methods of reminder recall for patients eligible to receive a second dose of the influenza vaccine. The key definitions

used throughout the evaluation and discussion of the project including the following terms discussed in this section.

- **Caregiver**-the custodial adult(s) responsible for the care and well-being of the patient (parent, grandparent, foster parent, other family member, etc).
- **Reminder/recall**- American Academy of Pediatrics (AAP) defines as “cost effective methods to identify and notify families whose children are due soon for immunizations (reminder) or already behind (recall)” (aap.org, 2020).
- **Preferred method of communication**-reported by the caregiver as their communication method of choice.
- **Successful telephone call**-one which the staff member is able to reach the caregiver directly. A voicemail does not meet the definition of a successful phone call for the purpose of this project.

Limitations

Expected limitations of this project are two-fold. First, resources and time will be significant limitations as the bulk of the callbacks are assigned to two staff members in the pediatric primary care clinic. Additionally, organizational limitations exist as the only approved methods of communication are currently telephone, mail or via the electronic health record (EHR).

Ethical Considerations

Influenza illness is a public health concern with particularly serious implications for the youngest members of the population. Young children are among the groups most profoundly impacted due to influenza illness and related complications. The influenza vaccine remains the most effective method of preventing infection and minimizing severity of symptoms if infection occurs, yet immunization rates remain low. Only about half of young children eligible to receive two doses of influenza vaccine get their second dose. Pediatric primary care practices should evaluate the methods of communicating reminders to their families and customizing those reminders in order to promote increased influenza vaccine rates according to recommendations from the CDC. Establishing a reliable system for reminder recall providing patients with time sensitive information like their child's influenza vaccine status stands to improve the overall health of the youngest members of the population by providing them with the best available protection against influenza infection.

REVIEW OF THE LITERATURE

Introduction

A search of the literature discussing the effectiveness of various methods of communication as it pertains to immunization rates overall and specifically influenza vaccination rates was conducted to evaluate the body of existing research on this topic. The following databases were searched: CINAHL, PubMed, Google Scholar, and Cochrane Review. The key terms in the search included but were not limited to the following: immunization rates, pediatric immunization rates, influenza vaccination rates, parents' preferences in communication, providers' preferences in communicating with families, reminder/recall for immunization rate improvement, cost-effectiveness of reminder/recall, text messaging as a reminder and e-mail-based reminders. Only studies published within the past five years were selected for synthesis. A total of 16 studies were included in the synthesis of the literature. Of these studies, 8 are specific to influenza vaccination rates and 8 discuss childhood vaccines in general. A key limitation of the review was the presence of several studies in pre-publication but not yet available in full text for review. This finding however suggests that a focus on identifying further trends in this area of healthcare delivery continues and additional recommendations for practice will likely emerge as a result.

Through the course of the review of the literature, three main themes emerged as central to the research. The themes which will be discussed throughout this review are as

follows: use of reminder/recall systems in an effort to improve overall immunization rates, various methods of reminder/recall and evaluation of effectiveness, cost effectiveness and parents' and providers' preferences. In addition to these themes in the literature, specific attention will be paid to influenza vaccine specific programs and how interventions to improve influenza vaccine rates may need to be approached with a different lens than those targeted at improving routine immunization rates in early childhood.

Reminder/Recall Systems

Reminder/Recall systems have been established as the leading intervention for vaccine uptake, with several studies citing that this intervention has been shown to be the most effective and cost-effective (depending on the method) when compared to other methods aimed at improving overall immunization rates in the pediatric population (Brown, 2017; Domek, 2016; Kahn, 2018; Kempe, 2017; Kempe, 2019; Lonergan, 2018; Rand, 2015; Sahni, 2016; Saville, 2016; Wallace, 2019). Reminder/recall programs are recommended to providers and practices by the U.S. Department of Health and Human Services' Community Preventative Services Task Force to increase vaccination rates (Frascella et al., 2020).

The structure of a reminder/recall system may be centralized or practice-based and the methods can vary from automated phone calls, live phone calls, postal mailers, email reminders, and text message reminders (American Academy of Pediatrics, 2020).

