

Cost of Delivering Centralized and Decentralized Reminder/Recall for Vaccinations to Children and Adolescents in an ACO

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ABSTRACT

OBJECTIVES: Within an accountable care organization (ACO), we compare the investment needed to deliver reminder/recall (R/R) for childhood and adolescent vaccinations via 2 approaches: (1) centralized R/R with messages delivered to all patients of the ACO by a single organization versus (2) decentralized R/R with messages delivered to ACO patients by their primary practice.

STUDY DESIGN: A cost analysis was conducted to calculate the total cost of initiating and implementing centralized and decentralized R/R.

METHODS: Domains of resource use included collaboration, training, and recall. Personnel time was monetized using standardized federal wage rates for each occupation. Nonpersonnel resources were calculated using invoices for R/R activities. Start-up and implementation costs were stratified by approach (centralized and decentralized) and population (child and adolescent).

RESULTS: Of the 11 practices that agreed to participate in decentralized R/R for children at their practice, just 1 conducted R/R. Similarly, of the 15 practices that agreed to participate in decentralized R/R for adolescents at their practice, just 5 conducted R/R. This study found that start-up costs for R/R were similar across approaches (\$1366 for centralized and \$1300 for decentralized), but implementation costs differed. For R/R in children, implementation costs were more than twice as much for decentralized R/R (\$3.92 per child recalled) than for centralized R/R (\$1.78 per child recalled). Similarly, the cost of R/R for adolescents was \$1.37 per adolescent recalled in decentralized R/R and \$0.78 per adolescent recalled in centralized R/R.

CONCLUSIONS: Centralized R/R within an ACO was less costly than decentralized R/R and resulted in more patients being reached.

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Accountable care organizations (ACOs) are groups of healthcare providers and facilities that unite to share the responsibility of providing medical care to a set of patients.¹ There are now more than 600 ACOs in the United States.² These entities are held accountable by healthcare payers for the quality and cost of care delivered to their patients.¹ Although the design of ACOs varies due to different provider configurations and payment models, some features are generally common to all ACOs.¹ These commonalities include that they are provider-led with a foundation in primary care, they are held accountable for the quality and cost of care for their patients, they link payments to quality improvements that reduce cost, and they integrate sophisticated performance measurements to demonstrate savings through improved care.¹ ACOs are thus incentivized to improve the quality and efficiency of care provided to their patients and to demonstrate the value of the healthcare they deliver.²

Vaccination represents one of the most valuable health interventions available. It can prevent the direct and indirect costs associated with treating and managing vaccine-preventable diseases.³ Research has estimated that for every dollar spent on vaccines, there are savings of \$3 to the payer and \$10 to society.³ ACOs should be encouraged to increase vaccination coverage for their patients to improve patient health outcomes by reducing the number of preventable infectious diseases and to promote efficient healthcare by providing healthcare interventions proven to generate cost savings.

Evidence suggests that reminder/recall (R/R) is associated with an increase in vaccination coverage by notifying patients of vaccinations that are due soon (reminders) or are overdue (recall) via mailed postcard, phone call, text message, or some combination of these.^{4,5} Recent studies have evaluated different approaches to R/R, including centralized and decentralized approaches. Centralized R/R approaches refer to R/R messages sent by a single entity (eg, state health department^{6,7} or managed care organization⁸) to health systems or entire counties using centralized patient data from a state or jurisdictional Immunization Information System (IIS). A decentralized approach refers to R/R conducted by individual practices using administrative, electronic health record, or IIS data to reach out to their own patients. Although both approaches are effective at increasing vaccination coverage, their adoption by state health departments, managed care organizations, and individual practices has been limited. Centralized R/R has only recently been described and has not been broadly adopted by state health departments or managed care organizations. Decentralized R/R is conducted by less than 20% of practices⁹ due to time constraints, financial barriers, and lack of technical support.^{9,10} Because ACOs generally include a group of practices, they could use either approach to increase vaccination coverage for their patient population.

The objective of this analysis was to calculate the investment needed to deliver R/R to the child and adolescent populations of an ACO via both centralized and decentralized approaches, in order to inform ACOs of the approach that is least costly.

