Supplemental materials for:

Krist AH, Woolf SH, Bello GA, et al. Engaging primary care patients to use a patient-centered personal health record. *Ann Fam Med*. 2014;12(5):418-426.

ONLINE APPENDIX. Impact of Practice Characteristics and IPHR Implementation Strategies on IPHR Use

Development of Implementation Strategies

The IPHR implementation strategy evolved over the study period through two general mechanisms – group learning collaborative activities and individual practice-level activities.

Learning collaborative participants included one or two clinicians, nurses, or office managers from each practice. The learning collaborative members served as practice champions who provided input into the IPHR design, decided how to initially implement the IPHR at their practice, trained all of their practice clinicians and staff to use the IPHR, shared with other learning collaborative members their experiences, decided how to evolve their practice's IPHR implementation strategy based on what they learned from other practices, and coordinated all study data collection activities.

Learning collaboratives were facilitated by the research team (PLK and AHK), but members set the collaborative's priorities. There were three learning collaboratives prior to the IPHR go live date and four after practices began to implement the IPHR. Learning collaborative members from all of the practices met together in person for the meetings. Further details of the learning collaborative process are available from the Agency for Healthcare Research and Quality (http://healthit.ahrq.gov/KRIST-IPHR-Guide-0612.pdf).

The general learning collaborative agenda was as follows:

TABLE 1. Learning collaborative agenda and timeline	
Learning collaborative #1: Conducted 4 months prior to go-live.	Reviewed the function and purpose of the IPHR. Discussed the goals and role of the learning collaborative. Considered how clinicians enter data needed by the IPHR into the electronic health record.
Learning collaborative #2: Conducted 2 months prior to go-live.	Began to illustrate the practice's current workflow for preventive care and the plans for changing the workflow with the IPHR. Reviewed the practice's baseline preventive care delivery measures.
Learning collaborative #3: Conducted 1 month prior to go-live.	Completed the practice's workflow analysis. Developed a training program to get practice personnel prepared to implement the IPHR. Reviewed baseline data about the practice's prevention delivery.
Learning collaborative #4: Conducted 1 month after go-live.	Shared initial go-live experiences. Identified implementation problems and developed solutions.
Learning collaborative #5: Conducted 3 months after go-live.	Reviewed and discussed how well each practice implemented the proposed workflow revisions.
Learning collaborative #6: Conducted 6 months after go-live.	Shared successes and challenges with IPHR implementation. Developed strategies to overcome the challenges.
Learning collaborative #7:	Developed strategies to sustain IPHR use. Decided on future

Conducted 12 months after go-live.	directions for the IPHR and prevention delivery. Reviewed workflow and how well they implemented their proposed changes. Listed strategies for other practices to do or avoid when implementing an IPHR.

Individual practice-level implementation activities occurred more spontaneously and informally at several individual offices. They occurred between learning collaborative meetings and were usually implemented by a single office initially, but often spread to other offices after sharing their experiences.

To track each practice's individual implementation experience, we used both quantitative and qualitative data.

(1) All learning collaborative meetings were audiorecorded, transcribed, coded, and analyzed to understand factors influencing implementation. Research team members took field notes.
(2) The research team monitored the number of new IPHR users for each practice weekly. The number of new users was shared among all the offices for benchmarking and group learning. Variations in use prompted a discussion between the research team and practice champions to document possible causes for the change.
(3) Each practice created a diagram to map their workflow for delivering preventive care prior to implementing the IPHR. Each practice revised their workflow to incorporate its IPHR implementation strategy. Three months after the IPHR go-live date, practices reviewed and revised their implementation workflow. Twelve months after the IPHR go-live date, the practices reported to the research team the fidelity of their implementation strategy.
(4) Six and twelve months after going live, 320 patients who created an IPHR account and 320 patients who did not create an IPHR account were mailed a survey to understand their perspective on how their practice engaged them to use the IPHR and how the IPHR influenced their care.
(5) After preparing all data presentations, research team members met with each practice's champions to review their overall and practice specific data. Practice champions were asked to react to and describe implementation and contextual factors that they thought might have influenced results.

Initial IPHR Implementation

Prior to the go-live date the learning collaborative members created several strategies to notify patients about the new IPHR functionality. These included

- Passively introducing the IPHR through introductory information posted on:
    - Practice websites
    - Telephone hold messages
    - Check-in kiosks
    - Waiting room posters
- Actively introducing the IPHR through handouts with IPHR sign-up information on:
    - Business cards

- Brochures
- Health maintenance forms

Initially, learning collaborative members focused on developing the passive and active introductory materials. All practices planned to engage patients through passive materials and to rely on clinicians and nurses to distribute sign-up information during office visits as appropriate.

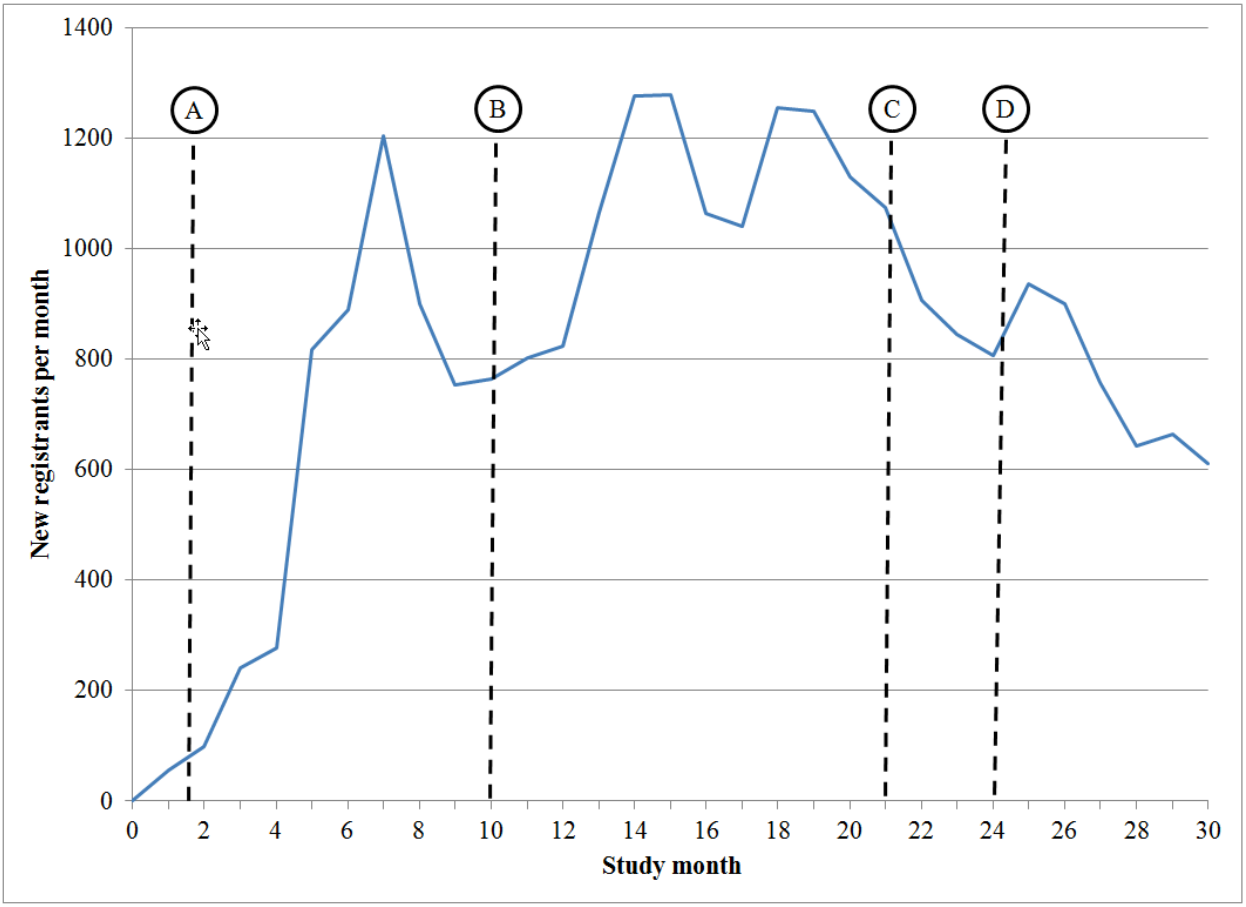
Influenced by the availability and skills of practice staff (nurses and medical records staff) as well as practice culture, the practices developed three workflows to deal with incoming IPHR clinical summaries. Practices 1, 5, and 8 had the IPHR send summaries to medical records staff and practices 3 and 4 had the IPHR send summaries to a central nurse. Through a protocol developed by the learning collaborative members, the medical records staff or nurse would address flagged issues as appropriate, such as scheduling an appointment or arranging the delivery of a preventive service, and then forward the summary with an explanation of what they did to the patient's primary clinician to review and sign. Practices 2, 6, and 7 had the IPHR send clinician summaries to the patient's primary care clinician. He or she would be responsible for either personally addressing the flagged issues or tasking staff for assistance. During the study period, no practices changed their workflow for handling the IPHR clinical summaries.