Overall and cost-effectiveness of centralized reminder/recall when compared with practice-based reminder recall was examined along with caregivers' and providers' preferences regarding reminder/recall origination (Kempe et al., 2017). The trials were conducted in Colorado and the centralized reminder/recall intervention was conducted utilizing the state-wide immunization information system (IIS). Each state in the United States has a state-wide immunization registry with the exception of New Hampshire, but the study found these systems to be an under-utilized resource in most areas.

These trials randomized a total of 41,819 children in 15 counties across Colorado into one of three sequential studies. The main findings suggested that not only were centralized reminder/recall programs more cost-effective than practice-based programs, they also had an average of 5% higher uptake in immunization rates when compared with the practice-based programs. Additionally, a survey of providers' attitudes concerning centralized reminder/recall programs demonstrated that 85% of providers either felt neutrally or in support of utilizing the immunization information systems and outsourcing reminder/recall to the local health department (Kempe et al., 2017). A second study aimed at assessing providers' attitudes towards centralized reminder/recall found that a majority strongly supported the idea of working with the health department if the practice name was still included in the reminder/recall notification (Saville, et al., 2016). This suggests that while providers see the benefit to utilizing the resources of the health department, most of them feel more comfortable with this notion if their practice name continues to be included in the conversation regarding reminder/recall for their patients.

Methods of Reminder/Recall. As technology has advanced and methods of communication become more diverse, another trend in research has emerged. Not all methods of communication have proven as effective with regard to reminder/recall. A systematic review which specifically evaluated email reminders (Frascella, et al., 2020) suggested the existing body of research pertaining to email reminders indicated that while email reminders tend to be more effective than no reminder, this mode of communication does not have the reliability of other methods. An additional review conducted by Jacobson, et al. (2018) concluded that the most effective method continues to be a live telephone call, followed by letters, text messaging, postcards and autodialed phone calls, “and that combinations of interventions were not as effective” (p. 434).

While telephone calls were identified as the most effective method, a survey of parents in a 2017 study showed that parents’ preferences did not necessarily align with efficacy. Bay, et al. (2017) tested multiple forms of communication to provide maximum uptake in influenza rates in a pediatric pulmonology clinic. At the end of the study period a survey was sent to parents and a resounding 80% of respondents cited email as their preferred method of communication, followed by text and telephone.

The disparity between efficacy and preference with regards to the method of reminder/recall should be considered when developing a communication program for vaccine uptake. Caregivers’ preferences should be considered, but research supports the utilization of telephone calls to promote timely administration of vaccines in early childhood.

Influenza Vaccine Specific Trends

Historically influenza vaccine rates have been an underperforming area for many practices caring for pediatric patients. With the success of reminder/recall programs on routine childhood immunization rates, it was hypothesized that the same success could be realized with the influenza vaccine (Kempe et al., 2019). A two-state randomized controlled trial with n=54,353 in one state and n=65,777 in the second showed little effect on influenza rates when compared with outcomes realized in like modeled studies evaluating routine immunization rates. These findings in this study indicated that there may be other factors which influence whether parents elect to proceed with influenza vaccination for their children (Kempe et al., 2019). Field et al. (2016) set out to evaluate the potential reasons for underutilization of influenza vaccination. The study team utilized a questionnaire which assessed parents' attitudes and perceptions toward both the vaccine and influenza illness and whether those attitudes impacted decision making regarding influenza vaccination. Key findings revealed that 46% of parents surveyed reported a "low perceived risk of influenza" and over a third of parents listed being "afraid of possible side effects" as a reason for not vaccinating against influenza. These findings suggest knowledge deficit regarding the implications for influenza illness in young children when compared with the potential risk for side effects from the vaccine.

Another challenge with influenza vaccination improvement efforts is sustainability. A seasonal influenza vaccine is recommended by the CDC each year for everyone 6 months of age and over (Centers for Disease Control, 2019). Sustainability of

a successful influenza vaccination intervention through maintenance monitoring was examined through the evaluation of vaccination rates across two influenza seasons. The baseline influenza data for all sites was 50.3%. The multi-strategy intervention focused on a process improvement toolkit, education for providers, early delivery of vaccines and planned feedback on progress. The team implemented interventions to improve convenience vaccine services, education for parents on the importance of yearly vaccination against influenza, enhanced office systems to facilitate immunizations and a program champion within each clinical site. During the maintenance year influenza vaccination rates had improved to an average of 61.1% across all sites. Uptake was highest amongst the youngest eligible patients, with 72.9% of children ages 6-23 months receiving the influenza vaccine in the maintenance year (Nowalk et al., 2016). The uptake realized in this study suggested that improving influenza vaccination rates required a different set of interventions than had been utilized when addressing rates of routine childhood immunizations.

