

# Findings Report: 2D Vaccine Barcode Scalability Pilot



## Prepared for

Immunization Services Division  
National Center for Immunization and Respiratory Diseases  
Centers for Disease Control and Prevention

## Prepared by

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May 2018



These bad boys are  
a game-changer



*Pilot Participant*

## 2D Barcode Scanning: The Need, Current Pilot and Findings At-A-Glance

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### Issue

- >100 million vaccines administered annually in the US
- Most vaccines in ambulatory settings still manually recorded (typed into electronic medical records), with documented entry errors and inefficiencies
- Lot number, expiration date, and product ID printed in small font to fit on vaccine vials/syringes
- Scanning used in other contexts to aid patient safety
- Accuracy of vaccine records critical to patient safety and in the event of vaccine recall or disease pandemic

### Opportunity

- 2D barcode scanning technology is available and 2D barcodes are now on most vaccine products, but scanning is not widely used
- Two previous CDC pilots of 2D barcode scanning found improved accuracy, time savings, and user satisfaction, but challenges to implementation remained, including low scanning rates
- Even small improvements to vaccine record accuracy or efficiencies can have meaningful impact due to volume of vaccines and consequences of inaccuracies

### Current Pilot

- CDC partnered with a large health system to pilot 2D barcode scanning implementation across 27 diverse care centers (2015 – 2017); care centers varied by specialty, size, vaccine volume, geographic location
  - Adherence strategy groups added to pilot to assess whether implementation changes could improve scanning rates
- Data collected: deidentified EMR vaccination records, online survey, on-site observations, and group discussions

### Main Pilot Findings

- Accuracy and completeness of vaccine data records improved from 5-9%, depending on data element
- Time savings of 21 seconds per vaccine recorded when scanned (versus non-scanned comparison) — 75% improvement
- High scanning rates overall (94% across pilot); variation in scanning rates by specialty, volume, strategy group, site; all adherence strategies effectively improved scanning rates, compared with training-only group
- Participants noted satisfaction, improved safety, efficiencies, and reduced strain with scanning
- Some sites and practitioners experienced challenges and struggled to implement scanning consistently

# Findings Report Outline

**1. What is Vaccine 2D Barcode Scanning?**

**2. Our Pilot in Brief**

**3. Key Pilot Findings**

**4. Where to Go from Here?**

**5. Learn More About Our Work**

# What is Vaccine 2D Barcode Scanning?

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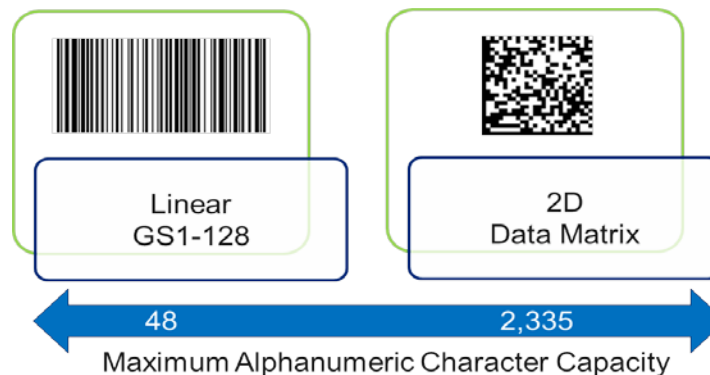
**5. Learn More About Our Work**

# Vaccine 2D Barcode Scanning

## What's in a 2D barcode on a vaccine?

Vaccine two-dimensional (2D) barcodes contain more data than traditional, linear barcodes

Vaccine Barcode Contents by Type	
Linear	2D
National Drug Code (NDC)	Global Trade Identification Number (GTIN) <ul style="list-style-type: none"><li>• Includes NDC</li></ul> Lot Number Expiration Date



## How does it work?

Vaccinators scan the 2D barcode on a vaccine vial or syringe with a 2D barcode scanner, which then populates data into their electronic medical record (EMR)



# Our Pilot in Brief

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# Selection of System, Sites, and Timeline for Pilot

Pilot planning began in August 2015, followed by protocol development, pilot system and site selection, scanner installation, data collection and analysis, through report completion in February 2018

## Selection of Health Care System

- Recruitment Criteria for Health Care System
  - Sutter Health selected based on criteria, including:
    - Interest and willingness to participate
    - Use of a single EMR systemwide that supported scanning
    - Ability to confirm whether vaccine record scanned or not



## Selection of Sites

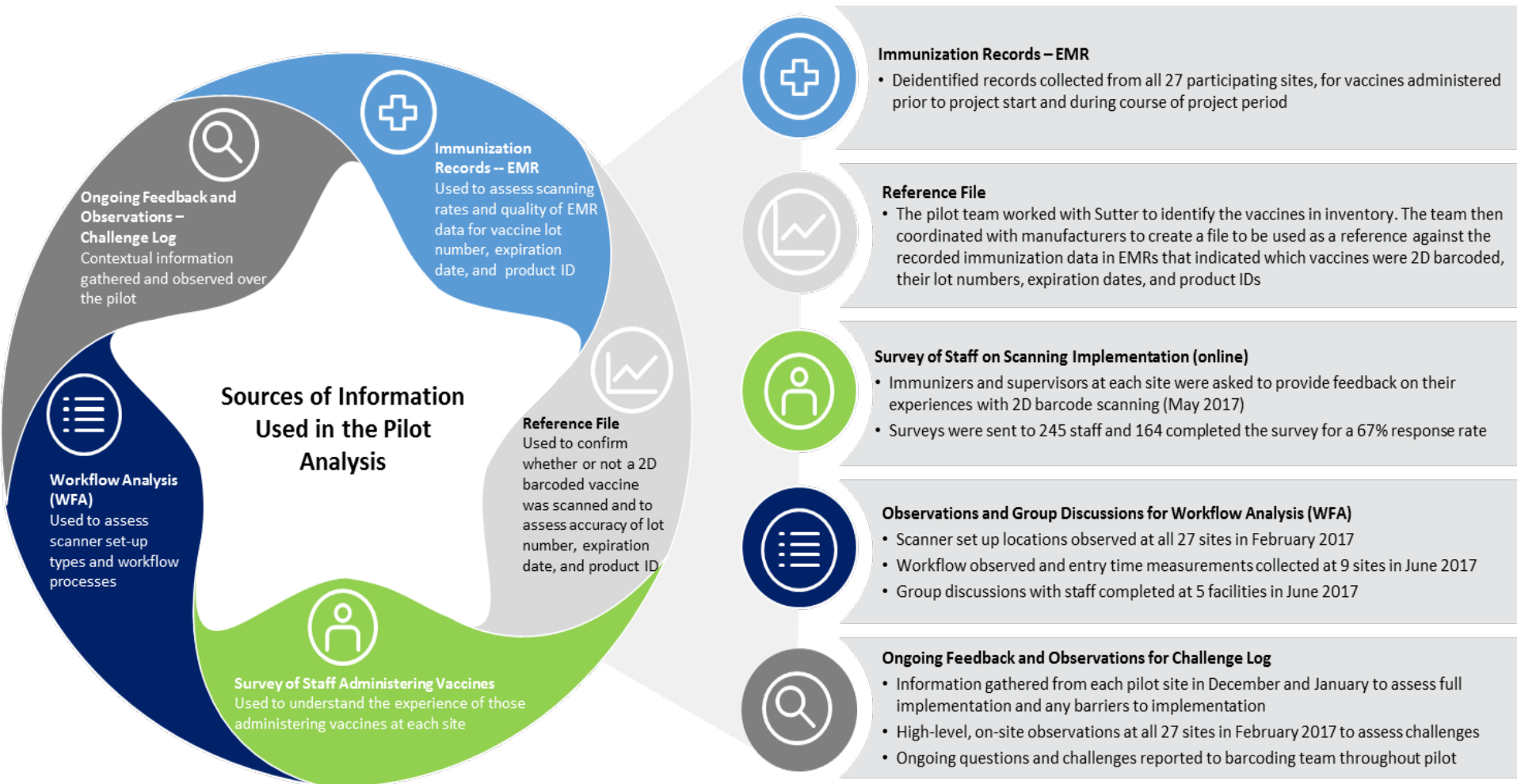
- Selection of 27 Sites within the Health Care System
  - Sites selected based on:
    - Interest and willingness to participate
    - Diversity of centers administering vaccines (e.g., pediatrics, vaccine clinic, internal medicine)
    - Agreement to installation and use of scanners
    - Agreement to data collection and assigned adherence strategy group

## Pilot Timeline



# Pilot Data Sources Overview

Multiple sources of data assessed pilot implementation and feedback from participants. Further descriptions of each data source provided at end of report.





# “Nudging” Scanning Rates with Adherence Strategy Groups

## Benefits of barcode scanning only realized when technology is actually used

Pilot sites were stratified, then randomly assigned to one of four adherence strategy groups to assess whether changes to implementation could improve scanning rates

### Training Only

Training on use of 2D scanners and protocol for scanning

*Training + No other steps*

### Commitment Card

Written personal rationale for scanning/signed commitment to scanning

*Training + Commitment Card (shown below)*

### Scanning Adherence Report

Posted report – compares individuals at center and center to other centers

*Training + Scanning Adherence Report (shown below)*

### Combination

Combination of all previous strategies

*Training + Commitment Card + Scanning Adherence Report*

## Commitment Card

### Commitment to Patient Safety with 2D Scanning

I, \_\_\_\_\_, am committed to patient safety and protecting the health of my patients. I will do my best to scan each vaccine product with a 2D barcode that I administer to my patients.



I believe that scanning is important to patient safety because:

Signature \_\_\_\_\_

Date \_\_\_\_\_



## Sample Scanning Adherence Report



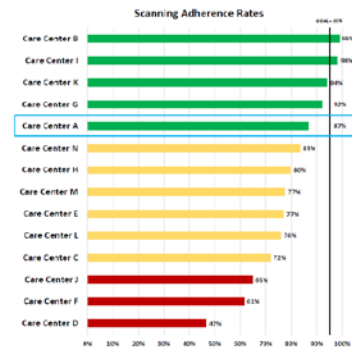
### Care Center A Scanning Adherence Report

Week of XX to XX

Care Center A  
Cumulative Scanning Rate  
**87%**

Rank This Period	Team Member	Vaccines Scanned	This Period	Pilot to Date
1	Kelly	7 out of 7	100%	89%
2	Jessica	9 out of 10	90%	87%
3	Calib	14 out of 16	88%	79%
4	Liz	30 out of 35	86%	79%
5	Alaina	26 out of 32	81%	87%
6	Rebecca	20 out of 25	80%	84%
7	Angela	13 out of 14	79%	80%
8	Jacqueline	10 out of 13	77%	51%
9	Stella	9 out of 12	75%	83%
10	Ryan	5 out of 7	71%	70%
11	Patrice	10 out of 15	67%	63%
12	Jane	22 out of 34	65%	87%
13	Susan	6 out of 22	27%	57%
Total		179 out of 242	74%	87%

GOAL – 95% 2D SCANNING ADHERENCE RATE  
Thank you for participating in CDC's 2D Barcode Scanning Pilot!  
**REMEMBER TO SCAN YOUR 2D BARCODED PRODUCTS!**



# Key Pilot Findings

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# Key Findings: Benefits, Challenges, & Feedback from 2D Scanning Implementation



## Accuracy Increased

- **When scanned:**
  - **Lot number improved 4.6%** (to 99.7%)
  - **Expiration date improved 9.2%** (to 99.97%)
  - **NDC improved 5.7%** (to 99.99%)
- Improvements varied by specialty



## Time Savings Observed

- **21 seconds saved per vaccine entered when scanned** (average 7 seconds scanned, 28 seconds not scanned)
- One site **added 12+ appointments per week with time saved**



## Scanning Rates Varied

- **High scanning rates overall (94%** of vaccines given during pilot)
- Variation in scanning rate by site, specialty, volume, strategy group
- **All adherence strategies (reports, cards) improved scanning rates**, compared with training-only group



## Scanner Fit Mattered

- Critical to **find best fit of scanner location within context** to ensure integration into workflow and consistent use
- **Various scanner locations** and set-up types **effective** across pilot sites



## Users Satisfied

- Participants **satisfied with their experience scanning (94%)**, **want to continue scanning (97%)**, and found **change in process worthwhile (96%)**
- **Improved safety, reduced strain, and improved efficiency** noted



## Challenges Experienced

- **Early pilot challenges:** scanner location/workflow fit, staff/leader buy-in, scanning glitches
- **Remaining at end:** workarounds, scanner location, buy-in
- Some sites and practitioners **struggled to scan consistently**

## **Lessons Learned from Pilot that Can Support Future Scaling Efforts**

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Several key lessons for successful vaccine scanning implementation became evident from the pilot data. This guidance can benefit other organizations embarking on this process.

