

## Reducing Phlebotomy in Hemodialysis Patients: A Quality Improvement Study



Ian E. McCoy, Lisa Shieh, and Pedram Fatehi

**Rationale & Objective:** Hospitalized patients receiving hemodialysis frequently have routine, daily laboratory studies drawn by peripheral venipuncture—a painful process that damages peripheral veins that may be needed for future dialysis access. Some of these peripheral venipunctures are likely preventable by drawing blood samples off the hemodialysis machine circuit. We describe an initiative to allow and encourage blood to be drawn “with dialysis.”

**Study Design:** Quality improvement study.

**Setting & Participants:** Non–critically ill adult patients treated with hemodialysis at Stanford Health Care between September 2018 and September 2019.

**Quality Improvement Activities:** We modified the electronic health record to allow providers to order laboratory studies with the frequency “with dialysis.” Use of the “with dialysis” frequency was promoted through educational efforts aimed at primary medical teams, nephrology consult staff, and nephrology advanced practice providers.

**Outcomes:** We tracked the number of “with dialysis” blood draws and the number of eligible patients per week during the first year of implementation.

**Analytical Approach:** The number of “with dialysis” blood draws and eligible patients per week were measured over time. Cost savings were estimated by multiplying the difference in cost between peripheral venipuncture and “with dialysis” blood draw by the number of “with dialysis” blood draws performed.

**Results:** Uptake during the first year of implementation was an average of 6.3 “with dialysis” draws per 100 eligible patients per week. Estimated savings exceeded \$7,000 in the first year of the program.

**Limitations:** Our single-center study may not be generalizable to other institutions, especially those without dialysis ordering and laboratory ordering housed within the same electronic system. We were unable to track additional outcomes, including the number of peripheral venipunctures and delays in laboratory results.

**Conclusions:** The prevention of unnecessary peripheral venipuncture in hospitalized patients receiving hemodialysis is a promising and valuable quality improvement target, which may be aided by the electronic health record. Future work is needed to increase recognition and use of “with dialysis”-blood work options.

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Peripheral venipuncture is painful. Furthermore, venipuncture damages veins that may be needed for future hemodialysis access. Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines recommend that forearm and upper-arm veins suitable for vascular access should not be used for venipuncture in patients with chronic kidney disease stage 4 or 5.<sup>1,2</sup> Current interventions in place at our hospital include bedside signage instructing phlebotomy and nursing to draw blood and place intravenous lines preferentially to the dominant arm and ideally only to veins on the back of the hand that cannot be used for future dialysis access. However, ultimately, blood is drawn from wherever a peripheral vein can be accessed. Damage and scarring from peripheral venipuncture destroy potential hemodialysis access sites and increase the risks for all the complications associated with lacking a functional fistula.<sup>3-5</sup>

Hospitalized patients with kidney failure receiving hemodialysis frequently undergo peripheral venipuncture every morning for routine nonurgent laboratory studies. Some of these peripheral venipunctures are likely preventable by drawing blood samples off the hemodialysis machine circuit. Although ordering providers can

sometimes have laboratory studies drawn on dialysis by contacting hemodialysis staff directly, this process was not standardized at our hospital, was not possible through the electronic health record (EHR), and was rarely used.

Beginning in 2017, we sought to improve patient care and satisfaction by creating a standardized pathway for any ordering provider to designate laboratory studies to be drawn with dialysis in the EHR. Our aim was to avoid some peripheral venipunctures and thereby reduce pain, interruption to sleep, damage to veins, and phlebotomy costs. Here we describe our experience with implementing this quality improvement intervention.