New IPHR registrants as a function of implementation changes

Figure 1 below shows the number of new IPHR users per month for all eight study practices in relation to four major changes in IPHR functionality, IPHR implementation, or other practice activities. In month 1, several practices launched a team-based approach for introducing the IPHR to patients (labeled A on the figure). Practices had previously relied on clinicians to inform patients about the IPHR. In the team-based approach, check-in staff distributed information to patients, nurses discussed how to sign up when rooming patients, and clinicians reinforced the value of enrolling. In month 10, the IPHR functionality expanded to include the ability to notify patients of all laboratory test results, not just the results for certain screening tests (labeled B on the figure), but only certain practices offered this new feature to their patients. In month 21, all practices implemented a new practice management system for scheduling appointments and submitting claims. Finally, in month 24, the practice's EHR was upgraded in preparation for Stage 2 Meaningful Use. Part of the upgrade included an aftercare summary print out for clinicians to give to patients after a visit. Information about how to create an IPHR account was automatically included on every aftercare summary and some practices used this to promote patient enrollment.

Overall, the greatest increase in the number of new users occurred after the introduction of the team-based approach, followed by the ability of the IPHR to show patients all laboratory results. The mention of the IPHR in aftercare summaries was followed by a slight increase in the number new IPHR accounts, but the effect lasted only two months. There was a decline in new IPHR registrations when practices were preoccupied with implementing their new practice management system. There was also a general decline towards the end of the study in new enrollments – partly because a greater proportion of patients being seen already had accounts. Details about how these changes impacted each individual practice are presented below.

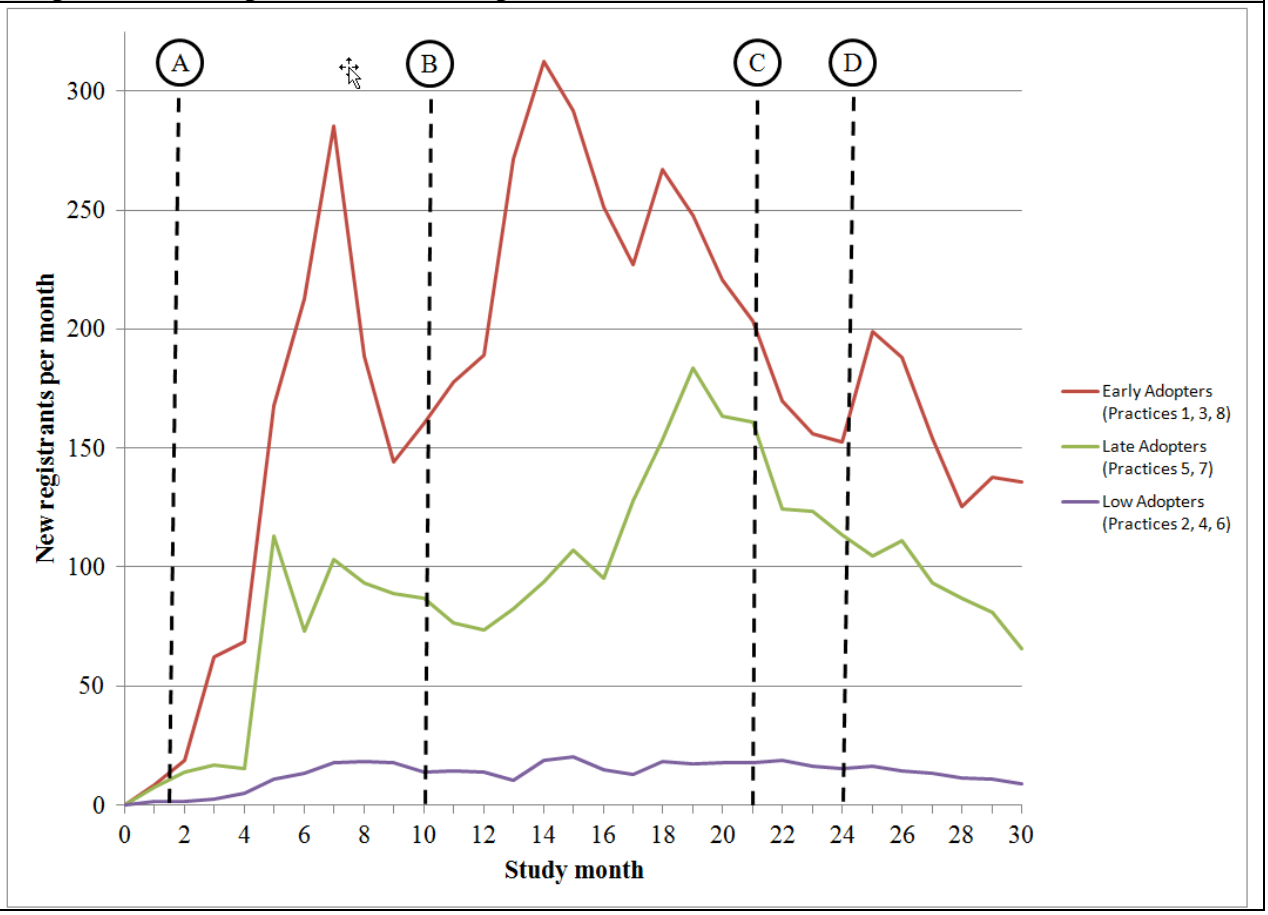
FIGURE 1. Number of new IPHR users per month for all study practices



Notes:
A = Introduction of the team approach; B = Expanded IPHR functionality to show patient all laboratory results; C = Practices implemented a new practice management system; and D = Expanded EHR functionality to generate aftercare summaries for patients

When reviewing the number of new IPHR registrants each month for the individual practices, practices appear to fall into one of three categories – *early adopters* (Practices 1, 3, and 8), *late adopters* (Practices 5 and 7), and *low adopters* (Practices 2, 4, and 6) (see Figure 2 below). These findings are further supported and reinforced by the qualitative data. The early adopter practices were the first practices to try new implementation strategies, while late adopter practices learned from early adopters and implemented similar strategies several months later. Low adopter practices had steady rates of new IPHR registrants but reported limited or no adoption of new implementation strategies and experienced no spikes in new users.