### **Early Planning and Decisions Made a Big Difference (Take the Time to Get It Right From the Start)**

- Sites that found early and lasting success with high and consistent scanning rates typically:
  - Revised their workflow process and protocol from the start
  - Strategically selected scanner location, with input from staff

### **Patterns of Use and Implementation Were Evident Early**

- Given the same information, tools, and strategies, sites performed differently, with differences seen early
  - High volume sites, such as Pediatrics/Shot Clinic, scanned at high rates from the start until pilot end
  - Low vaccine volume sites, including Internal Medicine, struggled the most to scan consistently

### **Adherence Strategies “Nudged” Participants to Scan More Frequently**

- All three groups with a strategy added to promote scanning had the highest scanning rates and the group receiving only the training had the lowest scanning rate
  - Increases to scanning rates aligned with the timing of each strategy implemented
- Scanning rates matter, as benefits of scanning are only realized if the technology is actually used

### **Adjustments to Resolve Challenges Mid-Course Improved Scanning Use**

- Revisiting foundational planning decisions and making revisions improved scanning rates and buy-in
- Ideas for adjustments, even after implementation underway, include:
  - Offering troubleshooting support to work through specific challenges,
  - Providing data on scanning rates to staff and leaders, and
  - Engaging leaders at sites and within organization



# Accuracy



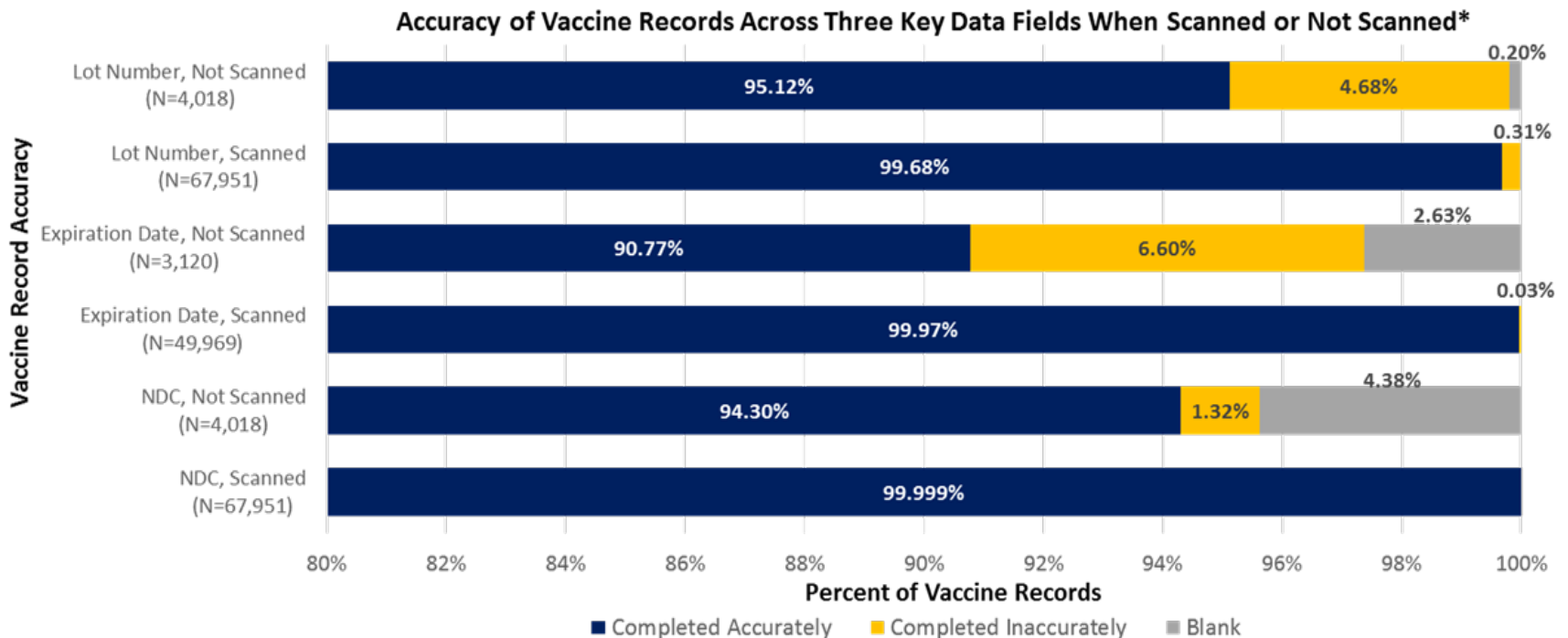
# Scanning Greatly Improved Accuracy of Data

Vaccine **lot number, expiration date, and NDC data fields significantly more accurate when scanned**, rather than entered manually (p<.01)

- **Lot number field improved 4.6% (to 99.7%) when scanned**
- **Expiration date field improved 9.2% (to 99.97%) when scanned**
- **NDC field improved 5.7% (to 99.99%) when scanned**

## Accuracy = Complete + Accurate Record

(a record must first be complete (*something is there*) and data contained in the field is also accurate)

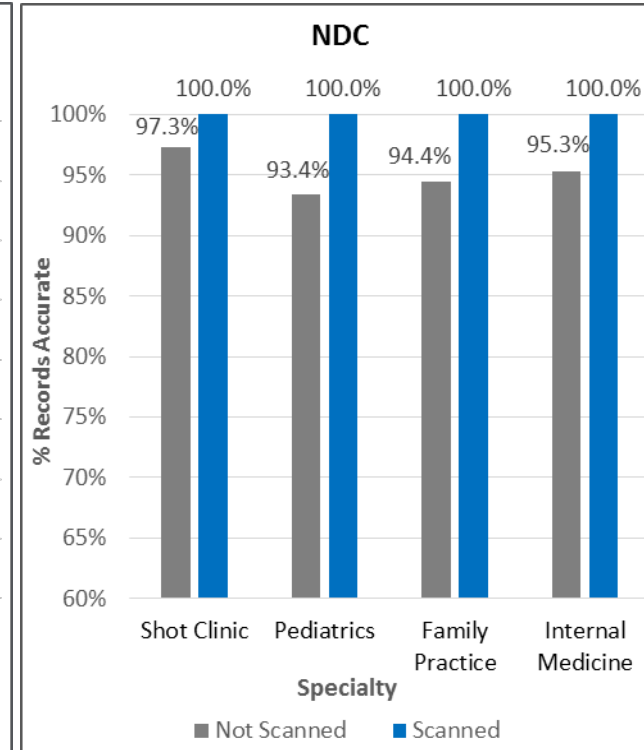
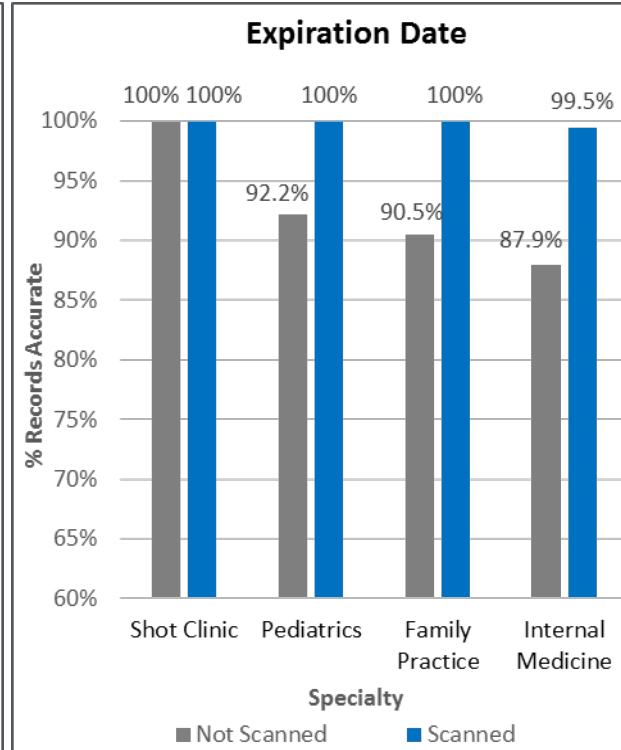
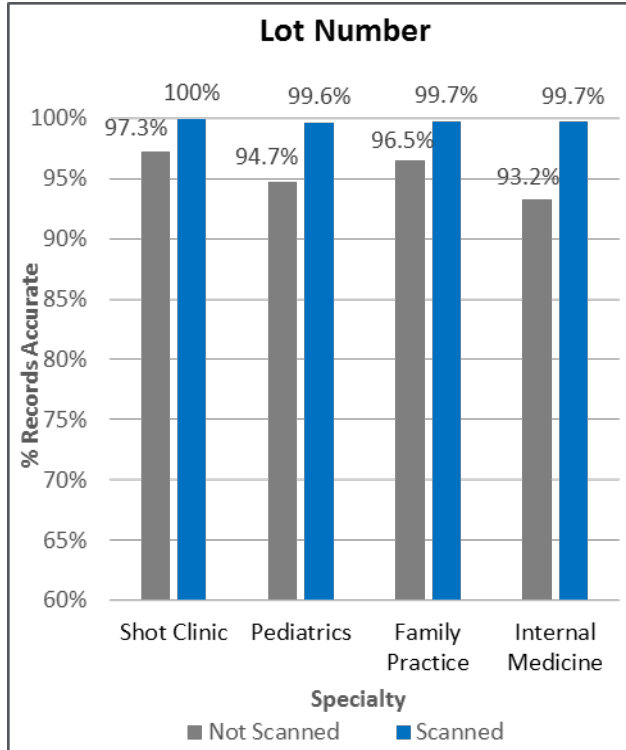


\*A data element was considered “complete” if the field was not blank. “Accuracy” was determined by comparison with our reference file. Lot numbers and NDC matching the reference file were deemed “accurate,” whereas, records with something in the field, but without a match to the reference file were “inaccurate.” As lot numbers were needed to identify correct expiration dates, records with inaccurate or blank lot numbers were not included in the expiration date analysis. For NDC, matches to either the unit of use or unit of sale were counted as “accurate.”



# Accuracy Improvements Varied by Data Element and Specialty

- **Improvements to record accuracy** when vaccines scanned (compared with not scanned) **ranged from 2.7%-6.5%** for **lot number**; **0%-11.6%** for **expiration date**; and **2.7%-6.6%** for **NDC**
- Scanned records highly accurate (99.5%+) across specialties and data elements, with **most variation in records not scanned**
- Differences when scanned or not scanned **statistically significant** (except where noted)\*



\*Statistically significant difference ( $p < .01$ ) between scanned and not scanned accuracy of vaccine records for each specialty, within each data element, with the exception of the expiration date field comparison for the shot clinic.



# Why Accuracy Matters

**Volume of Vaccines Given** – With over 100 million vaccines likely administered annually in the US,\* small improvements to vaccine record accuracy can have meaningful impact – **a 1% improvement in data accuracy could impact a million or more vaccination records. Data accuracy in pilot sites improved by 5-9%.**

**Compliance and Recall Support** – Added accuracy and completeness of data recorded in the EMR aids compliance with requirements to record specific data elements (e.g., lot number, manufacturer). Accurately recorded lot numbers can also identify patients who need revaccination following a recall.

**Patient Safety** – Scanning is regularly used elsewhere to aid patient safety during medication administration and for patient identification, among other uses. Further, pop-up notices included in some EMRs can alert staff to potential safety concerns. **Increased accuracy of data with 2D scanning can ensure alerts as intended.** Pilot sites received alerts if a scanned vaccine was expired or did not match the doctor's vaccine order.

## Pilot Feedback

- About half of pilot survey respondents identified the **pop-up notices as a benefit of 2D scanning**
- **48 survey respondents** (34% of survey participants) **actually received one of these pop-up notices during the pilot** (38 received a **mismatch pop-up notice**, 10 received the **expired vaccine notice**)
  - **Reasons for a mismatch** (of the 38 respondents having received a mismatch pop-up notice):

Reason(s) for receiving mismatch notice (could select more than one)	# Reporting
Clinician selected wrong vaccine from list of same type as that scanned**	20
Clinician selected a specific brand rather than vaccine type**	15
Pulled the wrong vaccine from the refrigerator	8
Another reason	2

**“We had an immunization error, HepB given instead of HepA. That was caught by the scanner "vaccine not ordered" when documenting after administration.”**  
 – Survey Respondent

\*Estimated 130+ million vaccines likely administered to ages <18 years, extrapolated from sample (Rogers et al (2018)); estimated 10 million given to <1 year of age (VAERS, 2015); over 150 million doses of injectable flu vaccine available for 2017-2018 season (Flu CDC Key Facts 2017-18)

\*\*E.g., brand selected may not match stock or version without preservatives available, but different version ordered; would not necessarily result in the wrong vaccine being administered