Summary of Review

Reminder/recall programs have been shown to be highly effective and, if designed wisely, cost-effective interventions for the improvement of routine immunizations of early childhood. Despite the development of newer technologies which provide diverse methods of communication, a telephone call from either the public health department (centralized reminder/recall) or the provider's office (practice-based reminder/recall) remained the most effective across multiple studies in this review (Brown, 2017; Kempe,

2017; Loneragan, 2018; Rand, 2015). However, parents indicated that they preferred reminders via email in two studies (Bay, 2017; Rand, 2015) which suggests a disconnect between preference and effectiveness of an intervention. An improvement project aimed at uptake of immunization rates therefore needs to evaluate how to navigate this gap to best serve the customer while also delivering an evidence-based model of care.

Influenza vaccination rates proved to have variables unique to that vaccine and therefore require a more multi-faceted approach at improving uptake. Reminder/recall had little impact on influenza rates in a two-state randomized control trial (Kempe, et al., 2019) modeled after another trial which showed significant improvement in rates of routine immunization with reminder/recall programs in place (Kempe, et al., 2017). An innovative approach across 10 primary care sites focused on sustainability of improved influenza vaccination rates showed significant improved which was maintained beyond the intervention period utilizing a four-pillar approach to address potential barriers which prevented parents from vaccinating their children every year against seasonal influenza (Nowalk, et al., 2016). The literature supports innovative collaboration among primary care clinics in order to effectively address the complex challenge of sustained improvement of influenza vaccination for the youngest members of our population.

METHODS

Local Problem

Most healthcare organizations establish yearly goals for improving patient outcomes and the health of the community which they serve. A pediatric primary care clinic in the western United States which functions within a multi-site health system identified a local problem regarding immunization rates in early childhood. In recognizing this as a problem which impacts the health of the community at large, a goal for the clinic to “improve up-to-date vaccination rates by the 2nd birthday to 80% overall” was established by organizational leadership. Upon assessment of the individual immunizations, it was identified that influenza vaccination rates were significantly lower than other routine immunizations given in the first two years of life. The most recent data for influenza vaccination rates in patients <2 years of age was 58% during the 2018-2019 flu season. Comparatively, rates for other routine vaccines in the same patient population were in the 80% range. Further evaluation of the problem focused on patients in this age range whom had received their first dose in the season but did not receive the second dose per the recommendation of CDC. An opportunity for a simple intervention of a reminder/recall in the form of a telephone call to the caregivers of eligible patients was then identified. Evaluation of other potential methods of communication was also identified as a priority to provide the patients and caregivers in the local community high quality care for best possible outcomes.

Project Purpose

The aim of the proposed project outlined in this paper is to improve vaccination rates for children under 2 years of age to 80% by focusing specifically on influenza vaccination rates. The main intervention after evaluating the available methods of communication which are supported by the organization within which this project is proposed would be implementing a reminder/recall system in the form of a telephone call to caregivers of eligible children to promote timely administration of both doses of influenza vaccine. While the proposed project aims to promote a clinic goal, on a much larger scale aim is to promote public health and wellness by ensuring that the youngest and most vulnerable members of our community receive the most effective prevention against seasonal influenza illness.

Development and Planning

A reliable method of identifying patients whom are eligible to receive the second dose of influenza vaccine will be established within the existing electronic health record prior to implementation of the proposed project. Ongoing multi-disciplinary collaboration regarding the process in which this project would be integrated into the practice should be iterative; it is imperative that the reminder/recall intervention did not interfere with daily operations and that the process is reliable regardless of which staff are present. The project will rely heavily on generating a report of eligible patients, development of a script, and completion of the phone call as outlined by the project leader. Further, the iterative process will include ongoing evaluation of project and

effectiveness of the reminder/recall intervention as evidenced by vaccination rates and subsequent reports.