FIGURE 2. Number of new IPHR users per month for three cohorts of practices – early adopters, late adopters, and low adopters



Notes:
New registrants per month presented as practice average for practices included in cohort (e.g. for early adopters = (new registrants for practice 1 + practice 3 + practice 8) / 3 practices

A = Introduction of the team approach; B = Expanded IPHR functionality to show patient all laboratory results; C = Practices implemented a new practice management system; and D = Expanded EHR functionality to generate aftercare summaries for patients

IPHR implementation facilitators and barriers

Table 2 presents six analytic findings with supportive themes and example quotes that emerged from the qualitative analysis of learning collaborative discussions with respect to IPHR implementation facilitators, barriers, and workflow changes. Findings associated with facilitators were having a culture amenable to change and getting buy-in from all clinicians and staff. All practices cited the critical importance of clinician buy-in, while the importance of staff buy-in was cited more often by practices that implemented a team-based approach. Learning collaborative members consistently cited two implementation barriers –prior negative

experiences with other informatics tools and competing demands on staff, a particular challenge to adopting a team based approach.

Two strong analytic findings were found with respect to practice workflow. First, learning collaborative members discussed the importance of redesigning workflow to allow staff to function at a higher level, such as using IPHR summaries as nurse standing orders and having medical records staff update the chart and contact patients. This finding was more dominant in non-clinician centric offices (e.g. practices that used the team engagement approach or sent summaries to nurses and medical records staff). Second, learning collaborative members reported that implementing the IPHR helped the practices to deliver care outside of visits and to engage patients in their care through access to information on demand, generating new questions for their provider, and a mechanism to update their records. These features also seemed to help facilitate buy-in for IPHR implementation among clinicians and staff.

TABLE 2. Facilitators, barriers, and workflow changes to implement the Interactive Preventive Health Record (IPHR), as expressed in learning collaboratives

Analytic Findings	Themes Supporting Findings	Example Quotations
Facilitators		
A practice culture amenable to change allowed practices to adopt the IPHR.	• Practices are local change leaders (10) • IPHR supports ongoing practice activities (8) • Practices monitor quality measures (6) • Want to use IPHR to improve care (4)	*"You know this is a change organization. We are constantly changing workflows and bringing out new things and ideas."* [Clinician] [Negative quote] *"I have a provider out there that probably, I'm not sure how they'll respond, because it kind of crimps into the way they do things and they don't want to change."* [Office Manager]
Buy-in from all clinicians and staff was essential to promote IPHR use.	• Clinician support necessary (14) • Team-based patient engagement worked (12) • Practice presented a consistent elevator pitch (12) • Nurse and staff critical to engage patients (10) • Clinicians and staff designed implementation workflow(6)	*"I really like this and I think it has a lot to offer my patients."* [Clinician] *"Provider participation makes a huge difference."* [Nurse] *"I saw a lot of physicians actively asking patients to sign in and I've seen a huge jump and that's because of that."* [Nurse] *"The front desk was doing a very good job at handing out cards. Then when nurses were taking the patients back, they were also reminding patients."* [Office manager]
Barriers		

Competing demands on staff made IPHR implementation more difficult.	• Practices are making other changes (doing other studies) (10) • Nurses are too busy (8) • High nurse and staff turn-over (8) • Check-in staff are too busy (6)	*"We've got a lot of staffing issues and stuff."* [Nurse] *"If they remember, because it's kind of hard with our front desk and answering phones"* [Nurse Manager]
Negative experiences with prior IT implementations hinder adoption of new IT tools.	• Secure messaging portal functions poorly (14) • Patients may not like using the Internet (6) • Worried information in EHR may not be accurate (4)	*"I mean, [*practice secure message portal*], you know everybody was promoting it. Hurray, hurray this is an awesome. Then it fails. The trust isn't there."* [Nurse] *"I think a lot of people stepped away from it [*EMR health management section*] because they didn't want to go off of it if there were so many errors."* [Nurse]
Workflow Changes		
Practices redesigned workflow to allow staff to function at a higher level.	• IPHR use reduced practice workload (18) • Practices already doing this work (10) • Engaged patients at multiple times (10) • Summaries served as standing orders (6) • Rethinking workflow is difficult (6) • Inexperienced staff could not use summaries (1)	*"That way, even before I get to go the room, the nurse can say oh you need a flu shot today, boom, we got that."* [Nurse] *"I would put this information right to my unit clerk and let them begin to decipher. It's not a task that needs to go to the doctor."* [Nurse]
IPHR use helped practices to engage patients and deliver care outside of office visits.	• IPHR use improved preventive care (12) • IPHR use improved documentation (8) • Patients asked more questions about care (4) • Patient interest catalyzed practice change (4) • Patients liked using the IPHR (4) • Information may cause patient anxiety (1)	*"When the patient ends up leaving the office, a lot of time we have difficulty tracking them in terms of their glucose, their weights. We really can't keep tabs on them, but if they are using [the IPHR], it will send them information."* [Nurse] *"It's amazing the kind of questions that come from the patients. The kind of stuff that patients ask. And we're getting phone calls – so when is my mammogram due?"* [Nurse] *"They'll* [patients] *actually enter the colonoscopy and the mammogram and stuff in the EMR."* [Nurse]

		"We just cut a huge chunk of workflow every day." [Office Manager]

Note:
Numbers presented in "Themes Supporting Findings" represent the frequency of participant quotations supporting the theme.

Themes in red counter analytic findings.

Patient Perceptions of IPHR Implementation

Among survey respondents who used the IPHR (Table 3, below), the majority reported being introduced to the IPHR by their clinician, followed by the front desk staff, and their clinician's nurse. The importance patients placed on the clinician promoting the IPHR is not consistent with our observation that IPHR use was more likely when the clinician had a secondary role and the IPHR was promoted under a team-based approach. However, this finding is consistent with the results of our bivariate analysis, in which the variance between practices lost significance (variance=0.00; p=0.368) whereas the variation between clinicians persisted (variance = 0.28; $p<0.001$). Taken together, this evidence suggests that the team-based approach may be needed to do the work of engaging patients to create an IPHR account, but the patient may remember the clinician endorsement and use of the system.

Only 22.5% of non-users reported being told about the IPHR, although 61.7% had visited the practice's website that contained a link to the IPHR and 11.7% had even used the practice's secure email system. This is consistent with our finding that passive mechanisms of engaging patients to use the IPHR seemed to have very little overall impact on IPHR use. When the IPHR was described to survey respondents who had not yet created an IPHR account, 67.1% reported being "very interested" or "somewhat interested" in using the system, suggesting that practices have an opportunity to engage even more patients to use the IPHR.