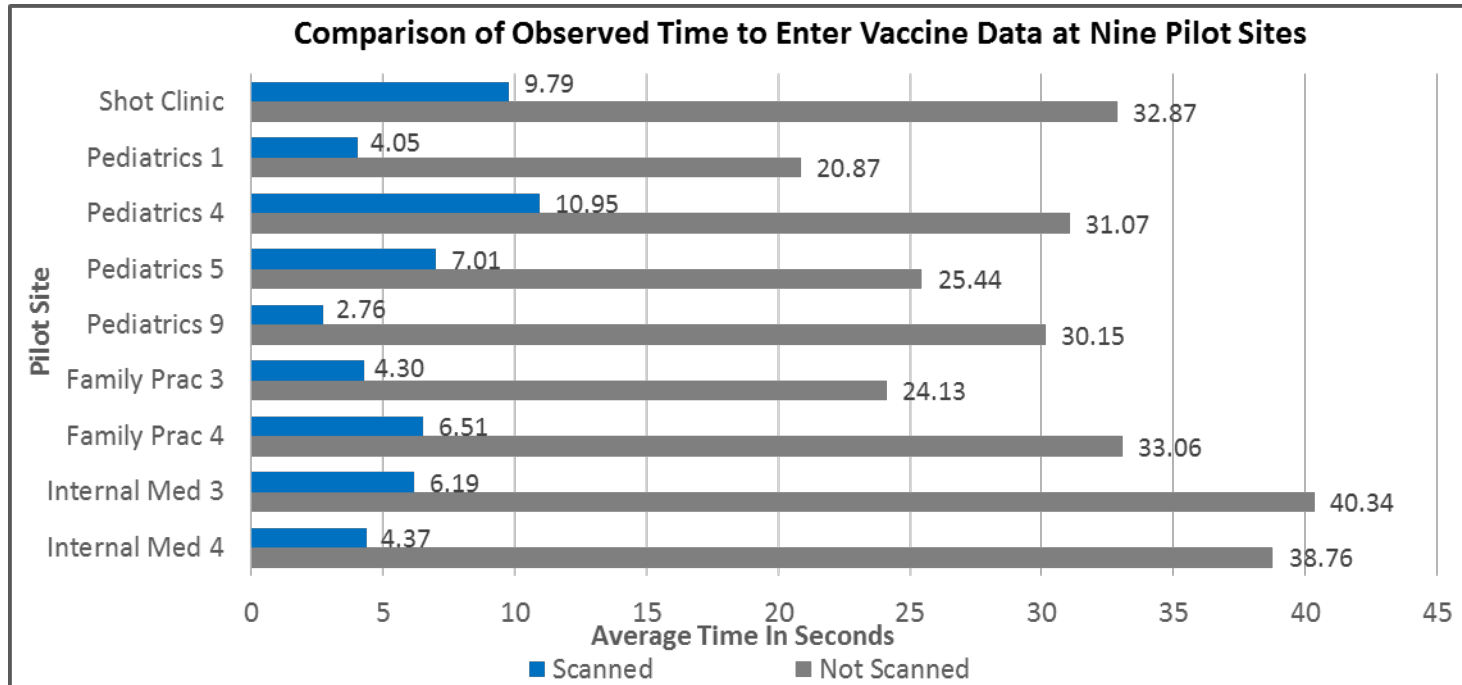


# Time Savings



## Sites Could Realize 75% Improvement in Time Savings with Scanning

Time measurements comparing vaccine entry methods across nine of the pilot sites found an average of **21 seconds saved per vaccine entered when vaccines scanned** (average of 7.04 seconds when scanned and 28.19 seconds when not scanned\*) – a **75% improvement**



### Potential Time Savings

- While time savings varied by site, the average calculates out to **5.83 hours saved per 1,000 vaccines scanned**.
- These nine sites administered more than 45,000 vaccines during the six-month pilot. If each entry were scanned, **time savings would total 262 hours saved** (for these nine sites), ranging from 3-116 hours for individual sites based on volume scanned.

\*Time measurements taken outside actual patient encounters to ensure protocol consistency (using a test EMR portal that functions the same way as the actual EMR); same protocol used and same vaccines recorded across both scanned and not scanned observations; measurements with 13 practitioners across 9 sites



## Pilot Participants Described Time Savings From 2D Barcode Scanning

In addition to measured time savings, through group discussions and user survey feedback, practitioners noted time savings with 2D barcode scanning

One pediatric site described **adding two vaccine-only appointments daily**, for an **additional 12 to 14 vaccine appointments per week due to time saved** with the introduction of 2D barcode scanning.

**Added  
12-14  
appointments**

**“Faster process adds to patient satisfaction.”**  
– Survey Respondent

**95%  
“Scanning  
saves  
me time”**

**95% of survey respondents (n=131) agreed or strongly agreed with the statement, “Scanning saves me time.”**

**“Major time savings, not having to type it in.”**  
– Discussion Participant

**98% of survey respondents (n=135) agreed or strongly agreed with the statement, “I was able to record data quickly using 2D barcode scanning.”**

**98%  
“Able to record  
data quickly”**



# Scanning Rates and Adherence Strategies



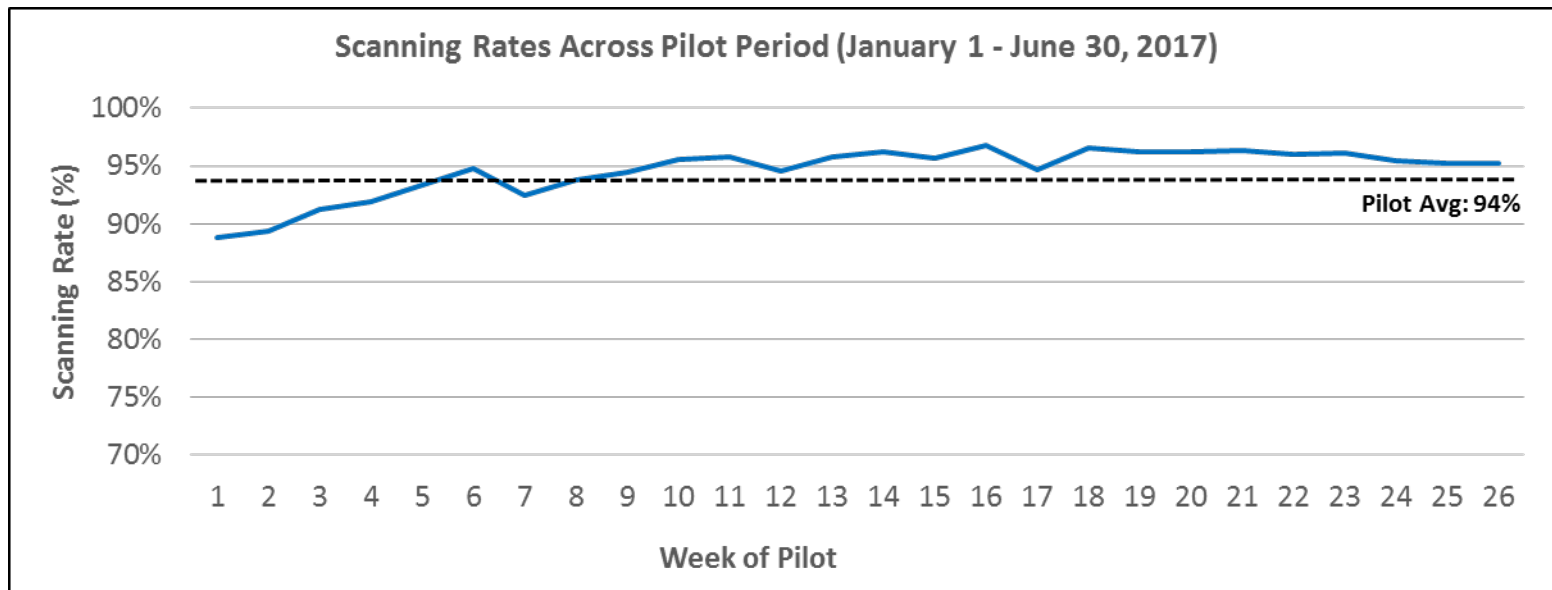
# Scanning Rates High Overall During Pilot, Though Key Variations Detected

**Users scanned most (94%) of the 2D barcoded vaccines administered during the pilot** (n=67,951)\*

- **98% (n=71,979) of vaccines administered during the pilot had a 2D barcode** (thus, could be scanned)\*\*
- Scanning rates rose during the first 10 weeks, from an average of 89% at the beginning of the pilot to 95% or above, where scanning rates remained until the end of the pilot

**Significant variations in scanning rates identified from the start and through pilot end**

- **Characteristics of sites and practitioners linked to scanning rates** (e.g., volume of vaccines given, specialty)
- Though characteristics may not be changeable, **adjustments to aid scanning are possible** and are described



\*Scanning rates calculated by total 2D barcoded vaccines scanned over the total number of 2D barcoded vaccines

\*\*Vaccines administered that were not known to have a 2D barcode were classified as non-2D (including the few vaccines on the market without a 2D barcode and any records where confirmation of 2D barcoding could not be made)



# Variability Found in Pilot Scanning Rates

Analyses of pilot scanning rates found variability by site, specialty, vaccine volume, and strategy groups

## Site



**39% - 99%**

Though the **overall scanning rate was 94%** across all sites during the pilot, **individual sites varied** from 39% to 99% of vaccines scanned

## Specialty



**71% - 98%**

**Pediatric sites (97%)** and a **Shot Clinic (99%)** had **highest scanning rates**; Internal Medicine sites had lowest scanning rates (71%), with Family Medicine sites in the middle (87%)

## Volume



**74% - 97%**

Average **scanning rates differed by weekly vaccine volume**, from 74% for low-volume sites (<25 vaccines per week), to 90% for medium-volume sites, to 97% for high-volume sites (>100 vaccines per week)

## Adherence Strategy Group



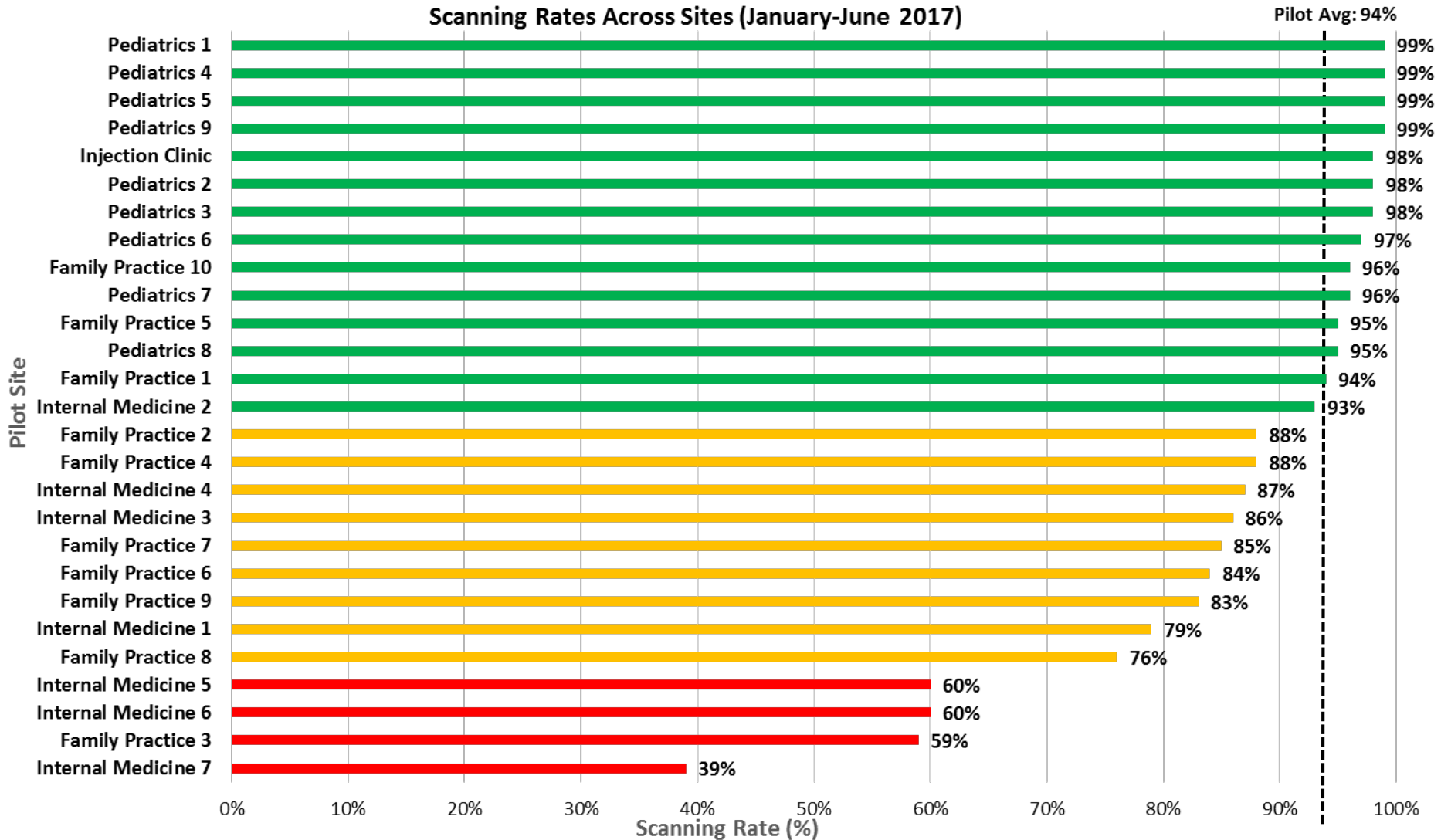
**92% - 96%**

Four groups compared; all **groups with a strategy beyond training had the highest scanning rates** compared with the training-only group, on average and at the end of the pilot



# Average Scanning Rates Ranged from 39% to 99% Across All Pilot Sites

Over half the pilot sites scanned more than 90% of their vaccines, with several scanning nearly all vaccines. Four sites scanned 60% or fewer of their 2D barcoded vaccines during the pilot. Sites color-coded by high, medium, low rates.