Identifying team members within the practice as champions will also be essential to the success of the proposed project. Additionally, education regarding the scripting and execution of the improvement protocol would be provided for all staff who may be carrying out the reminder/recall intervention.

Population and Setting

The target population for the proposed project is children under the age of 2 years whom have not yet received both doses of seasonal influenza vaccine. The proposed setting is a pediatric primary care clinic in the western United States within a small multi-site health system. The proposed practice site serves approximately 5,000 patients from birth to 19 years of age according to a 2019 microsystem assessment. The professionals within the practice consist of six pediatricians, one nurse practitioner (FNP) and one physician's assistant (PA-C) along with nine registered nurses.

Plan-Do-Study-Act (PDSA)

The Plan-Do-Study-Act (PDSA) cycle would be used throughout the planning, implementation and evaluation of the proposed cycle. This model is widely used in healthcare and is utilized locally. The proposed site for this project has full PDSA toolkits available for all quality improvement projects implemented within the organization.

By utilizing the PDSA model the team may discover other interventions are necessary for sustained improvement in influenza vaccination rates. Using an iterative approach like the PDSA model allows for appropriate evaluation of the effectiveness of each intervention to maximize the impact at each phase. Support from the quality department as well as clinic leadership to evaluate each PDSA cycle would be crucial for the success of this project. Frequent communication with staff regarding successes and/or setbacks may also be helpful to the team in identifying additional adjustments which may optimize the process.

Data Analysis

The clinical informatics team will be responsible for analytics of this quality improvement project. Standard descriptive statistics will be utilized to describe the population. Group differences will be analyzed using standard psychometric measures.

Role of the Clinical Nurse Leader

Utilizing the Clinical Nurse Leader (CNL) as the team leader on this project is consistent with the roles of the CNL as outlined by the White Paper on the Education and Role of the Clinical Nurse Leader (American Association of Colleges of Nursing, 2007). Specifically, the roles of the CNL as a clinician, outcomes manager and team manager would be critical to the success of the project in the clinical setting. While the CNL is a graduate level prepared nurse, the role was designed to support care delivery at the point of care. According to the Competencies and Curricular Expectations for Clinical Nurse Leader Education and Practice (American Association of Colleges of Nursing, 2013), the

CNL “assumes accountability for patient-care outcomes through the assimilation and application of evidence-based information to design, implement, and evaluate patient care processes and models of care delivery” (p.4) and should be a part of a care team which is at the point of patient care. For the purposes of the proposed project, the CNL would be a valuable member of the team to help facilitate multi-disciplinary collaboration and evaluate effectiveness of communication methods as well as suggesting additional interventions which may contribute to further uptake in influenza vaccination rates for the pediatric population.

Continuous evaluating of the process and identifying potential areas for improvement often come from those at the point of care in high functioning microsystems (Sprankle et al., 2015). This principle further supports utilizing the CNL as a leader in process improvement.

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APPENDIX

LITERATURE REVIEW TABLE

Author, Title, Journal	Year Published	Purpose	Variables		Subjects			Data		Comments
			Independent	Dependent	# of subjects	Characteristics	Sample design	Source/Instrument	Yr data collected	
Baskin, E., Increasing influenza vaccination rates via low cost messaging interventions, <i>PLOS One</i>	2018	To evaluate the effectiveness of email communication including various types of information regarding university held vaccine clinics	Standard email Incentive for vaccine email Negative impacts of influenza illness email Map included in email	Whether the recipient of the email received a flu vaccine	30,748	Students, faculty and staff at a large university 18% undergrad students 23% graduate and professional students The remainder of the study sample consisted of staff and faculty	Random sample; Emails were divided into 12 conditions in a 2x3x2 design	Vaccination rates depending on which condition individuals were randomized into	2014 - 2015 influenza season	Study findings: Increased flu vaccine rates only in the email group which received a map to locations of flu clinics on campus suggesting an increased likelihood to receive a flu vaccine based on perceived convenience
Bay, S. & Crawford, D.J., Using technology to affect influenza vaccine coverage among children with chronic respiratory conditions, <i>Journal of Pediatric Health Care</i>	2017	Utilizing a multicomponent strategy for uptake of influenza vaccine	Text and email messaging initiated through the EMR Embedded links to community resources within the messages Follow up survey sent out two months later	Influenza vaccination rates	Email: 3,140 Text: 75 Survey respondents: 107	All patients of the chosen site received the intervention, no exclusion criterion noted. The study site was a pediatric pulmonology clinic. 75% of patients had a diagnosis of asthma	Mixed methods; Email and text messaging provided to all patients initiated via the patient portal in the EMR Follow up survey regarding parents' perceptions of the	Measurement of successfully delivered messages compared with attempted messages; survey measured parent's recall of the intervention, whether the patient received a flu	2015 - 2016 influenza season	Study findings: delivery of messages was efficient and required few resources, are cost effective 80% of survey respondents stated that their #1 preferred method of commun