TABLE 3. Patient perspective survey responses

How did you hear about the IPHR	IPHR users	IPHR non-users
My clinician	57.3%	11.2%
The office's front desk	30.4%	6.1%
My clinician's nurse	20.5%	7.3%
The practice's website	11.1%	5.5%
A poster, pamphlet, or check-in card	8.2%	0%
Phone or email after a visit	2.9%	0%
Phone or email before a visit	1.8%	0%

Practice 1's IPHR Implementation Experience (Early Adopter)

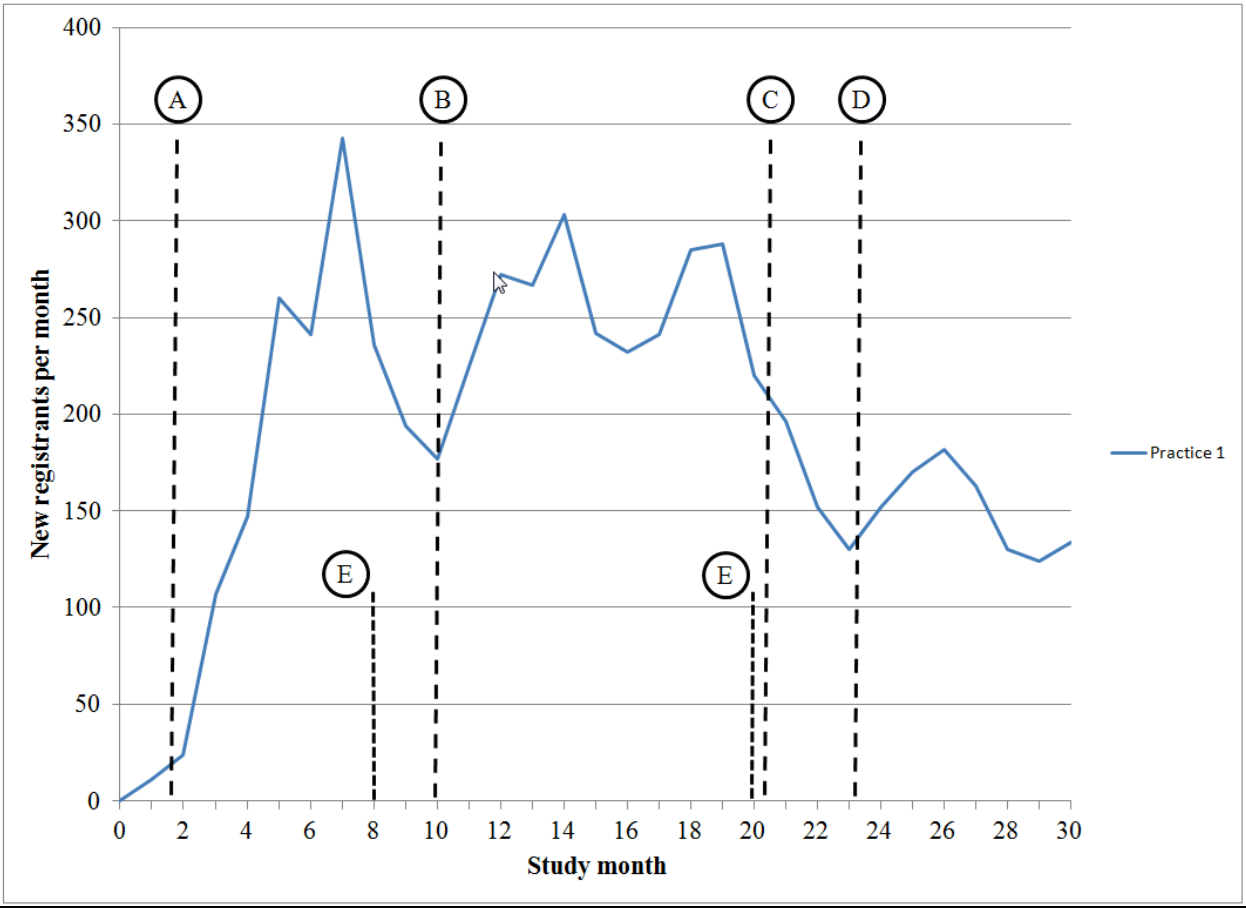
Practice 1 is notable for the following practice characteristics:

- Largest office (12 clinical full time equivalents, 250 patient visits per day).
- Only residency training site.
- General organizational change leader among all the offices.
- Average number of IPHR users (Practice 1 = 25.0%, Average = 25.6%).

Practice 1's implementation strategy is notable for the following:

- Medical records staff received IPHR summaries.
- Large size made training more difficult.
- Early adopter (month 2) of team approach to actively engaging patients to use the IPHR.
- Heavily encouraged clinicians to use the IPHR to notify patients of laboratory results.
- Attempted to use the after care summaries to engage patients to use the IPHR.

FIGURE 3. Number of new IPHR users per month for Practice 1



A = Team based approach, B = All laboratory results available, C = New practice management system, D = Aftercare summaries available, E = New residency year (change in residents)

Practice 2's IPHR Implementation Experience (Low Adopter)

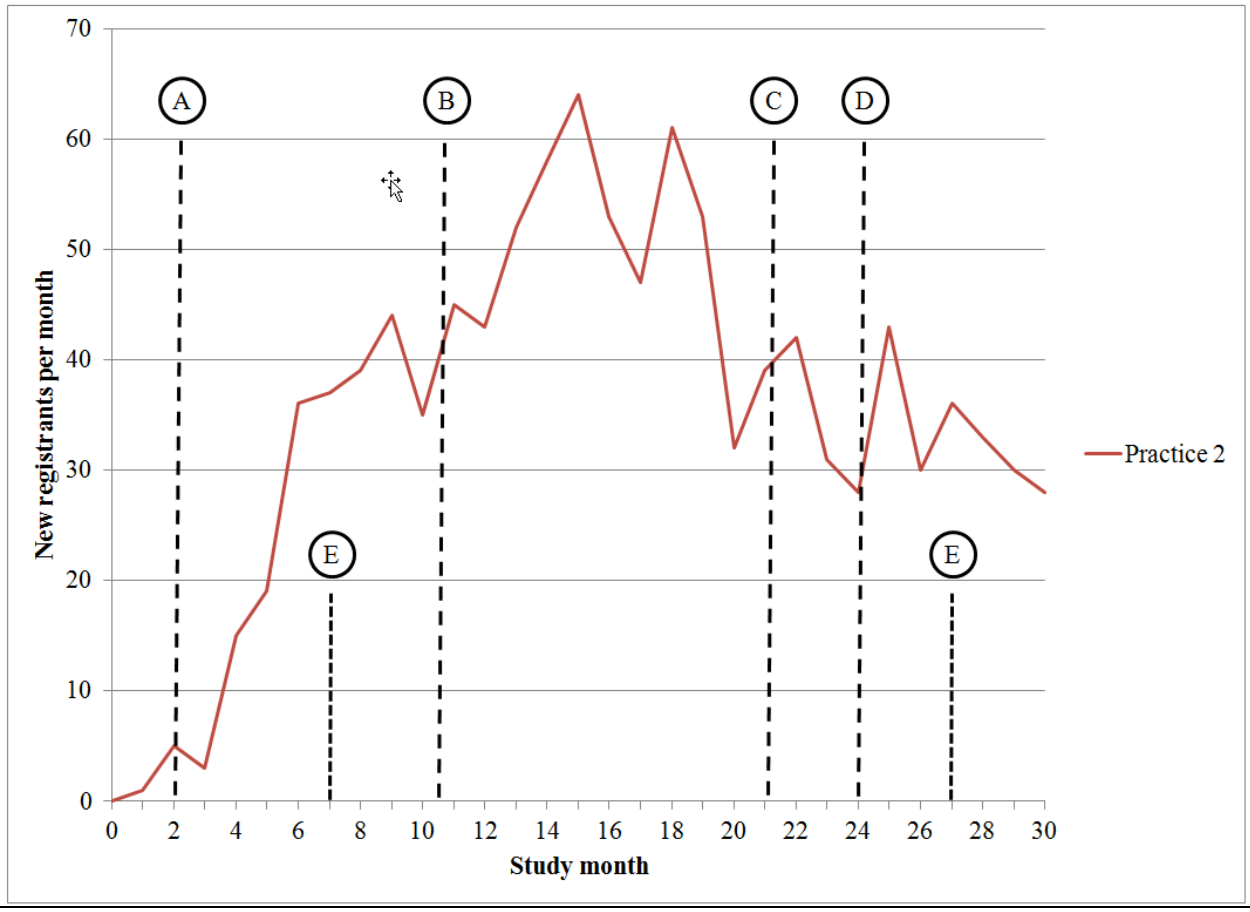
Practice 2 is notable for the following practice characteristics:

- Smaller office (3 clinical full time equivalents, 60 patient visits per day).
- Newest office (opened 2 years prior to study).
- Below average number of IPHR users (Practice 2 = 23.2%, Average = 25.6%).

Practice 2's implementation strategy is notable for the following:

- Primary care clinician received IPHR summaries.
- Mainly clinician dependent approach to actively engaging patients to use the IPHR with some front desk assistance. Nurses did not participate in process.
- Primarily introduced patients to IPHR at wellness visits.
- Clinicians called or mailed patients laboratory results rather than used the IPHR.

FIGURE 4. Number of new IPHR users per month for Practice 2



A = Team based approach, B = All laboratory results available, C = New practice management system, D = Aftercare summaries available, E = Existing nurse practitioner leaves and a new one is hired

Practice 3's IPHR Implementation Experience (Early Adopter – except implementing team approach)

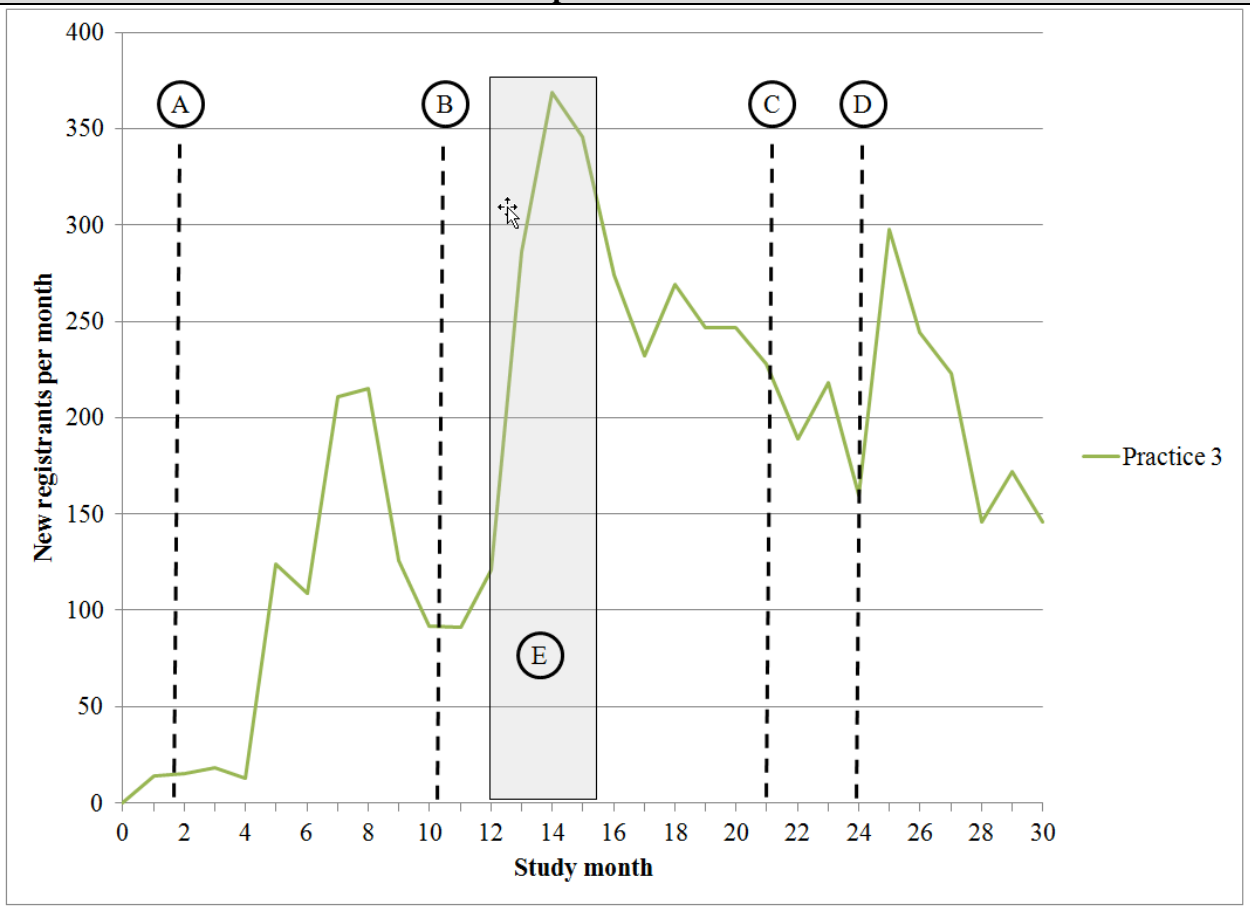
Practice 3 is notable for the following practice characteristics:

- Larger office (11 clinical full time equivalents, 225 patient visits per day).
- Highly competitive office and office manager who wanted most patients using IPHR.
- Above average number of IPHR users (Practice 3 = 26.7%, Average = 25.6%).

Practice 3's implementation strategy is notable for the following:

- Central nurse received IPHR summaries.
- Late adopter (month 3-4) of team approach to actively engaging patients to use the IPHR.
- Encouraged clinicians to use the IPHR to notify patients of laboratory results.
- Pushed use of aftercare summaries for 2 months to engage patients to use the IPHR, but became too labor intensive.