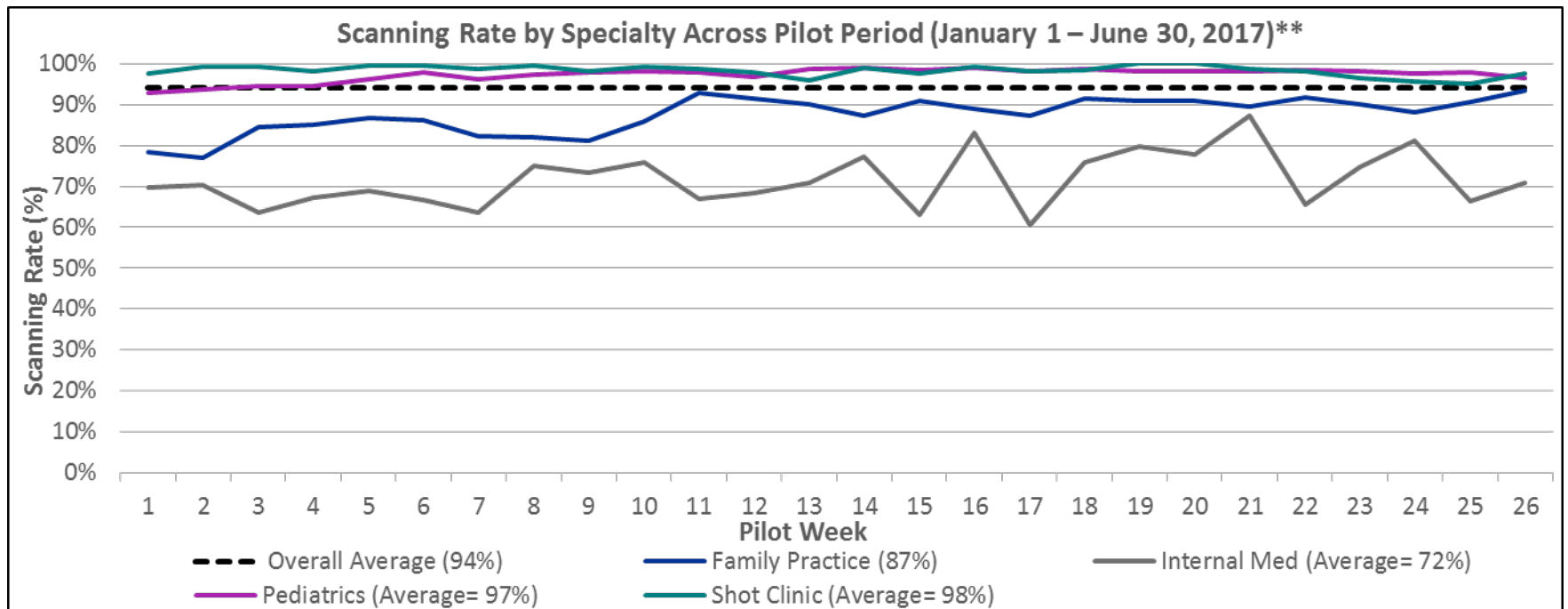
\*Scanning rates calculated by total 2D barcoded vaccines scanned over the total number of 2D barcoded vaccines



# Scanning Rates Differed Greatly by Specialty

Statistically significant difference in overall scanning rates by specialty\*

- **Pediatric** and **Shot Clinic** sites had consistently **highest scanning rates** (97% – 98% average) during pilot
- **Internal Medicine** sites showed greater variability, but always had the **lowest scanning rates** (average rate of 72%) across the pilot
- **Family Practice** sites (average scanning rate of 87%) **fell between** Internal Medicine and Pediatric scanning rates and showed a steady increase in scanning during the pilot period



\*Every specialty shows a statistically significant difference in overall scanning rates compared with every other specialty (P < .0001)

\*\*Scanning rates calculated by total 2D barcoded vaccines scanned over the total number of 2D barcoded vaccines

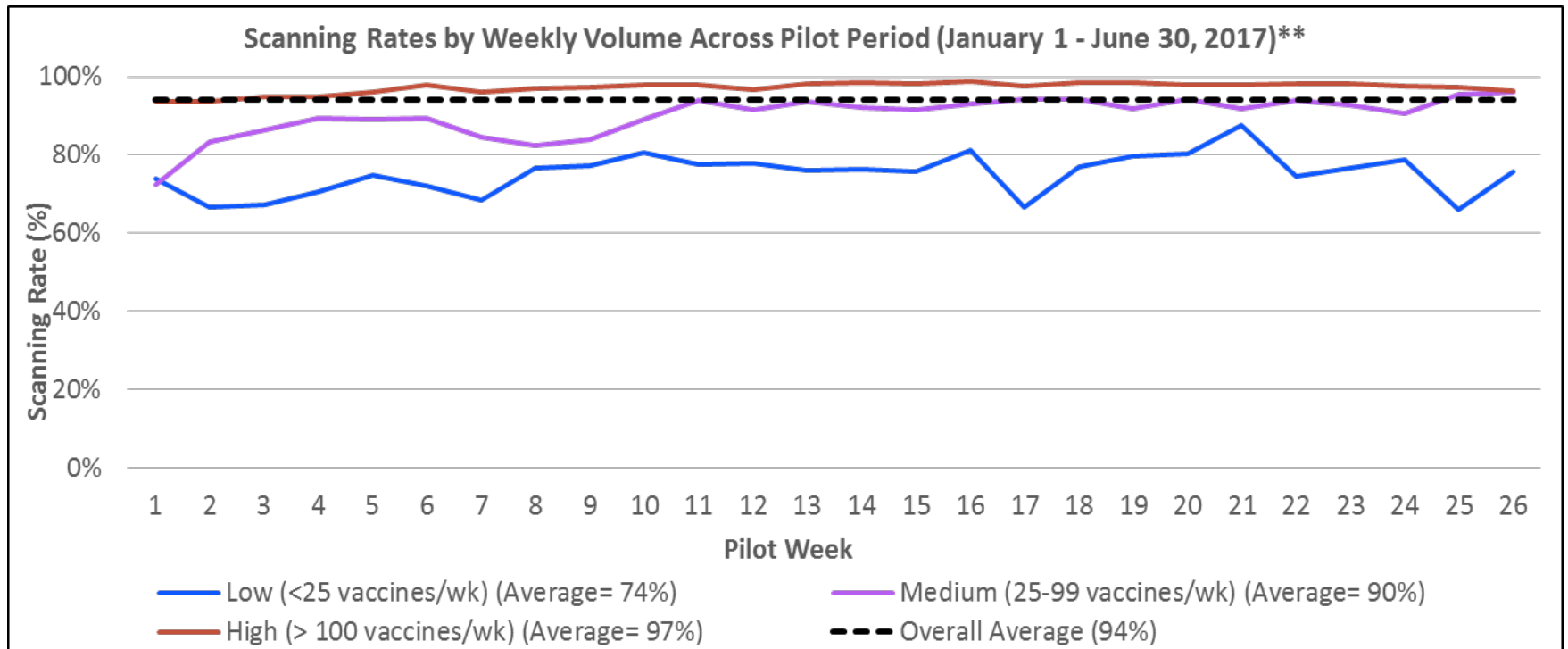




# Scanning Rates Increased as Weekly Volume Increased

Statistically significant difference in scanning rates by weekly volume,\* from **74% for low-volume sites** (less than 25 vaccines weekly average), to **97% for high-volume sites** (more than 100 vaccines weekly average)

- **Most growth seen in the medium-volume sites** from start to end of pilot
- Low-volume sites were frequently Internal Medicine sites



\* Low-, medium-, and high-volume sites all showed statistically significant differences from each other in their average scanning rates ( $P < 0.0001$ )

\*\*Scanning rates calculated by total 2D barcoded vaccines scanned over the total number of 2D barcoded vaccines



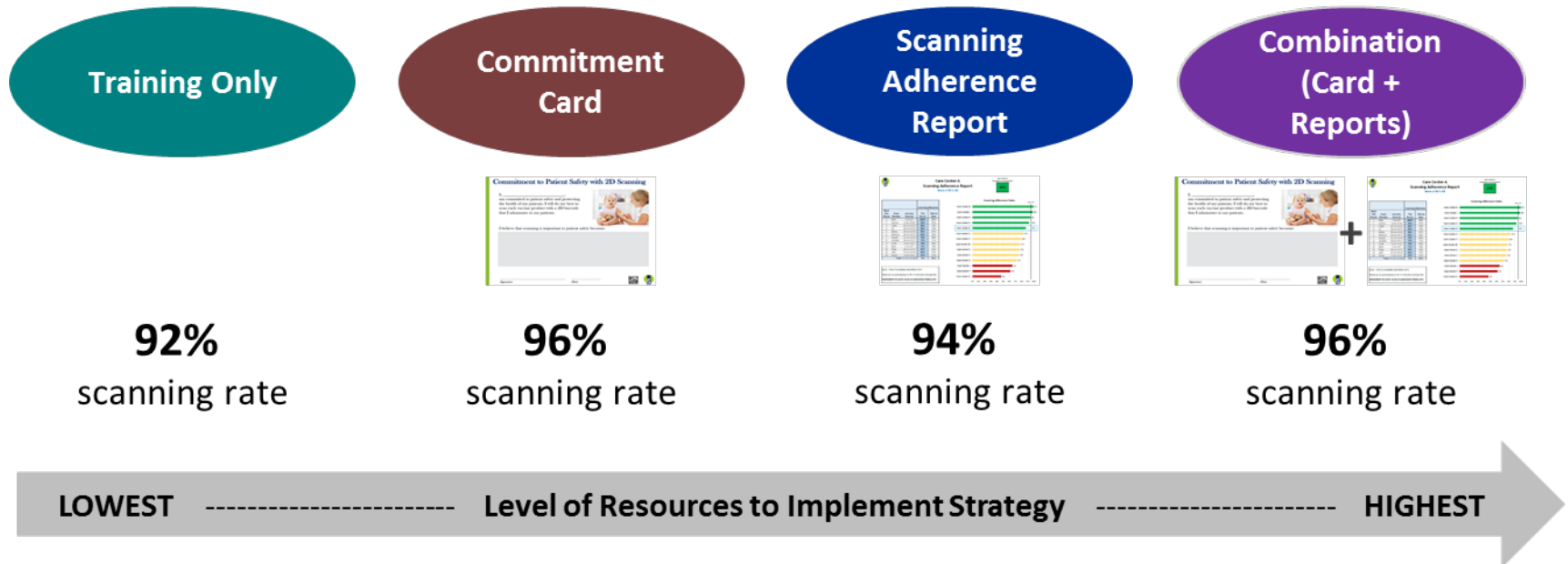
# Adherence Strategies Significantly Improved Scanning Rates

Adherence strategy groups aimed to maximize scanning use, with groups differing by levels of resources to implement and timing during the pilot

Significant differences found in average scanning rates across these groups,\* with:

- **Training-only** group having the **lowest average scanning rate** and
- **All other groups (with some additional strategy implemented)** having significantly **higher average scanning rates**

No significant difference between two highest rate groups (Commitment Card/Combination)



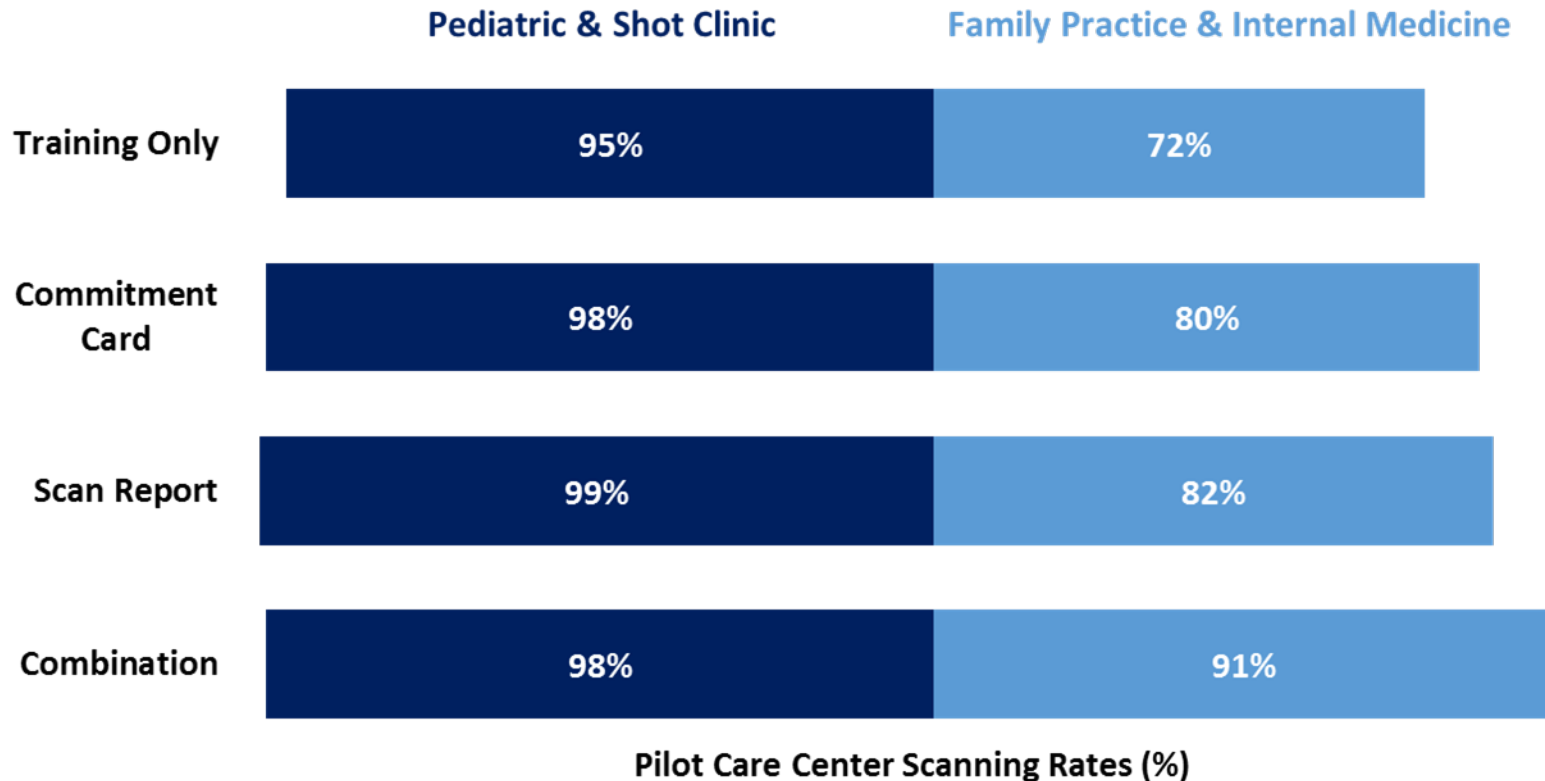
\*Statistically significant at the p<.0001 level