METHODS

Centralized Versus Decentralized Approaches to R/R

This study calculated the total cost of delivering 2 R/R approaches: centralized R/R and decentralized R/R. Both approaches used a state immunization registry, the Colorado Immunization Information System (CIIS), to identify patients who belonged to the ACO and needed at least 1 vaccine. The CIIS receives patient and immunization data through live entry into the web-enabled application and through electronic transfers from data sources maintained by providers and insurers. The CIIS includes historical data about immunizations given outside of the state, if data were entered by a provider within the state. Participating provider practices can access the CIIS via a web application to view and update a patient's immunization and demographic information. A report can be run by authorized users, including ACOs and practices, to identify patients in need of at least 1 vaccine.

In the centralized R/R approach, the Colorado state health department led the R/R efforts for the ACO patients. ACO patients in need of at least 1 vaccine were sent up to 2 automated phone messages followed by 1 postcard; reminders were sent approximately 6 weeks apart. If patients did not have a phone number in the CIIS or the phone number was determined to be incorrect, the patient received a

postcard instead of a phone call for each subsequent reminder. A toll-free number and an email address were included in the R/R message to allow the patient to opt out of receiving further messages. If a patient became up-to-date on their vaccines after the first or second R/R message or chose to opt out of future messages, they did not receive subsequent messages.

In the decentralized R/R approach, participating practices led the R/R efforts for their subset of patients, and each practice was compensated \$0.80 by the ACO per message sent out. The practices were offered training on using the CIIS to run R/R and could choose which format in which to send the messages (eg, postcard, phone call, text message). Practices could also elect to conduct a chart audit of the patient list generated in the CIIS to identify any patients within the CIIS who were no longer patients of their practice (eg, patients who had moved or gone to another practice). A scenario analysis was conducted to estimate the practice-level costs for a practice that elected to do a chart audit prior to sending the R/R messages to patients on the list.

Design

A cost analysis was conducted for centralized R/R and decentralized R/R done through an ACO in Colorado to quantify and monetize the personnel and nonpersonnel resources needed to initiate and implement each R/R approach. Domains of resource use included collaboration, training, and recall (**Table 1**). Collaboration included permissions and support for the implementation of the R/R program, as well as the identification of patients belonging to the ACO within the CIIS. Training included the time and resources needed to learn how to use the CIIS for R/R and the third-party system to deliver automated R/R phone messages. Recall included the development of R/R materials and delivery of R/R messages. Costs were stratified by start-up and implementation. Start-up costs were the costs needed to develop the R/R program and were considered one-time costs. Implementation costs were the costs needed to conduct the R/R program; these costs accrued each time R/R was implemented and varied according to the number of children or adolescents in the practice. To account for the variation in cost resulting from the number of children and adolescents in the practice, implementation costs were reported as cost per child/adolescent recalled and calculated by dividing the total implementation costs by the total number of children/adolescents recalled. Costs were also separated by perspective: ACO, state health department, and practice costs were captured.

Personnel costs for the ACO and state health department were estimated by capturing time spent on R/R tasks for each person at the ACO and state health department using a time log. Personnel time at the practice (decentralized R/R only) was collected using structured interviews with individuals involved with R/R to reduce the burden on the practice. Personnel time was monetized using

Table 1. Description of Each Domain Included in the Cost Analysis

Cost Domain	Start-Up	Implementation
Centralized		
Collaboration	Time and resources needed to obtain permissions and support for the R/R program. Activities included advisory committee meetings to gain support for and refine the program, as well as meetings with outside entities to obtain the permissions required to initiate the program.	Time and resources needed to identify the patients belonging to the ACO
Training	Time and resources needed to complete training on software system that generated the R/R automated phone messages	None
Recall	Time and resources needed to create phone scripts and templates for mailed postcards	Time and resources needed to pull IIS reports and send R/R automated phone messages and postcards to patients
Decentralized		
Collaboration	Time and resources needed to obtain permissions and support for the R/R program. Activities included advisory committee meetings to gain support for and refine the program, as well as meetings with outside entities to obtain permissions required to initiate the program.	Time and resources needed to identify the patients belonging to the ACO
Training	Time and resources needed to conduct and attend webinar explaining how to use the IIS for R/R	None
Recall	Time and resources needed to create templates for mailed postcards	Time and resources needed to pull IIS reports and send R/R postcards to patients

ACO indicates accountable care organization; IIS, immunization information system; R/R, reminder/recall.

standardized federal wage rates for each occupation type based on Bureau of Labor Statistics data.¹¹ Nonpersonnel resources were calculated using invoices paid for R/R activities.