### METHODS

The Stanford University Institutional Review Board exempted this quality improvement project (protocol #43826) from formal review required for human subjects research, and it was approved by hospital leadership. Working with the hospital’s EHR team, we created a new laboratory order frequency (eg, “lab one time,” “qAM lab,” “q6h lab”) called “with dialysis” (Fig 1). Any ordering provider, whether on the primary team or the

### PLAIN-LANGUAGE SUMMARY

Getting blood drawn by venous puncture is painful. It also damages veins that may be needed for dialysis access in the future. However, some venipunctures can be prevented by drawing blood directly off the dialysis machine circuit. We modified the electronic health record to allow providers to order blood to be drawn on dialysis. We observed limited use of this option and modest cost savings during the first year. Systems-based changes, including disabling standing morning laboratory orders, may help increase future use. Reasonable efforts to encourage blood to be drawn on dialysis and thereby reduce patient pain, protect patient veins, and lower costs should be undertaken.

consulting nephrology team, could order laboratory studies “with dialysis.” Orders designated with the “with dialysis” frequency would not be sent to phlebotomy but would instead be routed to hemodialysis nursing, to be released with the dialysis orders themselves. All adult hemodialysis patients were eligible, excluding patients in intensive care units. The “with dialysis” frequency went live in September 2018 and was monitored through September 2019.

After launch, we promoted use of the new frequency through e-mails to chief residents, flyers hung up in workrooms, and in-person visits with primary medicine teams. Providers were also educated that routine laboratory tests are generally not needed on nondialysis days for patients receiving maintenance hemodialysis who are in relatively stable overall health but who remain hospitalized following medical or surgical interventions. The nephrology fellows and faculty were informed of the new laboratory ordering option by e-mail and were encouraged to suggest the “with dialysis” frequency to the primary teams of suitable patients.

Tracking the use of the “with dialysis” frequency was challenging because our EHR does not record the number of venipunctures or the number of “with dialysis” draws, but rather the number of laboratory tests ordered. Therefore, we defined “with dialysis draws” as laboratory orders with the frequency “with dialysis,” excluding those within 1 hour of another “with dialysis” laboratory order to avoid

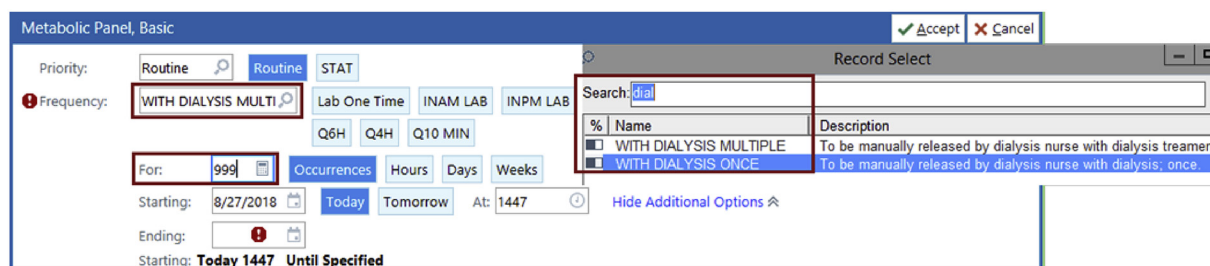
duplicate blood tests that were run on the same blood sample. To examine trends in “with dialysis” use, adjusted for the number of hemodialysis patients in the hospital, we counted the number of “eligible patients” in the hospital each week. Ignoring differences in length of stay and number of hemodialysis treatments per week, we defined eligible patients simply as the number of patients with a hemodialysis order placed during the weekly measurement period with a room number outside the intensive care unit.

We plotted “with dialysis” use in a run chart, analyzed using statistical process control methods looking for any shifts (defined as  $\geq 6$  consecutive points either all above or all below the median, not including points on the median), trends (defined as  $\geq 5$  consecutive points either all increasing or all decreasing), or nonrandom number of runs in the data.<sup>6</sup> Consultation with our finance department indicated that the potential monetary savings of drawing blood from the dialysis circuit as compared with using peripheral venipuncture by a phlebotomist was \$61 per draw based on internal costs. We report this study in accordance with the SQUIRE (Standards for Quality Improvement Reporting Excellence) guidelines.<sup>7</sup>