# Adherence Strategies Most Effective at Family & Internal Medicine Sites

Adherence strategies performed similarly for **Pediatric and Shot Clinic** sites with significant variation seen for **Family Practice and Internal Medicine** sites.\*

Training-only groups had the lowest scanning rates across all specialties in pilot.

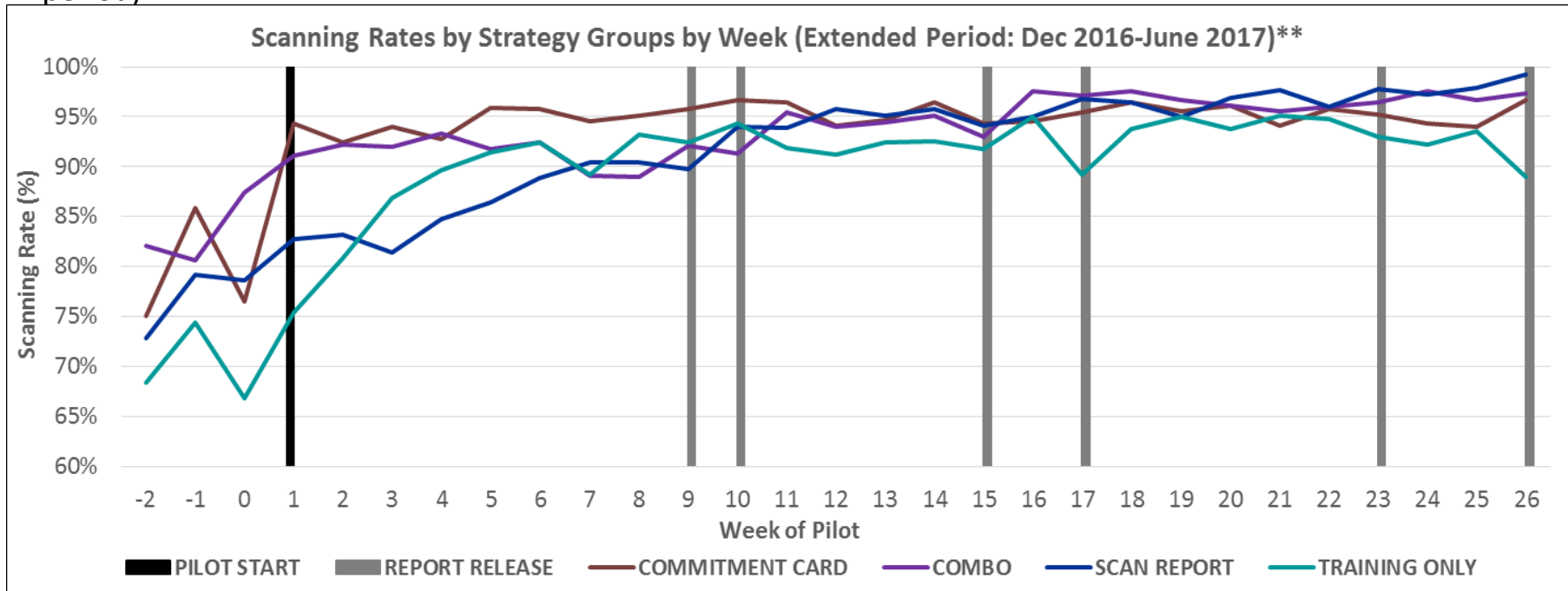


\*Differences statistically significant at the p<.001 level



# Strategy Group Scanning Patterns Differed Across the Pilot

- By end of the pilot, **all groups with adherence strategy implemented beyond training had the highest scanning rates** (97%+) compared with the training-only group (89%).
- **Increases seen at meaningful times** for groups with additional strategies: Commitment Card rose early/remained high; Scan Report group rose as reports released (**grey bars** show report release dates); Combo group started high, then declined until reports started.
- All groups showed a **quick uptake of scanning during the initial weeks of scanning** (week “-2” was first week post scanner installation, with three weeks of scanning — until **black bar** at week 1 — set aside as adjustment period).\*



\*Dips at “week 0” for several groups may be due to Christmas and New Year holiday; week 1 started January 2<sup>nd</sup>

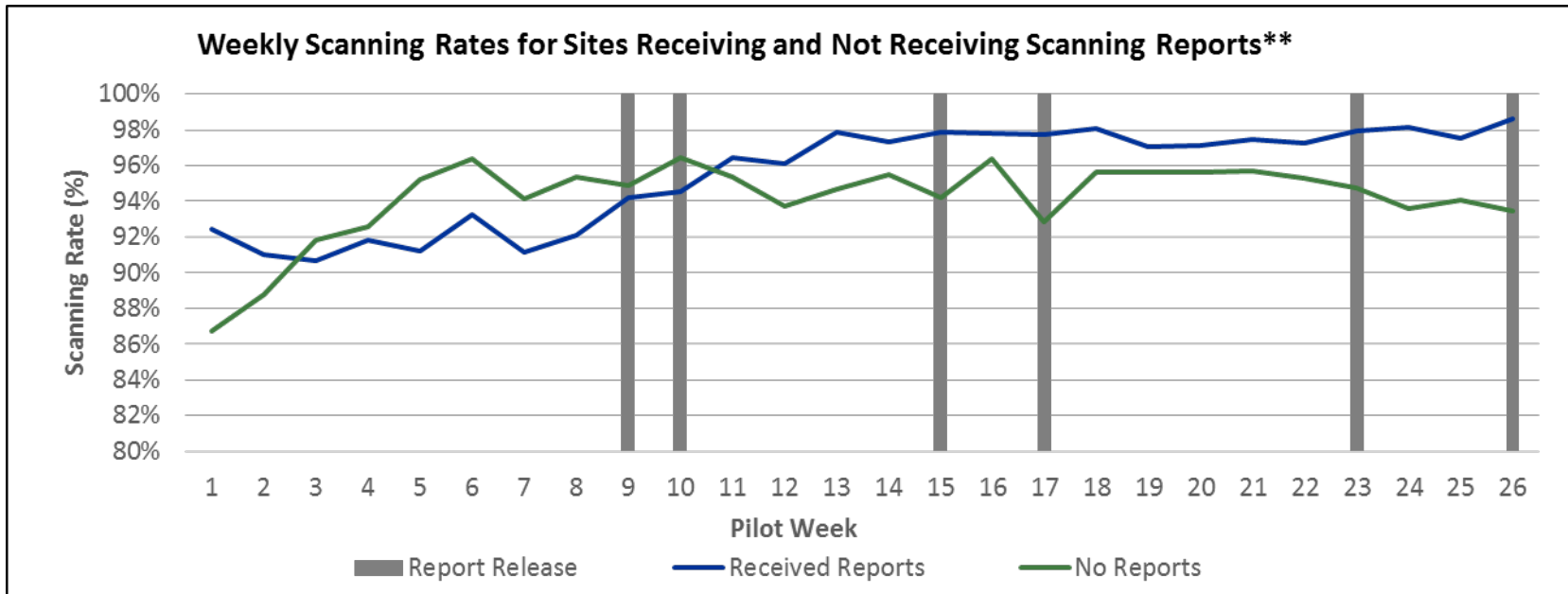
\*\*Scanning rates calculated by total 2D barcoded vaccines scanned over the total number of 2D barcoded vaccines



# Success of Scanning Reports Seen Through Scanning Rates and Feedback

Significant increase in scanning rates observed after release of initial scanning reports (for sites receiving reports, **blue line**).<sup>\*</sup> Increases continued as additional reports released through end of pilot. **Minimal changes in rates seen after release of reports for sites not receiving reports (green line)**. Grey bars show report releases.

Staff reaction to reports described **increased vigilance, improved awareness, and competition among colleagues**.



“It [the reports] definitely made me more vigilant.”  
- Discussion Participant

“I need to step up my game.”  
- Discussion Participant

“Humans are competitive. In this kind of thing it’s like, [name], you didn’t scan? You knocked down our score 6% because you missed one.”  
- Discussion Participant

<sup>\*</sup>Statistically significant increase in scanning rates after reports released for sites receiving reports compared with those not receiving reports; significant at the p<.001 level  
<sup>\*\*</sup>For sites receiving scanning reports, weekly vaccine volume varied from 838 to 1,615. For sites not receiving scanning reports, volume varied from 1,239 to 2,190.



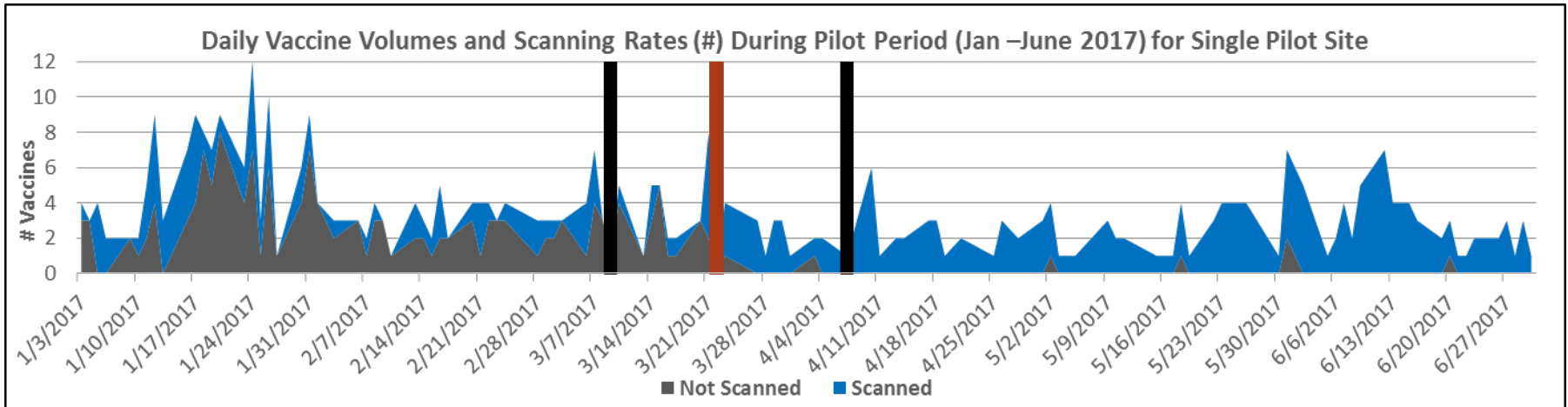
# Leadership Involvement Mid-Pilot Also Improved Scanning Rates

A strategy not planned by the pilot team involved a visit by health system leadership to a site with low scanning rates mid-pilot. **Statistically significant increase in scanning rate found after this leader visit.**

Comparison below of scanned and not scanned vaccines (by daily volume) across the pilot and an event period two weeks before and after this visit (March 22 visit shown in figure by **red bar**, event window by **black bars**).