						and the other 25% had a chronic respiratory condition other than asthma	intervention	vaccine, caregiver opinions regarding the flu vaccine and communication preferences		ication was email, followed by text and telephone
Brown & Oluwatosi, Feasibility of implementing a cellphone-based reminder/recall strategy to improve childhood routine immunization in a low-resource setting: A descriptive report, <i>BMC Health Services Research</i>	2017	To evaluate the feasibility of a cellphone-based reminder/recall program in an area with fewer available resources than had previously been studied	Control vs. intervention Intervention: phone call reminders to the cellphone number on file when patients were due for their immunization visits	Completion of vaccines per recommended schedule	595	Equal distribution of gender, family type, education level of mother, and mother's employment status across control and intervention group	Mixed methods, random cluster sample at the regional level and purposive sampling at the clinic level	Three questionnaires were used to collect data regarding demographics and checklists for tracking phone calls and immunization visits	8/2012-2/2014	Study findings: Even in areas of lower resources, almost all (99.2%) of mothers had access to a cellphone with a valid number. Of 974 reminder calls made, only 4.2% (41 calls) were not received. Completion of immunizations according to recommended schedule was 79.2% for intervention group and 46.4% for the control group
Domek, et al., SMS text message reminders to	2016	To evaluate the effectiveness of SMS-	Control vs intervention group (receive	Text message delivery, impact of the	321	Mean age at enrollment 9.5 weeks,	Random sample; computer generat	Completion of routine infant vaccines in	2013	Study findings: No statistically significant

improve infant vaccination coverage in Guatemala: A pilot RCT		based reminder system for completion of infant primary vaccine series	and a series for SMS text messages prior to their child being due for next in series of immunizations)	text reminders, parent satisfaction		Male 48.4% Female 51.6% 53.8% with 0 siblings, 44.1% with 1-3 siblings, 2.2% 4+ siblings	used randomized assignment scheme to assign eligible patients; investigator blind selection	intervention vs usual care group Parents' satisfaction with the intervention		not increase in completion of routine immunizations in either group, statistically significant increase in parent satisfaction in the intervention group
Field, S.S., Reasons for influenza vaccination underutilization: A case-control study, <i>American Journal of Infection Control</i>	2016	To evaluate potential reasons for underutilization of influenza vaccine	Positive cohort vs Negative cohort	Reasons for not receiving influenza vaccine	131	Ages 9 months-18years, equal distribution of race and gender	Convenience sampling of patients who were tested for influenza in 2012-2013 influenza season	Questionnaire assessing need/attitudes toward influenza vaccine; history of influenza illness	2012 - 2013 influenza season	Study findings: 46% of parents with low perceived risk of influenza Over a third of parents listed "afraid of possible side effects" as a reason for not vaccinating
Kahn, et al., Association between patient reminders and influenza vaccination status among children, <i>Vaccine</i>	2018	To identify the proportion of children for whom a reminder for influenza vaccine was received and whether receipt of a reminder	Survey which assessed whether 1) parents had received a reminder about influenza vaccine 2) If so, how were they	Receipt of influenza vaccine and when	n=33,538	Children ranging in age from 6 months-17 years from all 50 states and the District of Columbia, equal distribution of male and	National list-assisted randomized dialed frame land line and cell phone survey	Data from the National Immunization Survey-Flu (NIS-Flu) were tested using Wald chi-square tests and pairwise comparison	2014	Study findings: 22% of parents in the United States received reminders for influenza vaccine, vaccination coverage 73.7% when a reminder