FIGURE 5. Number of new IPHR users per month for Practice 3



A = Team based approach, B = All laboratory results available, C = New practice management system, D = Aftercare summaries available, E = Office competition for nurses and clinicians to increase IPHR use (winner got free lunch)

Practice 4's IPHR Implementation Experience (Low Adopter)

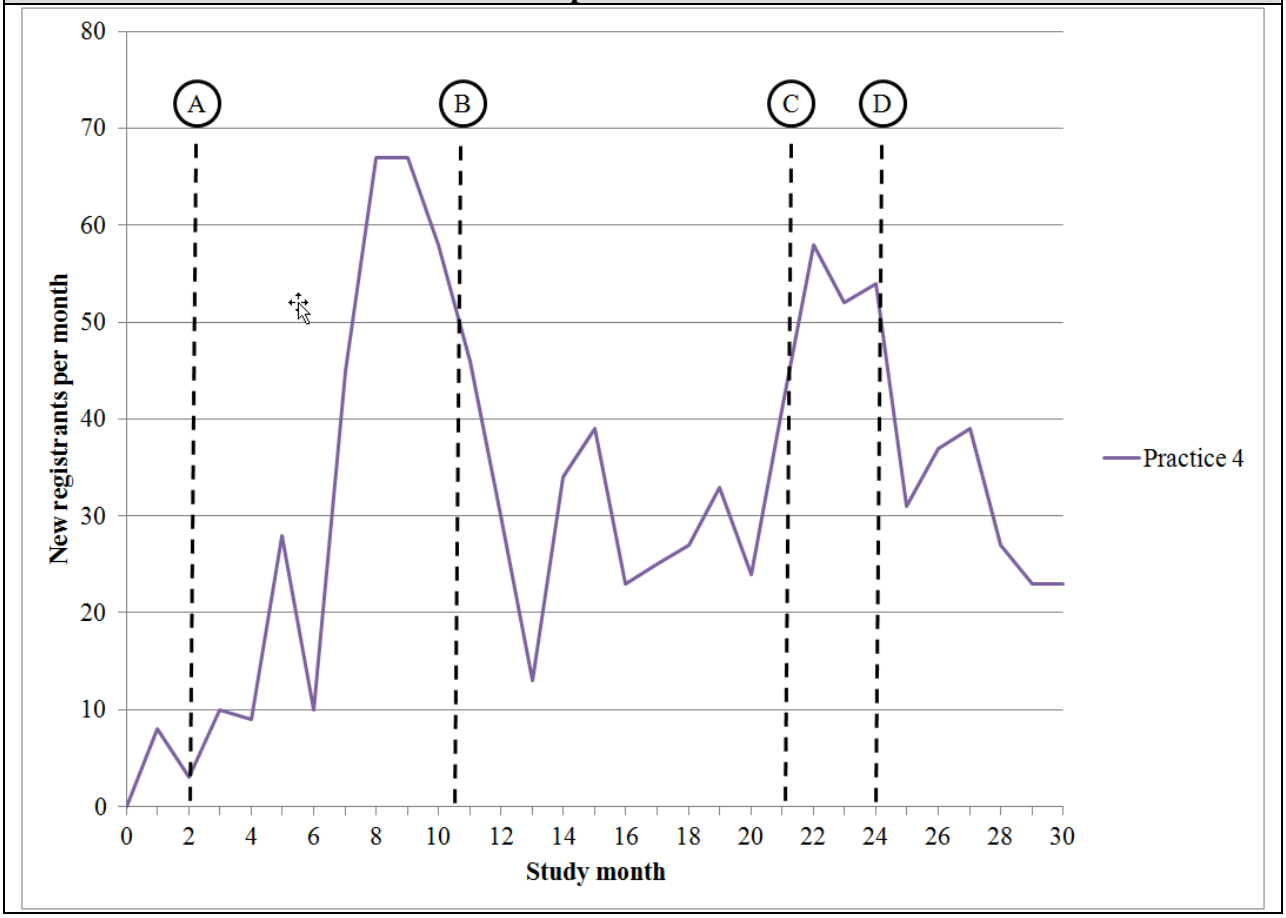
Practice 4 is notable for the following practice characteristics:

- Smaller office (4 clinical full time equivalents, 90 patient visits per day).
- Young, inexperienced nursing staff.
- Below average number of IPHR users (Practice 4 = 23.3%, Average = 25.6%).

Practice 4's implementation strategy is notable for the following:

- Central nurse received IPHR summaries.
- Attempted to notify patients about IPHR when scheduling appointments, but discontinued after 6 weeks.
- Front desk staff notified patients of IPHR during check-in.
- Nurses and clinicians less engaged in informing patients about IPHR.
- Clinicians called or mailed patients laboratory results rather than used the IPHR.

FIGURE 6. Number of new IPHR users per month for Practice 4



A = Team based approach, B = All laboratory results available, C = New practice management system, D = Aftercare summaries available

Practice 5's IPHR Implementation Experience (Late Adopter)

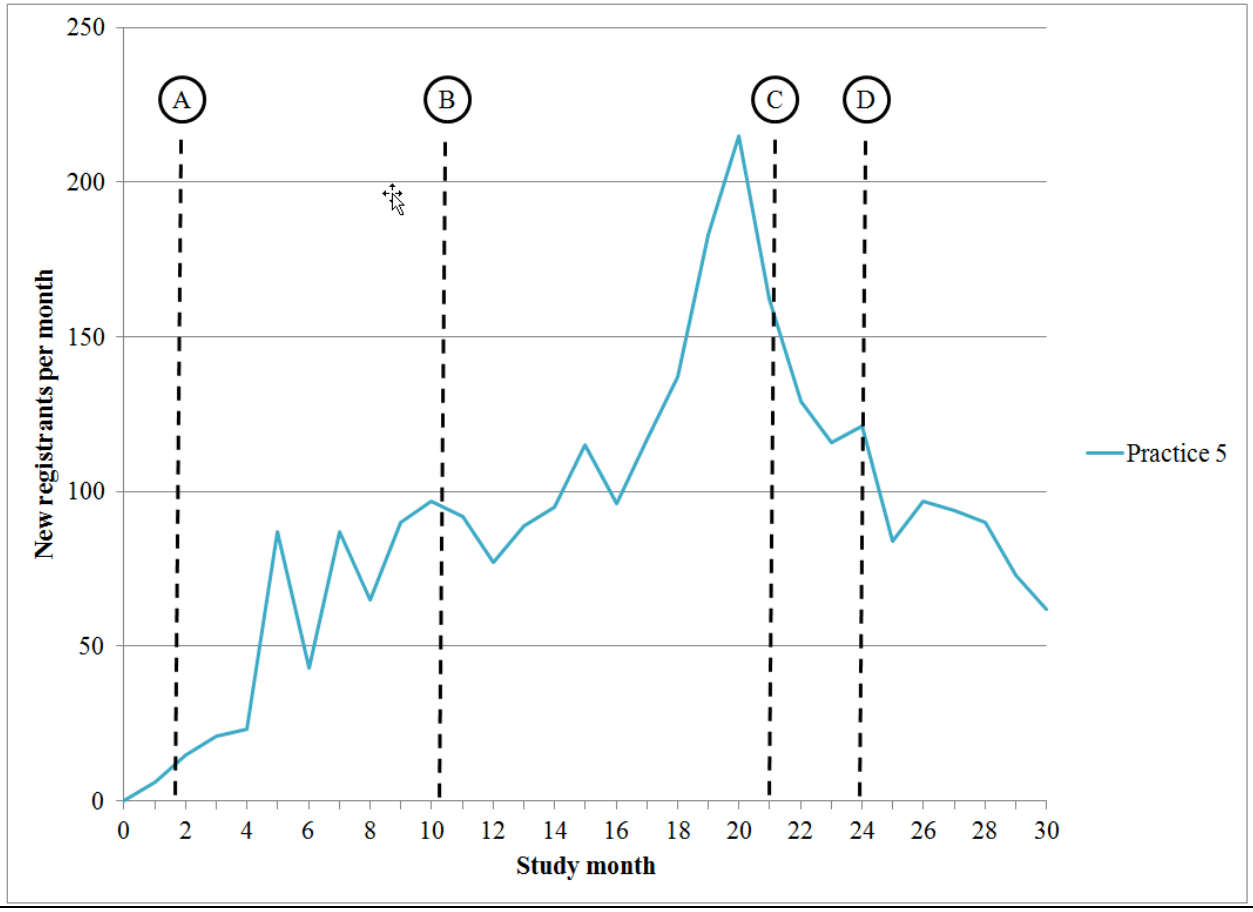
Practice 5 is notable for the following practice characteristics:

- Medium sized office (6.5 clinical full time equivalents, 160 patient visits per day).
- Strong champion who encouraged clinical partners to use the IPHR.
- The highest number of IPHR users (Practice 5 = 27.9%, Average = 25.6%).