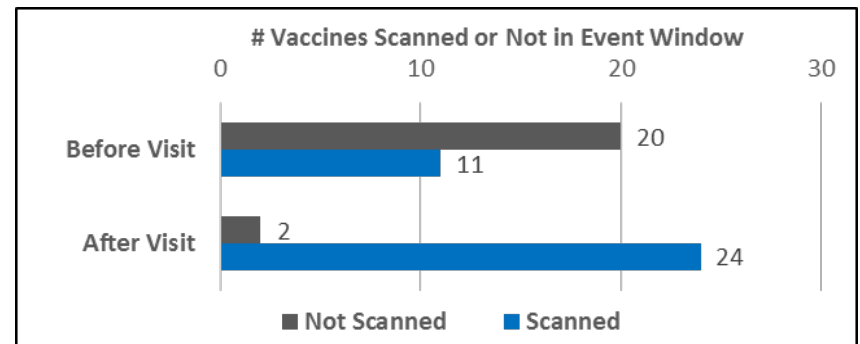
**Pilot Period: January 1, 2017 – June 30, 2017**

**Scanning Rate: Pre-visit: 34% and Post-visit: 97%**



**Event Window: March 10, 2017 – April 10, 2017**

Comparison of two weeks before (March 10-21) and two weeks after leader visit (March 23-April 10) found **significant increase in scanning rate at this site after leader visit** ( $p < .0001$ )





# Digging Deeper: Factors That Increase or Decrease the Likelihood of Scanning

Mixed-effects logistic regression used to better understand individual factors that affected whether or not scanning occurred (accurate 96% of the time). Below **factors individually either positively or negatively affected scanning rates.**\*

Factors that **increase** the likelihood of a vaccine being scanned:

## Commitment Cards

Staff who signed a **commitment card** were **more likely to scan in first 8 weeks of pilot**: 46% more likely at Family and Internal Medicine sites and 78% at Pediatrics and Shot Clinics.

## Scan Reports

At sites receiving scan reports, **staff members listed as having the lowest scanning rate at their site showed the largest improvements in their scanning rate after report was posted.**

## Staff Vaccine Volume

**Scan rates roughly doubled for every ten-fold increase in the volume of vaccines an individual personally scanned** (i.e. a staff member who administered 500 vaccines during the pilot period were about twice as likely to scan as someone who administered 50).

## Vaccine Manufacturer

There was variation in scan rates based on manufacturer. Vaccines by the manufacturer with the highest scan rate were **nearly twice as likely to be scanned** as the lowest rate.

## Leadership Visits

A personal visit by leaders to low-performing sites associated with an **immediate and large increase** in site-level scan rates.

Factors that **decrease** the likelihood of a vaccine being scanned:

## Flu Shots

**A flu shot was less likely to be scanned** than all other vaccines: 50% less likely at Family and Internal Medicine sites and 32% at Pediatrics and Shot Clinics.

## Staff Administering Vaccines at a Secondary Location

Staff administering a vaccine at a **secondary location** (also participating in the pilot) was **65% less likely to scan** than staff was at their primary location.

## Low-Volume Sites

Sites classified as **low-volume** (i.e., average of <25 administrations/week) were **59% less likely** to scan than other sites.

## Vaccines Administered Early in the Pilot Period

**The first months of the pilot had much lower scan rates overall than the last months.** At Family and Internal Medicine sites a vaccine administered in the first month of the pilot was 62% less likely to be scanned than one administered in the final 3 months. The difference at Pediatrics and Shot Clinics was 74%.

\* All listed factors were statistically significant at the  $p < .0001$  level



# Scanning Patterns Can Identify When Consistency is Found (or Not)

Figures below show **four scanning patterns by pilot sites**, which differ by how they started, variability in scanning rates, and when consistency was seen (from start, mid-way, never).

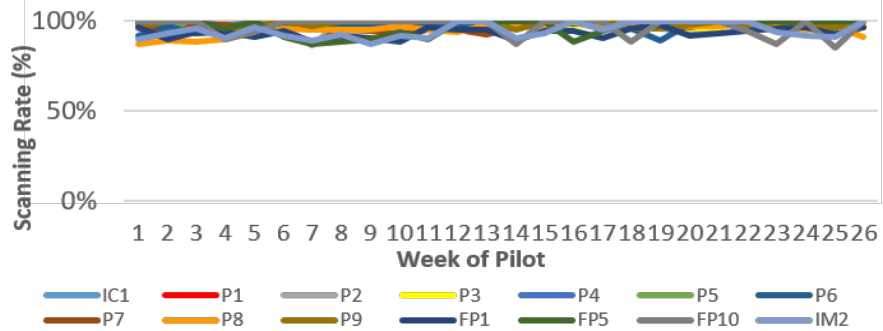
**Consistency = habit formation**

Even within the first few weeks, patterns of consistency were seen (or not).

This **enables targeted support for sites in need and lessons to be learned from sites easily integrating scanning.**

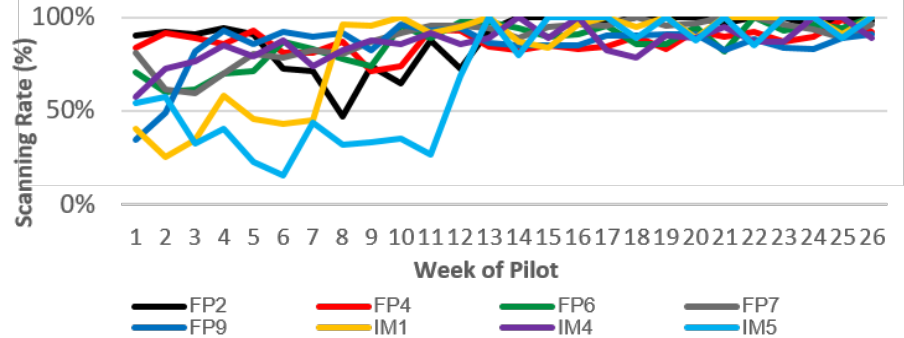
## Start Strong, Stay Strong (14 sites)

14 sites consistently scanned early and maintained throughout the pilot; these sites needed little support after initial planning efforts



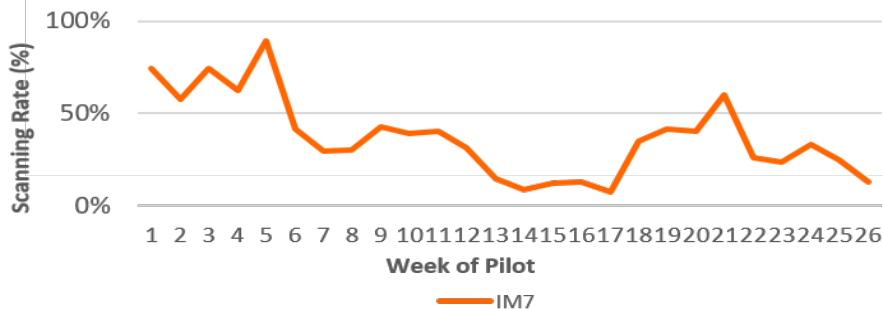
## Start Slow, Get Strong (8 sites)

8 sites started slow, but found more consistency part-way through the pilot; critical events, revisited planning, and receiving scanning reports noted



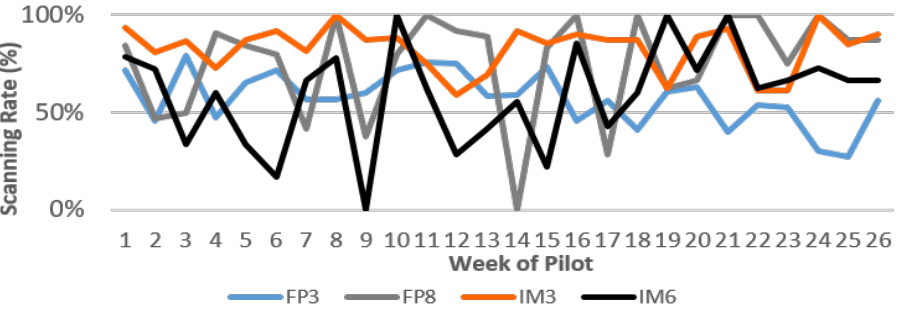
## Solid Start, Lose Ground (1 site)

1 site within this pattern; started fairly strong, then changed scanner location and lost momentum; such sites can benefit from additional support to address challenges and re-engage participants



## Low and High (4 sites)

4 sites varied greatly in scanning rates throughout the pilot and did not find consistency in scanning rates by pilot end; such sites can benefit from additional support to address challenges and re-engage participants







## A Focus on the Lowest-Performing Staff Members Can Pinpoint Struggles

Low scanning rates at the worst-performing centers were frequently driven by just one or two people.

**Use of scanning rate data can identify sites and practitioners with low scanning rates.**

Identification of individuals struggling to scan consistently and resolution of challenges being experienced can greatly improve scanning participation and benefits.

### 13 Sites (of 27 in pilot) had <90% Scanning Rate

- Staff members with the most unscanned vaccine administrations at these sites usually had **very low (<50%) personal scanning rates**.
- Unscanned vaccinations in this group often **concentrated in one or two staff members**.

#### CASE EXAMPLE (from a site with 59% scanning rate):

One staff member had a 40% personal scanning rate, accounting for 53% of this site's missed scans.

Two staff members at this site accounted for over 80% of the site's total missed scans.

#### Takeaway

The difference between high- and low-scanning centers is often just a few struggling staff members



# Pilot Participants Suggested Additional Strategies to Further Improve Scanning

Discussions with staff and leaders at pilot sites identified ways they had improved their own scanning rates or suggestions to help others scan more consistently

## Post Reminders to Scan

- A few sites developed signs to remind them to scan
- One site posted one-pager given at training to wall near fridge

## Resolve Challenges Being Experienced

- Develop a cheat sheet that includes:
  - How to hold the scanner/vial
  - Tips to get tricky labels to scan
  - Whom to call if there are problems
- Develop a protocol for physicians about their role aiding efficiency
  - For example, ordering vaccines while still in the patient room enables vaccines to be in the system, scanned, and verified promptly

## Formalize Protocol of Scanning within Workflow

- Make scanning mandatory and communicate this from the start
- Add a verbal check into the verification process to ensure vaccines are scanned prior to vaccine administration
- Have specific people (one or two) do all tray verifications to add consistency and accountability

## Ensure Scanning Takes Place and as Intended

- Observe staff to ensure workflow is implemented as intended and not using a workaround
- Identify other sources of data available to assess scanning

“One of the biggest frustrations for supervisors is looking at adherence to standards, workflows, and policies, a lot of it is based on observation... When you give an employee a review that they are not pleased with, it would be extremely beneficial to have data to support that.”

- Discussion Participant

“You can’t train someone to a standard process and then not audit them and not follow up to make sure. Just because someone has been trained doesn’t mean that it’s not still going to fall to the wayside.”

- Discussion Participant



# Knowledge About Differing Scanning Rates Can Inform Implementation

Participating pilot sites scanned at fairly high rates, on average, though great variation found. Knowledge of these variations, which may carry over to other organizations, can be used for:

## Strategic Selection When Weighing Resources

An organization might not have resources to implement scanning across all of its sites and may strategically select sites with greatest potential to realize benefits within resources available

- Selection of higher-volume or specific specialty sites may provide the greatest use and benefit, given higher scanning rates seen in these sites
- Alternately, an organization may decide to implement more broadly than anticipated if there is an opportunity to realize greater accuracy increases within certain sites and greater time savings within others

## Identification of Persons or Sites Needing Additional Support

Tracking of scanning rates provides the opportunity to identify ongoing challenges with implementation and locations where additional support may be needed

- Sites with a lower volume of vaccines given (e.g., Internal Medicine) may require additional support to fully implement scanning compared with sites with higher volumes
- Sites or practitioners without consistent scanning habits can be readily identified and offered support

## Identification of Ways to Maximize Scanning

Trainings developed, technical assistance provided, and decisions around the need for additional strategies to maximize scanning can be tailored with these findings in mind (and later modified as needed)

- Assessment of scanning rates and any variations experienced should take place and implementation further tweaked on an ongoing basis, as relevant
- Strategies added from the start and at mid-pilot effectively improved scanning in the pilot



# Scanner Location



# Location of Scanners at Pilot Sites Varied

Pilot sites determined the location for their scanners and opted to set up scanners in locations described below

- Scanner set-up shown as a **single location type**, **multiple location types** together, or a **primary location with backup**
- Refrigerator/Draw/Prep most commonly selected, either **alone (n=7)** or **in combination with other locations (n=10)**

		Location	Location Description	# Sites with Set-up*
Single Location	Individual Desk		<b>Individual desk computers of those administering vaccines</b> • This set-up was mostly used when desks were located on path between patient rooms and draw area and staff were used to entering patient information there	6
	Shared Desk		<b>Shared desk with computer and scanner outside the refrigerator area</b> • This set-up was used when shared computers used by staff for data entry and other computers often not available/regularly used by staff	4
	Refrigerator/ Draw/Prep Area		<b>Computer adjacent to where vaccines stored or prepped</b> • This location allowed staff to integrate scanning into the process of preparing vaccines	7
	Patient Room		<b>Computers and scanners located in each room</b> • Allows staff to complete the record in patient room, as vaccine being administered	0**
Multiple Locations	Refrigerator/ Draw/Prep Area + Other Location Used Equally (Individual Desk, Shared Desk, etc.)		<b>Refrigerator /draw/prep area + separate Individual Desks (used about equally often)</b>	3
			<b>Refrigerator /draw/prep area + separate Shared Desks (used about equally often)</b>	1
			<b>Refrigerator /draw/prep area + Individual + Shared desks (used about equally often)</b>	1
Backup	Primary + Backup Location <u>Rarely Used</u>	+	<b>Refrigerator/draw/prep area designated as “<u>Primary</u>” + another scanner as “<u>Backup</u>” in varied locations (backup scanner identified as rarely used by participants)</b>	5
			<b>Total</b>	<b>27</b>

\*Number of sites based on observation during pilot week 7. Three known shifts from installation date (Dec.) to observation date (Feb.) involved relocation from individual desks or patient rooms to refrigerator/draw/prep area (sometimes with a backup). After initial shuffling, no sites scanned in patient rooms as a primary location.