Population

An ACO serving patients in the greater Denver metropolitan area and northeastern Colorado was selected to participate in facilitating centralized and decentralized R/R programs for its patients. Children and adolescents in the ACO were covered by Colorado Medicaid or the State Children’s Health Insurance Program. These children and adolescents were assigned to a medical home that included single and multisite practices of pediatric and family medicine providers. Based on different vaccine recommendations, a separate R/R program was conducted for each age group. The child R/R program included children between the ages of 19 and 35 months and lasted from February 2015 through August 2015. For the child population, immunizations that were included in R/R were diphtheria, tetanus, and acellular pertussis; polio; measles, mumps, rubella; hepatitis B; *Haemophilus influenzae* type b; varicella; and pneumococcal disease, as recommended by the Advisory Committee on Immunization Practices.¹² The adolescent R/R program included young people between the ages of 11 and 17.9 years and lasted from July 2015 through July 2016. Immunizations for the adolescent population that were included in R/R were

human papillomavirus; meningococcal ACWY; and tetanus, diphtheria, and acellular pertussis.¹²

Eligible practices with patients belonging to the ACO were approached by the ACO and project staff to participate in R/R activities. Practices were eligible to participate in the child R/R program if they actively used the CIIS and had at least 50 children aged 19 to 35 months enrolled in the ACO. Practices were eligible to participate in the adolescent R/R program if they actively used the CIIS and had at least 50 adolescents aged 11 to 17.9 years enrolled in the ACO.

This study was approved by the Colorado Multiple Institutional Review Board (Protocol #13-2395) and the Colorado Department of Public Health Institutional Review Board (Protocol 2014-001).

RESULTS

Sample

There were 64 practices eligible for the child R/R program, of which 29 (45%) chose to participate. Practice clusters, defined as those within the same system, sharing patients, and in close geographic proximity with each other, were randomized. Of the 29 participating practices, 9 practice clusters, representing 18 practices and 631 eligible children, were randomly selected for centralized R/R. On the other hand, 8 practice clusters, representing 11 practices and 430 eligible children, were randomly selected for decentralized R/R. Of the 18 practices selected for centralized

R/R, 99% of the patients who needed at least 1 vaccine received at least 1 R/R message from the state health department. But of the 11 practices selected for decentralized R/R, less than 20% of the patients who needed at least 1 vaccine received an R/R message from their practice because just 1 practice conducted R/R. The practice that conducted decentralized R/R chose postcards as its route of message delivery.

For the adolescent R/R program, there were 64 eligible practices, of which 32 (50%) chose to participate. Of the participating practices, 8 practice clusters, representing 17 practices and 7240 eligible adolescents, were randomly selected for centralized R/R. On the other hand, 9 practice clusters, representing 15 practices and 7283 eligible adolescents, were randomly selected for decentralized R/R. Of the 17 practices selected for centralized R/R, 99.5% of the patients who needed at least 1 vaccine received at least 1 R/R message from the

state health department. Of the 15 practices selected for decentralized R/R, less than 45% of the patients who needed at least 1 vaccine received an R/R message from their practice because just 5 practice sites conducted R/R. All of the practice sites that conducted decentralized R/R chose postcards as their route of message delivery.

Costs

Costs were reported separately for each R/R approach (centralized and decentralized) and each population (child and adolescent). Start-up costs for centralized and decentralized R/R are reported in **Table 2**. Start-up costs were \$1366 for centralized R/R. For decentralized R/R, start-up costs were a minimum of \$1300. The start-up costs for decentralized R/R are dependent on the number of practices that are involved in the decentralized R/R. For each practice that is involved, an additional \$169 should be added to the start-up costs. Start-up costs did not differ by population; therefore, start-up costs were the same for both the child and adolescent populations within each approach. However, there were differences in start-up costs between centralized and decentralized R/R in both training and recall. With centralized R/R, training was required only for state health department employees to learn the automated phone system. Conversely, with decentralized R/R, the ACO had to recruit and organize a webinar on how to use the CIIS to conduct R/R, the state had to create and deliver the webinar content, and each practice had to attend the webinar. For the recall domain, the personnel implementing the centralized R/R approach created a postcard template and a phone script. Personnel implementing the decentralized R/R approach created only a postcard template.

Implementation costs are reported separately for each approach and population (**Table 3**), as well as on a per-person basis. For centralized R/R, the state health department was responsible for the majority of the costs. For decentralized R/R, individual practices were responsible for the majority of the costs. Compared with decentralized R/R, centralized R/R was less costly for both child and adolescent populations.