Practice 5's implementation strategy is notable for the following:

- Medical records staff received IPHR summaries.
- Late adopter (month 4) of team approach to actively engaging patients to use the IPHR.
- Check in staff pushed IPHR to reduce phone calls, nurses pushed IPHR as a means to reduce the work of calling patients with results.
- Encouraged clinicians to use the IPHR to notify patients of laboratory results.

FIGURE 7. Number of new IPHR users per month for Practice 5



A = Team based approach, B = All laboratory results available, C = New practice management system, D = Aftercare summaries available

Practice 6's IPHR Implementation Experience (Low Adopter)

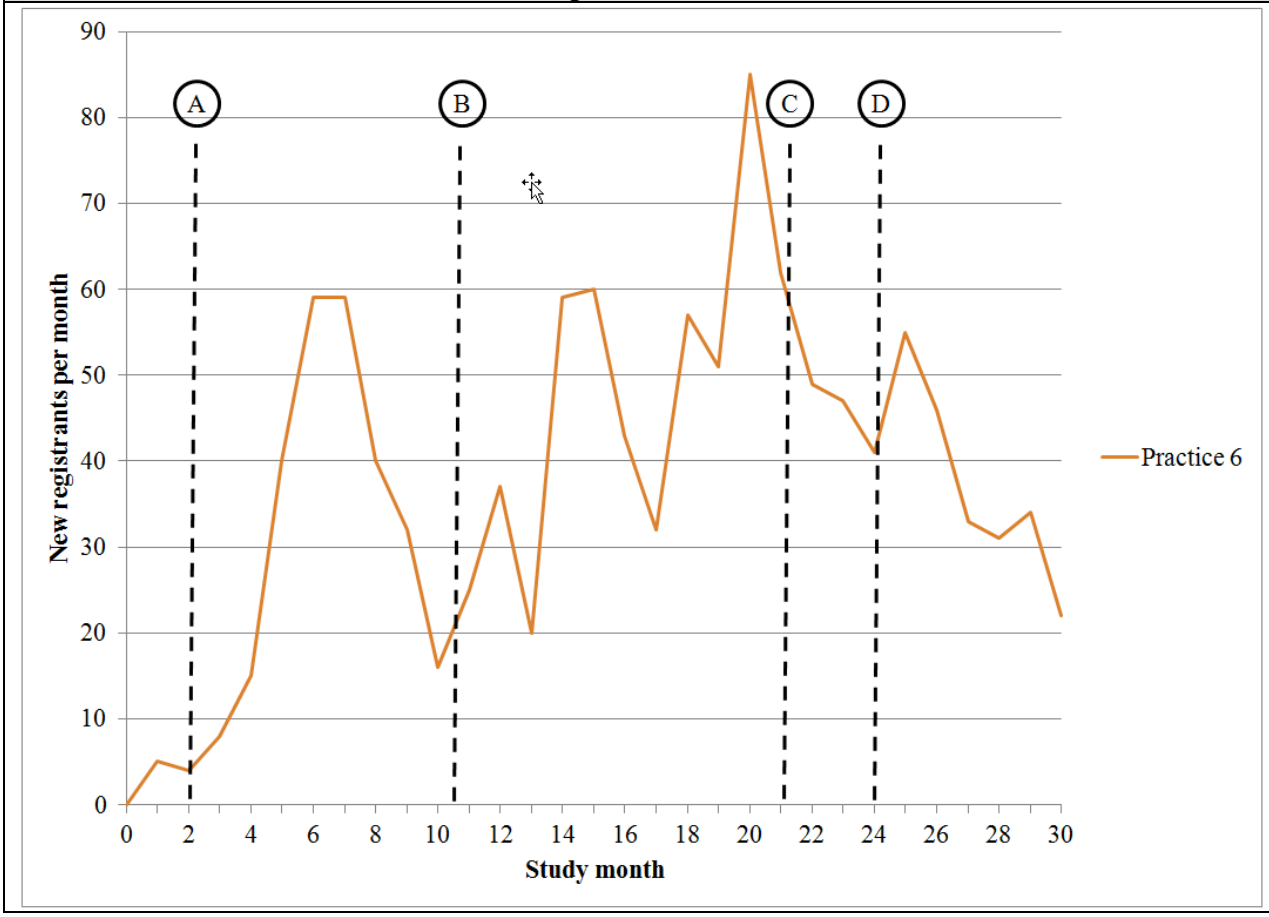
Practice 6 is notable for the following practice characteristics:

- Smallest office (2 clinical full time equivalents, 40 patient visits per day).
- Limited and overtaxed nursing staff.
- Least number of IPHR users (Practice 6 = 22.1%, Average = 25.6%).

Practice 6's implementation strategy is notable for the following:

- Primary care clinician received IPHR summaries.
- Partially implemented team approach for engaging patients (did not include nurses).
- Partial clinician use of the IPHR to notify patients of laboratory results, but greater reliance on calling or mailing results.

FIGURE 8. Number of new IPHR users per month for Practice 6



A = Team based approach, B = All laboratory results available, C = New practice management system, D = Aftercare summaries available

Practice 7's IPHR Implementation Experience (Late Adopter)