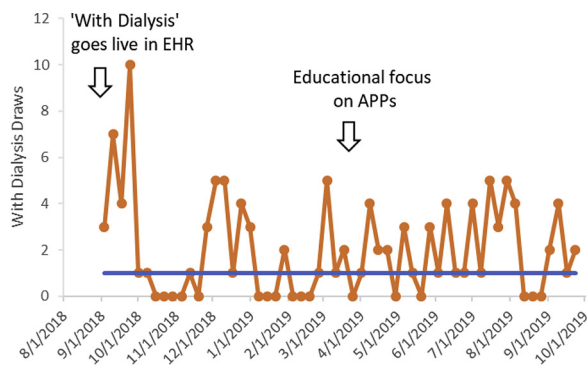
### RESULTS

Before the intervention launch, occasional “with dialysis” testing likely occurred through informal communication between floor nurses and dialysis nurses, but it is unclear how often this may have occurred. After launch, use of the “with dialysis” frequency was highest during the first month, with 24 “with dialysis” draws on 130 eligible patients (Fig 2). However, qualitatively, we found that knowledge of the “with dialysis” option was difficult to sustain with the constant rotation of new residents and attendings on the primary services and of the fellows and attendings on the nephrology consulting services.

Because our advanced practice providers do not rotate off service, we hypothesized that they may provide improved “institutional memory” of the “with dialysis” option. In spring 2019, we shifted our educational focus from primary teams and nephrology fellows to the advanced practice providers on our nephrology consult service. Qualitatively, we believed that this change resulted in more continuous “with dialysis” use, and analysis of the



**Figure 1.** Screenshot of “with dialysis” laboratory (lab) order frequency. Abbreviation: Q6h, every 6 hours.



**Figure 2.** “With dialysis” draws per week. Center line is the median. Abbreviations: APP, advanced practice provider; EHR, electronic health record.

run chart (Fig 2) showed a shift a few months after this change. However, no shift was present when “with dialysis” use was plotted per eligible patient (Fig 3).

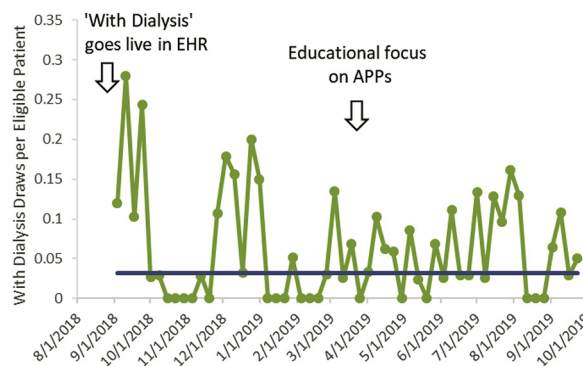
The average use during the first year was 6.3 “with dialysis” draws per 100 eligible patients per week. Estimated savings in the first year of the project were >\$7,000. If only half of those patients eligible switched from routine phlebotomy-drawn laboratory tests to the “with dialysis” option even once a week, annual savings accrued to the medical center would be >\$50,000, and many more patients would find themselves free from phlebotomy sticks.

## DISCUSSION

We created a standardized pathway within the EHR for “with dialysis” laboratory ordering. On average during the first year of implementation, about 1 “with dialysis” draw was performed in a given week for every 15 non-intensive care unit dialysis patients. Several barriers hindered more widespread use of the “with dialysis” laboratory frequency.

First and most importantly, the practice of ordering daily morning laboratory tests as part of the admission orders was ingrained at our hospital, as it is in many hospitals. If standing morning laboratory orders were in place, a provider had to discontinue those orders and place a new “with dialysis” order. Although convenient for providers, standing morning laboratory orders may result in unnecessary and repetitive testing with the associated costs, patient pain, and vein damage,<sup>8-10</sup> the latter particularly problematic for patients with advanced chronic kidney disease.<sup>11</sup> Repetitive laboratory testing in the face of clinical stability was recognized by the Society of Hospital Medicine’s Choosing Wisely campaign as one of the top 5 practices to be discouraged.<sup>12</sup> Hospital systems may do well to consider disabling or limiting the duration of standing morning laboratory orders, which has been shown to reduce unnecessary testing.<sup>13,14</sup>