A scenario analysis was conducted for a subset of adolescent practices that elected to conduct a chart audit to remove any patients no longer with the practice before sending the R/R messages. In the chart audit analysis, the cost for the nurse to review the chart was added into the final cost. The material and personnel costs required to send messages to the patients who were removed following the audit were excluded. **Table 4** presents the results of the scenario analysis. Although additional costs were associated with the personnel time required to review the chart for the

Table 2. Start-Up Costs Associated With R/R Approaches

	ACO	State Health Department	Practice ^a	Total ^b
Children				
Centralized total ^c	\$51	\$1315	\$0/practice	\$1366
Collaboration	\$51	\$787	\$0/practice	\$838
Training	\$0	\$51	\$0/practice	\$51
Recall	\$0	\$477	\$0/practice	\$477
Decentralized total ^d	\$255	\$876	\$169/practice	\$1300
Collaboration	\$51	\$787	\$0/practice	\$838
Training	\$204	\$89	\$16/practice	\$309
Recall	\$0	\$0	\$153/practice	\$153
Adolescents				
Centralized total ^c	\$51	\$1315	\$0/practice	\$1366
Collaboration	\$51	\$787	\$0/practice	\$838
Training	\$0	\$51	\$0/practice	\$51
Recall	\$0	\$477	\$0/practice	\$477
Decentralized total ^d	\$255	\$876	\$169/practice	\$1300
Collaboration	\$51	\$787	\$0/practice	\$838
Training	\$204	\$89	\$16/practice	\$309
Recall	\$0	\$0	\$153/practice	\$153

ACO indicates accountable care organization; R/R, reminder/recall.

^aCosts are reported per practice involved. For example, if 3 practices were involved in the decentralized R/R approach, practice costs would need to be multiplied by 3. There is no direct practice involvement with centralized R/R.

^bTotal cost assumes just 1 practice is involved, which is unlikely in an ACO population. If x practices were involved in the decentralized R/R approach, practice costs would need to be multiplied by x .

^cCentralized start-up costs do not differ based on population. Therefore, centralized start-up costs are the same for both children and adolescents.

^dDecentralized start-up costs do not differ based on population. Therefore, decentralized start-up costs are the same for both children and adolescents.

Table 3. Implementation Costs Associated With R/R per Person Recalled

	ACO	State Health Department	Practice	Total
Children				
Centralized total (n = 631; 18 practices)	\$0.31	\$1.47	\$0.00	\$1.78
Collaboration	\$0.31	\$0.12	\$0.00	\$0.43
Training	\$0.00	\$0.00	\$0.00	\$0.00
Recall	\$0.00	\$1.35	\$0.00	\$1.35
Decentralized total (n = 192; 1 practice)*	\$1.02	\$0.41	\$2.49	\$3.92
Collaboration	\$1.02	\$0.41	\$0.00	\$1.43
Training	\$0.00	\$0.00	\$0.00	\$0.00
Recall	\$0.00	\$0.00	\$2.49	\$2.49
Adolescents				
Centralized total (n = 7240; 17 practices)	\$0.03	\$0.75	\$0.00	\$0.78
Collaboration	\$0.03	\$0.01	\$0.00	\$0.04
Training	\$0.00	\$0.00	\$0.00	\$0.00
Recall	\$0.00	\$0.74	\$0.00	\$0.74
Decentralized total (n = 5472; 5 practices)*	\$0.04	\$0.01	\$1.32	\$1.37
Collaboration	\$0.04	\$0.01	\$0.00	\$0.05
Training	\$0.00	\$0.00	\$0.00	\$0.00
Recall	\$0.00	\$0.00	\$1.32	\$1.32

ACO indicates accountable care organization; R/R, reminder/recall.
*Includes only those patients in practices that conducted R/R.

audit, the procedure resulted in lower costs for postage and post-card materials. If a practice conducted the chart audit before sending out the messages, the cost per person was higher; however, if people were removed based on the audit, fewer people needed to be recalled. The chart audit could affect outcomes of R/R, such as percentages of patients who received a vaccination, which were not taken into consideration in this evaluation.

DISCUSSION

ACOs may wish to ensure the provision of R/R to their patient population to improve health outcomes and reduce healthcare expenditures. This study found that centralized R/R, or having a single site (in this analysis, the state health department) provide R/R to the ACO patient population, was less costly than having each individual practice provide R/R (decentralized R/R) to its subset of patients belonging to the ACO.