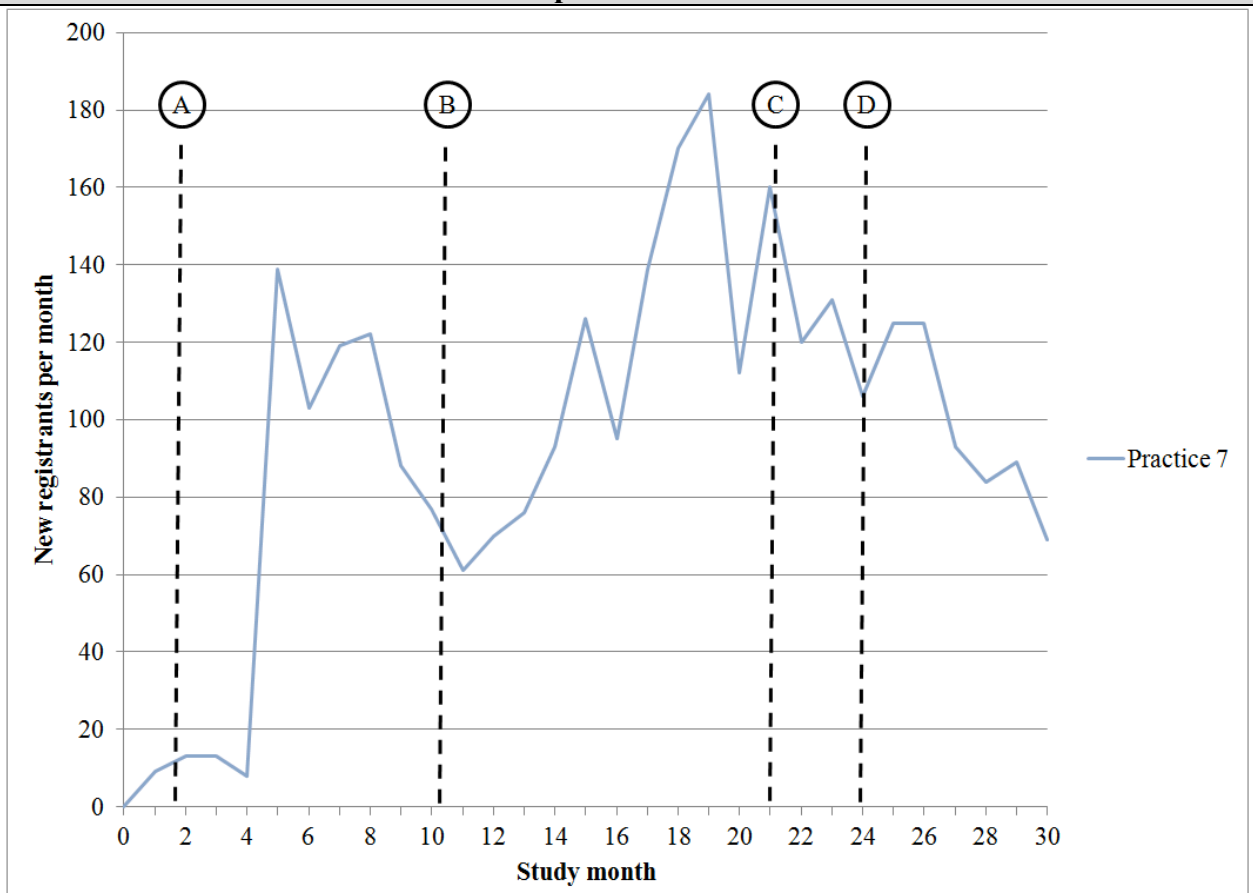
Practice 7 is notable for the following practice characteristics:

- Medium sized office (5.8 clinical full time equivalents, 120 patient visits per day).
- Highest proportion of Spanish speaking patients (about 8% of practice population).
- Average number of IPHR users (Practice 7 = 25.3%, Average = 25.6%).

Practice 7's implementation strategy is notable for the following:

- Primary care clinician received IPHR summaries.
- Later adopter (month 4) of team approach to actively engaging patients to use the IPHR.
- Encouraged clinicians to use the IPHR to notify patients of laboratory results.

FIGURE 9. Number of new IPHR users per month for Practice 7



A = Team based approach, B = All laboratory results available, C = New practice management system, D = Aftercare summaries available

Practice 8's IPHR Implementation Experience (Early Adopter)

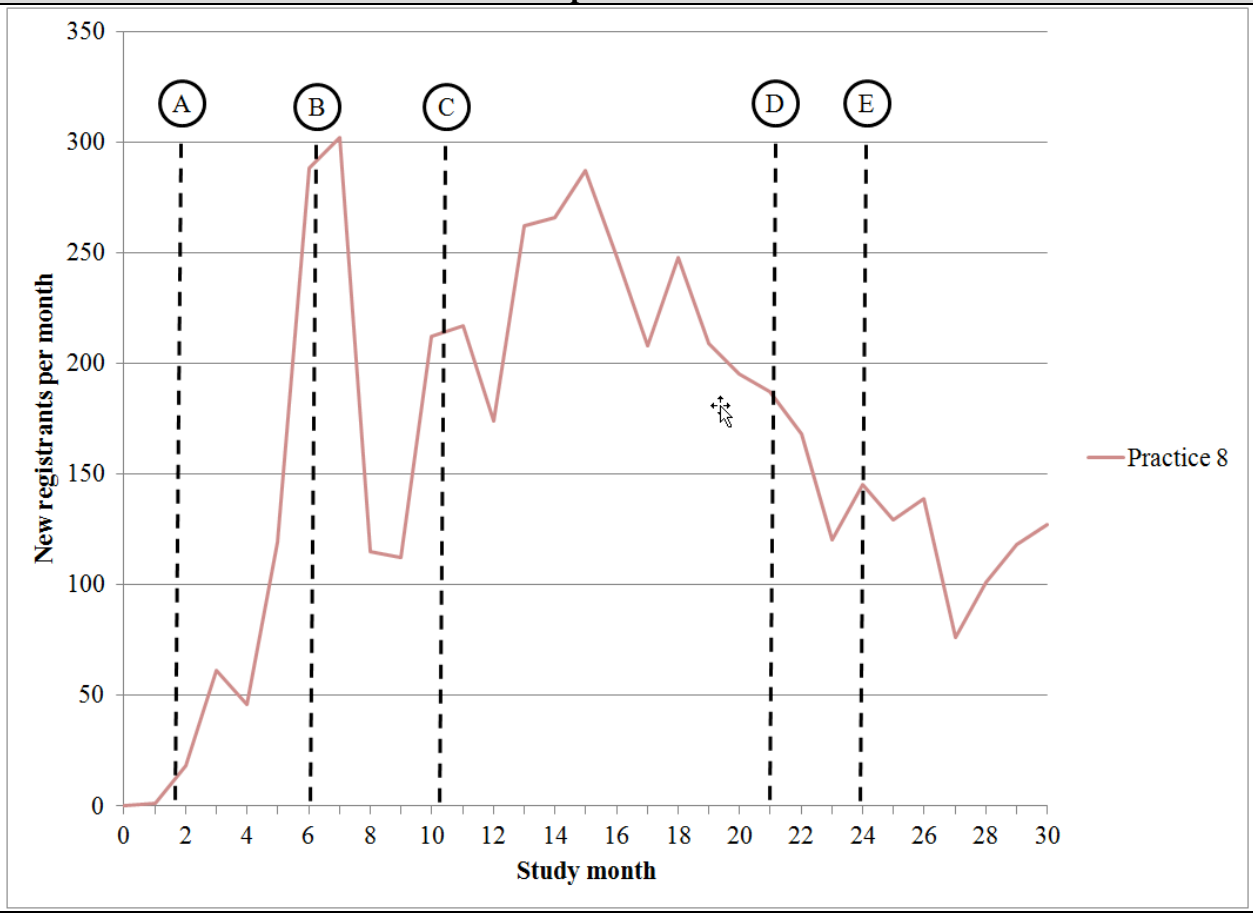
Practice 8 is notable for the following practice characteristics:

- Larger office (10 clinical full time equivalents, 220 patient visits per day).
- Patient population generally older than other practices (22% Medicare patients).
- Above average number of IPHR users (Practice 8 = 26.3%, Average = 25.6%).

Practice 4's implementation strategy is notable for the following:

- Medical records staff received IPHR summaries.
- First practice to create and implement team approach to actively engaging patients to use the IPHR.
- Encouraged clinicians to use the IPHR to notify patients of laboratory results.

FIGURE 10. Number of new IPHR users per month for Practice 8



A = Team based approach, B = Included IPHR registration material when mailed patients laboratory results; C = All laboratory results available, D = New practice management system, E = Aftercare summaries available