\*\*No pilot sites had scanners only in patient rooms, therefore, no further analyses provided - 37 -



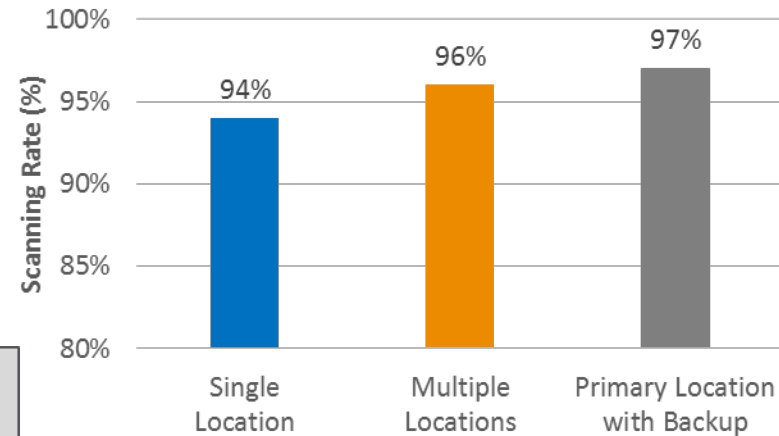
# Scanners Available in More Than One Location Had Highest Scanning Rates

In aggregate, **scanners at more than one location** (used equally often or a primary + backup option) **had higher scanning rates than single location set-up type**

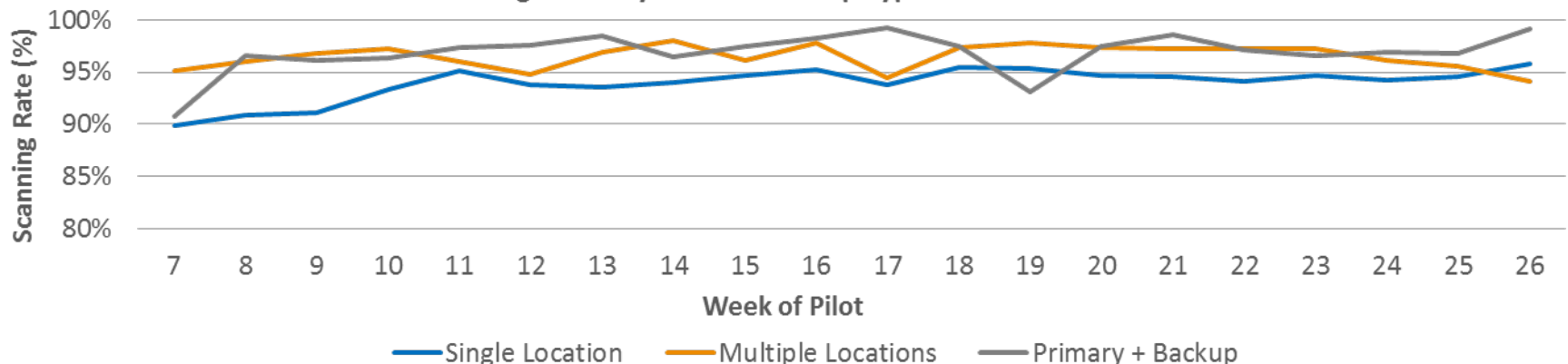
Scanning rates (starting in week 7\*) for all pilot sites show **variation among all scanner set-up types, indicating no one set-up type is solely ideal**

- **Single location type:** individual desk, shared desk, refrigerator/draw/prep
- **Multiple location type:** refrigerator/draw/prep + other location used equally
- **Primary + Backup:** refrigerator/draw/prep as primary, with backup option

Aggregate Scanning Rates by Scanner Set-Up Type (pilot weeks 7-26) \*\*



Scanning Rates by Scanner Set-Up Type Across Pilot Weeks 7-26



\*Week 7 is when on-site observations made for scanner location and set-up type; no known changes took place after this point

\*\* Statistically significant difference (at the p<.05 level) in scanning rates between the three location groups above



# Pairing of Refrigerator/Draw/Prep Location Had Highest Scanning Rates

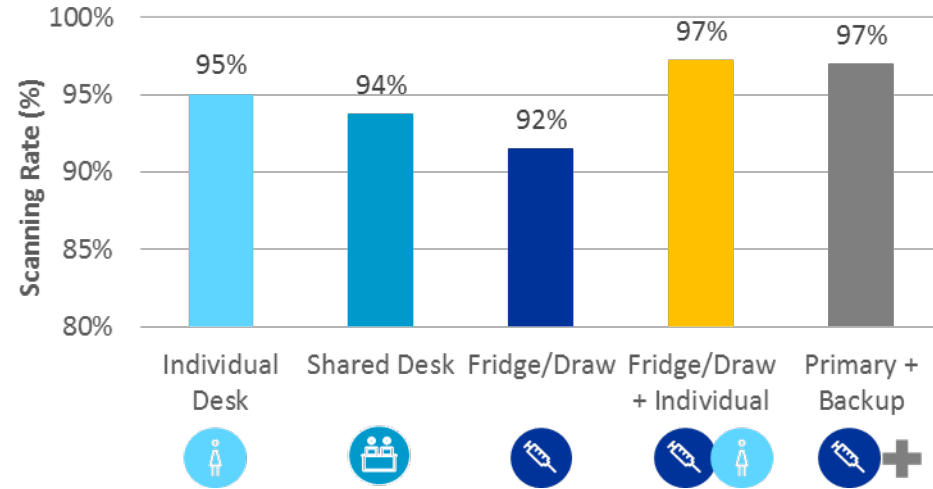
Aggregate scanning rates for five scanner locations selected most in the pilot ranged from 92%-97%

- Refrigerator/draw/prep area as only scanner location had **lowest scanning rates**
- Refrigerator/draw/prep area paired with another location (used equally or as primary, with backup also) had **highest scanning rates**

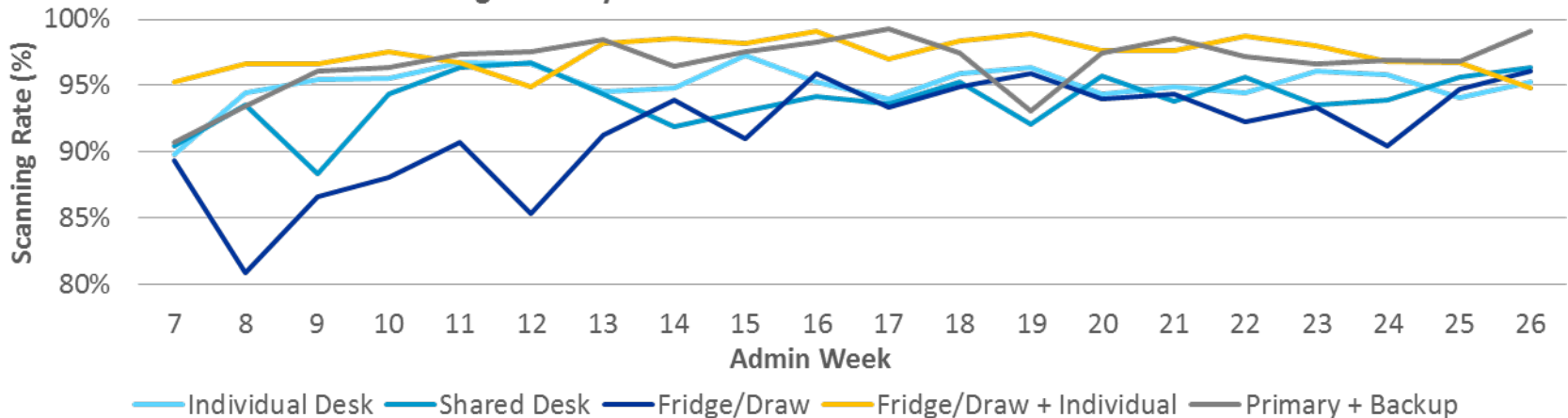
Scanning rates varied by scanner location across pilot

Comparison included scanner locations used by more than one pilot site,\*\* starting in week 7 (when observed and location had stabilized)

Aggregate Scanning Rates by Scanner Location\* (pilot weeks 7-26)



Scanning Rates by Scanner Locations Across Pilot Weeks 7-26



\*Statistically significant difference in scanning rates across locations above (at the p<.05 level), with the exception of no statistical difference between two groups both at 97%

\*\*In order to report findings by scanner location and not scanning rates for individual pilot sites, two scanner locations previously identified are removed from comparison in figures above (because only one site had each of two specific scanner location configurations)



## Success Strategies for Selection of Scanner Location and Revised Workflow

**Pilot participants described reasons for their success** and identified ways others could select scanner location and revise workflow processes with greatest success

- ❖ **Determine location of scanner and how scanning fits into workflow early** (prior to installation and start of scanning, if possible); **adjust location and workflow process as needed** rather than struggling with a set-up or process that is not working or not being used
- ❖ **Ensure staff are clear on expectations** – whether scanning is mandatory and when in the vaccine administration process scanning is to take place
- ❖ **Engage both leaders and staff in scanner location and workflow change discussions**
- ❖ **Make scanning second nature**, so that it integrates into process effortlessly
- ❖ **Scanners in the med room/refrigerator/draw areas identified as best location for many** because they **already go there to pull or draw vaccines**; this location **did not work for all** pilot staff or sites
- ❖ **Backup scanners** provide another option for scanning during busy times, problems with primary scanner, or for sites with an expansive layout
- ❖ **Don't roll out new workflow and entry process during busy time**, such as flu season; it's hard to adjust to a new process and work through challenges when too busy





# User Satisfaction



## Pilot Participants Described Satisfaction with 2D Barcode Scanning

Most users reported being satisfied with their experience scanning 2D barcodes, preferred scanning over other entry options, and found it worthwhile to make the change in their process.

**94%**  
Prefer scanning  
over other  
options

**94%** (n=152) **agreed or strongly agreed** with the statement, **“Overall, I prefer recording data about vaccines administered to patients using 2D barcode scanning over any approaches our care center has used in the past.”**

**“**These bad boys are a game-changer**”**  
*- Pilot Participant*

**94%** (n=152) **agreed or strongly agreed** with the statement **“Overall, I am satisfied with the use of 2D barcode scanning to record vaccine data at this care center.”**

**94%**  
Satisfied with  
Scanning

**96%**  
Scanning is  
worth  
the change

Of 138 user survey respondents, **96% (n=132) agreed or strongly agreed** with the statement, **“Scanning at the point of administration is worth the change in process.”**

**97%** of survey respondents reported **“Yes!”** or **“Leaning toward yes”** when asked if they **would like their site to continue scanning after the pilot ends** (n=159 of 164)



## Staff Safety and Other Benefits Experienced

Pilot survey respondents were asked to identify any benefits of 2D barcode scanning they had experienced. Most respondents selected multiple options. Select benefits are highlighted below.

### Staff Safety Benefits Experienced



**76%**  
(n=105)

#### Reduced eye strain

“...I have a hard time seeing the numbers, [scanning is] quick, accurate, and order is signed.”  
– User survey respondent

### Other Benefits Experienced



**71%**  
(n=98)

#### Ensure order in chart & signed before administration

Scanning (prior to administration) helped ensure that orders were final before administering the vaccine



**64%**  
(n=88)

#### Disposing of barcoded syringes in room instead of holding for entry later

Previously some staff would carry used/recapped syringes back to computers to enter data later



**59%**  
(n=81)

#### More complete records

Scanning enters additional data not consistently entered by staff

While other benefits were identified, including time savings and accuracy, only 4 respondents (3%) selected “none.”



## Participants Identified Additional Benefits Experienced

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Survey participants described **additional benefits** experienced through write-in responses. A number of responses reiterated **time and accuracy benefits**, while others described providing an **extra safety check** or **reducing risk for hand- and joint-related problems**. A few examples are highlighted below.

**“Accuracy** of information entered since reading tiny lot numbers is difficult. Saves time.”  
- Survey Respondent

“It is an **extra verification** step.”  
- Survey Respondent

“...[Scanning] **decreased risk** for hand- and joint-related problems related to data entry. Provides an **additional safety check** before vaccine administration.”  
- Survey Respondent

**“It saves time, ensures accurate and consistent data entry, and provides an extra safety step** prior to administration.”  
- Survey Respondent



# Challenges Experienced



# Key Challenges Found in the Pilot Across Multiple Data Sources

Pilot participants identified challenges experienced through multiple types of data collected across the pilot. **Several themes appeared across multiple data sources.**

Beyond describing breakdowns in the pilot implementation process, **these lessons can aid in improving efforts in the future.** Decisions during the planning stage and awareness during implementation may reduce challenges experienced by others.