Although Table 2 shows that start-up costs for centralized R/R (\$1366) are higher than those for decentralized R/R (\$1300), note

that the practice-level costs (\$0 for centralized R/R and \$169 for decentralized R/R) were reported on a per-practice basis. Therefore, if more than 1 practice was involved in the decentralized R/R approach—which is likely because of the coordinated structure of ACOs—the start-up costs for decentralized R/R would be greater than the start-up costs for centralized R/R. Start-up costs are the same regardless of population, but they differ slightly by R/R approach. The implementation costs were lower in centralized R/R compared with decentralized R/R. For R/R in children, the per-person implementation costs were more than twice as much for decentralized R/R (\$3.92 per child recalled) compared with centralized R/R (\$1.78 per child recalled). A similar trend was evident for R/R in adolescents (\$1.37 per adolescent recalled in decentralized R/R and \$0.78 per adolescent recalled in centralized R/R). The difference in cost per individual between the child and adolescent populations may be due to the lower number of children recalled in the child population. This may suggest economies of scale in that the marginal cost decreases as the number of people recalled increases.

This study also found that getting practices to participate in decentralized R/R was a challenge, even when they were compensated by the ACO. Of the 11 practices selected for decentralized R/R for the children at their practice, just 1 conducted R/R. Similarly, of the 15 practices selected for decentralized R/R for the adolescents at their practice, just 5 sites conducted R/R. This mirrors the findings of other recent trials

that compared centralized with practice-based approaches, in which participation in R/R by practices was extremely low, despite compensation for the costs incurred.^{6,7} Unlike in decentralized R/R, nearly all patients selected for the centralized R/R received an R/R message because the state health department was responsible for sending them out. With centralized R/R, only children who had inaccurate contact information in CIIS did not receive messages.^{6,8} Therefore, centralized R/R was not only less costly, but it was also able to reach a higher percentage of children and adolescents.^{9,10}

Limitations

This cost analysis is limited because without including health outcomes (number of vaccinations received), we are unable to assess whether the investment was a good use of resources. However, literature has documented the effectiveness of centralized and decentralized R/R.^{6,7} Other recent research completed in similarly aged populations has shown that centralized R/R is more effective in increasing vaccination coverage compared with decentralized R/R.

Table 4. Implementation Costs Associated With Decentralized R/R per Adolescent Recalled, With and Without Chart Audit

	ACO	State Health Department	Practice	Total
Without Chart Audit				
Adolescent, decentralized	\$0.04	\$0.01	\$1.32	\$1.37
Collaboration	\$0.04	\$0.01	\$0.00	\$0.05
Training	\$0.00	\$0.00	\$0.00	\$0.00
Recall	\$0.00	\$0.00	\$1.32	\$1.32
With Chart Audit				
Adolescent, decentralized	\$0.04	\$0.01	\$1.45	\$1.50
Collaboration	\$0.04	\$0.01	\$0.00	\$0.05
Training	\$0.00	\$0.00	\$0.00	\$0.00
Recall	\$0.00	\$0.00	\$1.45	\$1.45

ACO indicates accountable care organization; R/R, reminder/recall.

This factor would likely make centralized R/R even less costly compared with decentralized R/R if outcomes could be calculated.^{6,7,13} Secondly, because of the small number of practices that conducted decentralized R/R, we were unable to examine potential economies of scale. Our evaluation found that R/R in children was more expensive than R/R in adolescents. This could suggest economies of scale because there were fewer children recalled than adolescents recalled. Finally, variation could exist in the implementation of the R/R program, such as in the number of recalls and the format of recalls (eg, postcard, mail, text message, combination). The costs reported are based on the program that was implemented in this study. Program decisions, such as the format of messages, number of messages delivered, and software used, could produce different results than those presented in this analysis. For example, we assumed that the state health department would use a cloud-based automated phone system that costs \$0.045 per call to deliver the messages for centralized R/R. However, a state health department could elect to purchase an entire software system, which would cost approximately \$12,000, instead of paying per call for the cloud-based system. If the state health department planned on making at least 266,666 calls, purchasing the system would be a more efficient approach than using the cloud-based system. Using the purchase price of the entire system, instead of the cloud-based system used in this analysis, may generate different results.

CONCLUSIONS

Centralized R/R is less costly than decentralized R/R for children and adolescents. Further, centralized R/R does not rely on individual

practices conducting R/R, as all R/R messages are sent by a single entity. To increase vaccination coverage for their patient populations and, as a result, improve patient health outcomes and reduce unnecessary costs, ACOs may wish to implement R/R. Centralized R/R with an ACO was less costly than decentralized R/R and resulted in more patients being reached.

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