		is associated with vaccination status	contacted 3) who sent the reminder			female patients		son t-tests		was received vs 55.5% when no reminder was received, 66.3% of reminders came from providers' offices
Kempe, et al., Centralized reminder/recall to increase immunization rates in young children: How much bang for the buck? <i>Academic Pediatrics</i>	2017	To evaluate effectiveness and cost effectiveness of reminder/recall programs using centralized systems vs practice-based systems to improve immunization rates	Trial 1) centralized reminder/recall vs. practice-based 2) levels of C-R/R intensity 3) C-R/R with versus without the name of the child's provider	Optimal intensity of reminder/recall systems	15 counties in Colorado (7 urban and 8 rural) n=41,819 children	Children ranging in age from 19-35 months, 51% UTI, 93% white, 1% black, 3% other, families with median income of \$55,825	Sequential cluster random sampling within the counties; purposive selection of counties to minimize confounding factors	Cost-benefit analysis of utilizing central reminder-recall systems vs practice-based systems Survey of providers' attitudes regarding centralized R/R programs	March 2013 - May 2014	Study findings: Centralized R/R programs are much more cost effective than practice-based programs 85% of providers either preferred or were "okay with" C-R/R
Kempe, et al., Centralized reminder/recall to increase influenza vaccination rates: A two-state pragmatic randomized trial, <i>Academic Pediatrics</i>	2019	Assessing the impact that centralized reminder/recall programs has on influenza vaccine uptake compared with usual care	C-R/R vs usual care. Usual care 1 reminder 2 reminders 3 reminders	Influenza vaccine rates	CO n=65 primary care practices, 54,353 patients NY n=123 primary care practices, 65,777 patients	Age 6months-17.9 years, predominantly urban (85% in CO, 87% in NY) practices, mostly pediatric practice in NY (77%) and equal distribution between family medicine and pediatric practice	Randomized at the practice level into one of four arms of the study	Documentation of at least one influenza vaccine during the study period, timelines of vaccination and effectiveness within subgroups	10/2016-1/2017	Study findings: Limited effect on influenza vaccination rates in both CO and NY compared with effect realized in other studies on routine vaccination rates

						in CO (35% and 46%)				
Lonergan, et al., Implementing the evidence: Are call/recall systems for immunizations feasible in general practice? <i>Vaccines and Immunology Open Access Journal</i>	2018	To describe how general practice providers across London, UK are utilizing call/recall programs for vaccine uptake	N/A-qualitative study	N/A-qualitative study	1,301 general practices in London, UK	25 general practice managers participated in the in-depth interviews	Purposive sampling; 53% response rate with 684 general practice respondents responding to initial survey	Survey, in-depth telephone interviews to identify barriers to call/recall utilization as well as common themes for use of call/recall programs	10/2016-2/2017	Study findings and important themes: Letters and phone calls are better than texts Call/recall programs varied by practice General practice providers felt that "chasing patients" was not effective
Nowalk, et al., Maintenance of increased childhood influenza vaccination rates one year after an intervention in primary care practices	2016	Evaluating sustained effectiveness of a multi-strategy intervention aimed at improving influenza rates	Intervention year vs maintenance year Provider education, feedback on immunizations given, adequate supply to underserved communities	Influenza rates and rates of sustained improvement	10 sites	Eligible sites had access to immunization records via EMR, serve at least 200 eligible children, willingness to participate is established	Optimal design software was used to calculate necessary sample size to achieve 80% power, sites were randomized into 1- or 2-year intervention	Paired t tests were used for between-year comparison and Cochran-Armitage trend test was used to examine trends in vaccination rates over the 3 study periods	2011 - 2012 and 2012 - 2013 influenza seasons	Study findings: Baseline influenza vaccination rate: 42.2% avg Sustained improvement to 54.9% avg Uptake highest among 6-23 months of age
Rand, et al., Parent preferences for communicating with their adolescent's provider using	2015	To assess the view of parents of adolescents on means to communicate about	Reminders about vaccinations that are due, scheduling vaccine appts, obtaining refills,	Parents' preferences for communicating with their adolescent's provider	400	200 urban parents, 200 suburban; Predominately mothers (88%); 74% public	Cross sectional survey	Survey Monkey survey tool used to collect data during health care visits for their	2011	Study findings: Text messaging was used most amongst both groups (93% urban,