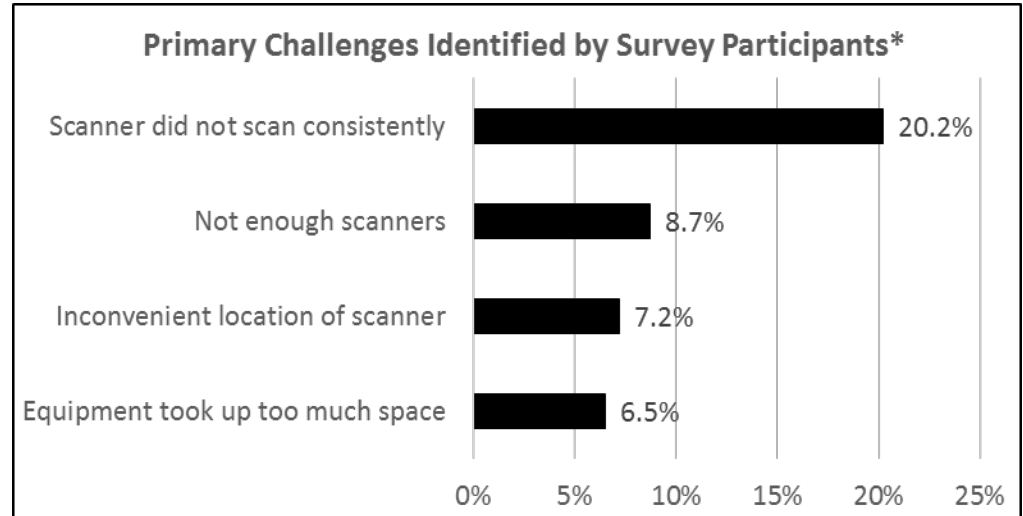
Challenge		Data Source(s) in which Challenge Was Identified		
Challenge Type	Challenge	User Survey	Group Discussions	Ongoing Observations/ Challenge Log
Scanning Difficulties	Scanner sometimes not scanning	●	●	●
	Some vaccines harder to scan	●		●
	Receiving error messages that NDC not in system/barcode not recognized		●	●
Scanner Location/ Issues	Location of scanner/set-up did not work	●	●	●
	Needing additional scanners	●		●
Low Engagement	Limited buy-in and understanding of scanning importance	●	●	●
Unclear on Scanning Protocol	Workarounds developed that do not align to scanning protocol (e.g., entering data in one step before or after administering vaccine)		●	●
	Unsure if staff is scanning	●	●	●



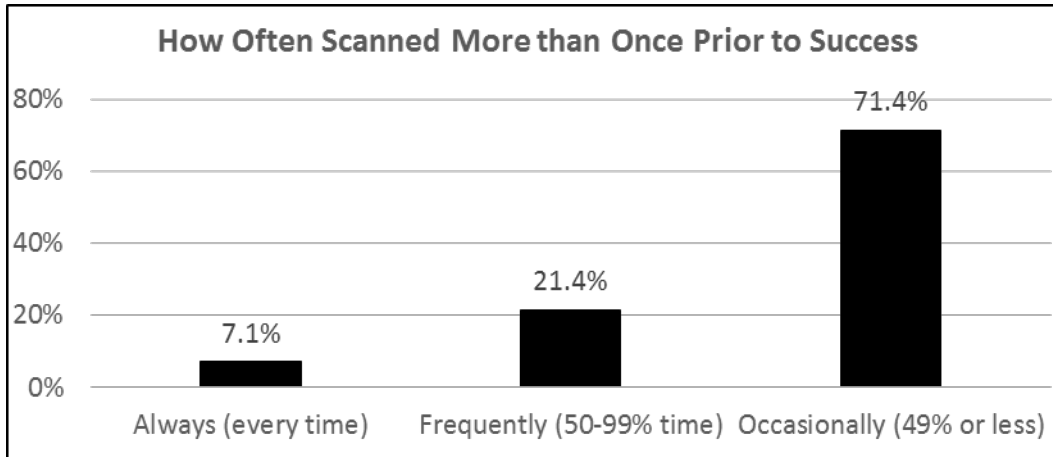
# Primary Challenges to Barcode Scanning Identified by Survey Participants

Survey respondents (n=138) agreed/strongly agreed they had **experienced specific challenges** (figure right) with barcode scanning.

**Inconsistency of scanners** (e.g., needing to scan more than once) **most frequently identified** (n=28), followed by needing more scanners (n=12), preferring different scanner location (n=10), or taking too much space (n=9).



The 28 respondents indicating scanners did not work consistently were then asked **how often they scanned more than once** to record the vaccine.



The 10 respondents indicating an inconvenient scanner location were asked preferred location.

- Preferred Location for Scanners**  
(could select more than one)
- Individual desks (n=7)
  - Shared computer (n=2)
  - Fridge room/ vaccine prep station (n=1)
  - Patient room (n=1)

\*Survey question: Please indicate the extent to which you agree or disagree with the following statements regarding potential challenges you may have experienced when using 2D barcode scanning to record data about vaccines administered to patients. Agree/Strongly Agree responses considered as challenge.



# Participant Patterns of Scanning Inconsistencies and Strategies to Resolve

Survey respondents experiencing inconsistent scanning challenges (n=28) described any patterns they noticed and solutions to resolve these issues.

## Specific Vaccines/Vaccine Labels

- A few specific vaccines were identified by type as particularly problematic (DTaP, hepatitis)
- Barcodes on certain vaccines partially cut off at the edge of the label
- Differences seen when labels are light or dark

## Could Not Identify Any Pattern

- Several respondents indicated “No patterns” or “None”
- Another noted “Sometimes there is a glitch.”
- “Very inconsistent if barcodes will enter data. More times than not it would tell me ‘barcode not recognized’ and I would have to input data manually.”

## Strategies Used to Resolve

### Holding Vial or Scanner Specific Way

- Holding scanner a certain way noted as making a difference
- Holding scanner for an extended period until barcode reads

### Solution, Even If Reason Unknown

- Restarting the EMR, then scanning would work
- Closing patient chart and reopening sometimes fixed issue
- Sometimes need to click a specific button before the scan will work

“No particular pattern, a few vials were not being captured by the scanner so I had to manually enter vaccine data.”

– Survey Respondent

“It isn't always the same vaccine. Not sure what the issue is.” – Survey Respondent

“How the vial is held under the scanner makes a difference if it is picked up by the scanning process.”

– Survey Respondent





# Workarounds and Adjustments Can Limit Scanning Benefits or Participation

Pilot participants described deviations from the trained scanning protocol that could limit the safety benefits of scanning. Additionally, an adjustment made during the pilot negatively impacted scanning participation at one site.

## Entry of Vaccine Data in One Step – Prior to or After Administration

- Two versions of this workaround identified: 1) entering data not yet confirmed (such as site of injection) prior to administration or 2) waiting until after administration to scan, when all data available for entry; either version provides potential for error and does not follow pilot protocol
- Both versions described by multiple pilot participants across several pilot sites from the pilot start and through the end

<b>Survey Confirmation</b>	17% of 138 survey respondents indicated scanning vaccines <u>after</u> administration (survey at end of the pilot period)
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## Switching Labels

When a label would not scan (if faded, cut off, or damaged), taking a different vaccine (of the same type, from the same lot) was identified as a way to scan the vaccine when manual entry would have been needed otherwise

“I came across one that was scratched or something, someone said, ‘Why didn’t you take a different one from the same lot and scan it?’” – *Discussion Participant*

## Adjustment of Scanner Location Affects Participation

One pilot site saw a sharp decline in scanner use when the scanner location moved; without resolution of this issue, scanner use stayed low through end of the pilot

“When the scanner was in the room, it was useful and great. When it was moved to a desk outside the lab requiring additional log-on, it was not used at all. If the scanner could be at each MA desk or each exam room, depending on MA preference, it would eliminate a lot of errors.” – *Survey Participant*

# Where to Go from Here?

1. What is Vaccine 2D Barcode Scanning?

2. Our Pilot in Brief

3. Key Pilot Findings

4. Where to Go from Here?

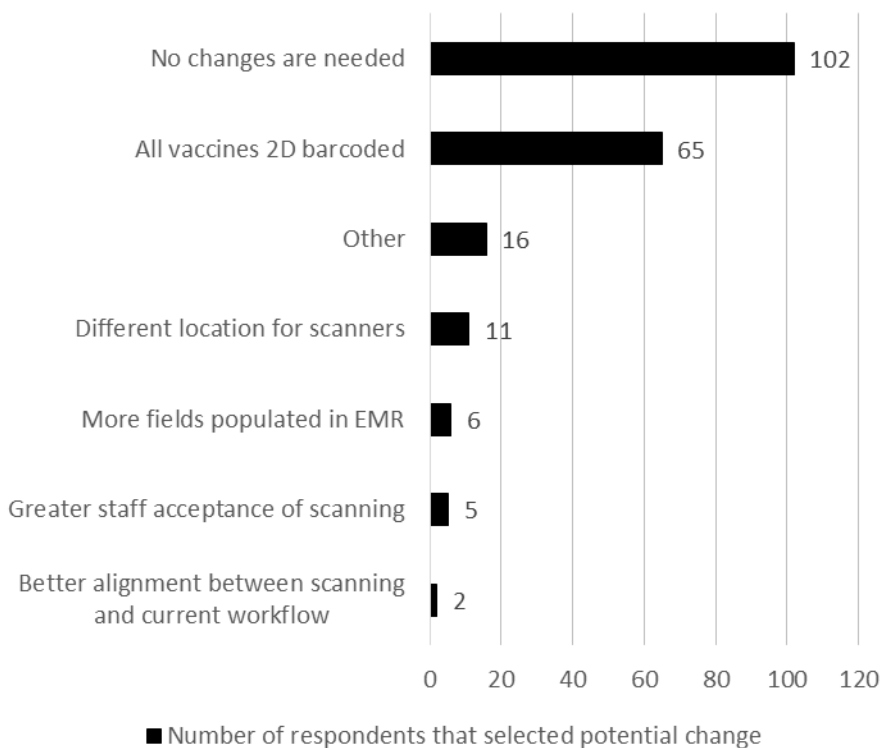
5. Learn More About Our Work

# Improve Scanning and Implementation Further – Pilot and Beyond

Survey respondents (n=164) identified **necessary changes** for 2D barcode scanning to be used more **regularly** at their site. Multiple options could be selected. **Most frequently “no changes” selected** (n=102), perhaps suggesting that high buy-in was achieved or the implementation was appropriate.

**Beyond the pilot**, such feedback provides guidance on ways to further improve 2D barcode scanning. Parties best able to address identified changes are identified.

Number of respondents that selected a potential change needed to increase use of scanning



## Role for Immunization Community

Various immunization community members are best positioned to address changes identified by pilot participants to increase use of scanning

- **Vaccine Manufacturers:** The most selected actual change needed was having **2D barcodes on all vaccines** (n=65)
- **EMR Vendors:** Expanded EMR functionality (n=6) that would enable **more information to be populated in the EMR** with a scan would require engagement of EMR vendors
- **Health Care System:** Changes to **scanner locations** (n=11), increasing **staff buy-in** (n=5), and **better alignment with the workflow** (n=2) could be addressed by organizations implementing scanning

# Engage Immunization Community to Support Scanning Efforts

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Various ways the immunization community can support improvement and expansion of scanning efforts

## Vaccine Manufacturers/Pharmaceutical

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- Include 2D barcodes on all vaccines
- Ensure print quality/contrast of labels to be easily picked up by scanners
- Ensure 2D barcodes on labels print correctly (do not get cut off)
- Consider adding 2D barcodes to other medications

## Scanner Vendors

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- Ensure scanner functionality with barcodes and EMR
- Streamline scanner configuration to work easily with EMR (currently coordination of EMR/scanner/health system)
- Ensure scanner has right sensitivity/ability to support scanning barcodes on curved vials and prefilled syringes or labels with limited contrast

## EMR Vendors

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- Increase/ensure functionality of EMR to support scanning
- Ensure indicator (scan flag) available for health care system to track whether scanning took place or not
- Streamline scanner configuration to work easily with EMR (currently coordination of EMR/scanner/health system)
- Add pop-up alerts if vaccine scanned does not match order or is expired (or others identified by users)

## Health Systems/Practitioners

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- Communicate with vendors any needs of health system/practitioners to support scanning and maximize benefits (whether expanded EMR functionality, barcodes on additional products, improvements to labels, etc.)
- Expansion of scanning through adoption by new health systems and scaling for those scanning on limited basis
- Ensure right scanner locations, workflow process, and staff buy-in to support successful implementation

# Learn More About Our Work

1. **What is Vaccine 2D Barcode Scanning?**

2. **Our Pilot in Brief**

3. **Key Pilot Findings**

4. **Where to Go from Here?**

5. **[Learn More About Our Work](#)**



### Where can I find additional information?

- Visit the **CDC 2D barcode site** for 2D vaccine resources :  
<https://www.cdc.gov/vaccines/programs/iis/2d-vaccine-barcodes/about.html>
- Search Key Words: “CDC 2D Barcode”

### What’s on the CDC 2D barcode site?

- 2D barcoding pilot reports and other pilot materials
  - Pilot **Findings Report** (*this document*)
  - How-to **Implementation Guide** for organizational decision-making
  - Summary reports from previous pilots
- Current list of 2D barcoded vaccines
- 2D Scanning Functional Requirements
- AAP Guidance
- GS1 Guidance
- Training videos