new technologies, <i>Journal of Adolescent Health</i>		vaccine reminders	and receiving lab results			insurance in the urban group, 88% private insurance in the suburban group		adolescent child		96% suburban) Urban parents preferred telephone communication for all reminders and scheduling. Suburban parents preferred scheduling via phone, but email for vaccine reminders, etc.
Rao, et al., Be influenza I: Evaluation of a multifaceted intervention to increase influenza vaccination rates among pediatric inpatients, <i>Vaccine</i>	2020	To evaluate a multifaceted approach to improve influenza vaccination rates among hospitalized children	Pre-and post-intervention Web-based education, reminders, huddles, vaccination reports, lists in EMR	Influenza vaccine rates among hospitalized children	8,573	Mean age 7.6 years, Mean stay 55 hours, equal distribution of gender, insurance type, admission type across both groups	Prospective pre-post intervention	Standing order use when nursing interventions used, influenza orders placed when evaluating provider performance, flu shot administered	2017	Study findings: Vaccine rates for eligible children increased from 28.8% pre-intervention to 50.2% during the intervention period
Sahni, et al., Understanding the financial implications of	2016	To evaluate the financial impact through revenue	Standard reminder recall (control) vs enhance	Scheduled appointments as a result of the	1,892	Equal distribution of demographic heterogeneous	Random sample; computer generated	Well-child appts scheduled and revenue generated	2008	Study findings: Reminder recall programs are at least

immunization reminder/recall in a multi-practice pediatric group, <i>Academic Pediatrics</i>		generated from well-child checks scheduled as a result of a reminder/recall program	d reminder recall (intervention)	intervention Revenue generated		characteristics across both groups; mix of public and private payor distributed equally across both groups	assignment to standard or enhanced reminder recall group	d for each group, comparison of financial implications vs effect on appointment scheduling for enhanced reminder recall vs standard		financially neutral and may actually generate additional revenue; no statistically significant difference between enhanced and standard reminder recall
Saville, et al., Provider preferences and experiences with a countywide centralized collaborative reminder/recall for childhood immunizations, <i>Academic Pediatrics</i>	2016	To assess provider preference regarding centralized reminder/recall conducted by the health dept and experiences with different methods of reminder/recall	N/A-qualitative	N/A-qualitative	229 providers	120 Urban clinics, 19 Rural; 33 male providers. 104 females; 36 pediatric practice, 89 family medicine, 12 multispecialty	Convenience sample of all 229 practices across 7 intervention counties	Survey mailed to all intervention practices from a previous RCT; measuring attitudes and experiences with centralized R/R	2014	Study findings: Most surveyed providers supported C-R/R when compared with practice-based R/R Preferred to have their practice name included in notification from PHD
Szilagyí, et al., School located influenza vaccinations: A randomized trial, <i>Pediatrics</i>	2016	To evaluate how offering influenza vaccine in school-based clinics impacted overall rates	Control vs. intervention group Predictors of vaccination (age, urban vs. suburban, hx of receiving flu shot)	Influenza vaccination rates	11,227 students across 24 suburban schools and 8,549 students across 20 urban schools n=19,776	Mean age: 8.08 years in suburban schools 8.35 years in urban schools Eligible for free/reduced lunch: 28% in suburban schools	Random sample; computer generated number allocation to determine whether a school would be control or intervention	Vaccine received in school; vaccine received in primary care; vaccine received anywhere	2014 - 2015 influenza season	Study findings: increased overall flu vaccine rates in both suburban and urban schools enrolled in the intervention group

						89.5% in urban schools	tion group			
Wallace, et al., Home-based records and vaccination appointment stickers as parental reminders to reduce vaccination dropout in Indonesia: A cluster-RCT, <i>Vaccine</i>	2019	To establish the effectiveness of home-based records and enhanced home-based records with immunization appointment stickers	Control group vs. intervention groups Home based record only vs. enhanced home-based record with immunization appointment stickers	Timeline of completion of vaccine series	3,616	Equal distribution across all three groups regarding age, gender	Random cluster sample; randomization at the health facility level Purposive selection of West Java province in Indonesia to achieve sufficient sample size	Receipt of recommended vaccines Timeline of receipt of the vaccines	2016	Study findings: The HBR+ sticker-based reminder led to higher rates of timely completion of recommended vaccines than the control group