Second, many primary care teams taking care of patients with kidney failure in the hospital may not realize that



**Figure 3.** “With dialysis” draws per eligible patient per week. Center line is the median. Abbreviations: APP, advanced practice provider; EHR, electronic health record.

patients receiving hemodialysis do not require daily routine laboratory studies. They may understandably assume that electrolytes need to be checked before each dialysis treatment. In reality, the standard of care in the United States for patients with kidney failure outside the hospital is checking blood work once per month.<sup>15</sup> A recent quality improvement effort in Canada suggested that spacing blood work out even further may reduce costs and physician workload without harm to patient safety.<sup>15</sup> In addition, providers without experience with dialysis may not realize that blood is easily drawn at dialysis without requiring peripheral venipuncture. Some mistakenly think that blood drawn at dialysis may be altered or inaccurate due to the dialysis process itself, not realizing that blood can be drawn off the circuit before it enters the machine for cleaning.

Ordering providers may also desire laboratory test results to be available early in the morning for rounds, rather than later in the day when the patient has hemodialysis. Inpatient hemodialysis schedules are usually not available to ordering providers and often change in real time. The resulting uncertainty regarding the time laboratory tests will be drawn represents another barrier to widespread adoption of “with dialysis” testing.

Little has been published on the problem of unnecessary peripheral venipuncture for laboratory testing in hospitalized patients receiving hemodialysis. Some hospitals have guidelines advising providers to have nonurgent blood work drawn in hemodialysis, but require the provider to contact hemodialysis staff directly and provide them with a requisition.<sup>16</sup> A multidisciplinary group at the University of Vermont who have previously published on avoiding unnecessary serum creatinine measurements in hospitalized patients with kidney failure<sup>17</sup> have undertaken a similar Dialysis Blood Draw Project but have faced challenges with workflow and decision support across multiple distinct electronic systems that control dialysis ordering, blood work ordering, laboratory information, and the primary medical chart (Drs Virginia Hood and Justin Stinnett-Donnelly; personal communication;

October 4, 2019). Another group at the University of California, San Francisco is considering automatically having morning laboratory studies drawn on dialysis for patients on the first dialysis shift of the day.<sup>18</sup> However, dialysis schedules are usually not stored in the EHR and often change in real time, complicating the determination of which patients will be dialyzed on the first shift and the cancellation of their peripheral phlebotomies.

Future efforts may be aided by disabling standing morning laboratory orders because this change would force providers to make a decision regarding the need for laboratory testing each day and allow them to direct a particular day's orders to be drawn on dialysis if appropriate. A best practice alert reminding providers of the "with dialysis" option may be another strategy if the best practice alert can be accurately targeted to only eligible hemodialysis patients. Finally, a systems-based approach that could automatically transfer laboratory orders from phlebotomy to dialysis nursing in real time if dialysis was imminent would be ideal because it would not depend on provider initiative, though substantial technical challenges to this approach remain. We hope to find increasingly innovative solutions as EHRs become more comprehensive and sophisticated.

Among proposed quality improvement projects, changes to the EHR are often prioritized based on their potential to generate cost savings, and drawing on dialysis appears to decrease costs. In addition to indirect cost savings from preserving peripheral veins for future fistulas rather than catheters with their associated complications, the blood drawing procedure itself is less expensive. Although drawing on dialysis marginally increases dialysis staff workload, larger cost savings occur by reducing phlebotomist workload and supplies needed for peripheral venipuncture that are not required to draw off of the dialysis circuit (eg, tourniquets and needles). These cost savings may help justify the allocation of limited programming resources required to make changes to the EHR for similar projects in different health care systems.

Our study has several limitations. We tracked the number of "with dialysis" uses rather than the more pertinent outcome of number of peripheral venipunctures saved because venipunctures themselves are not recorded in our EHR. Each "with dialysis" draw may have prevented more than 1 venipuncture because the first venipuncture attempt is not always successful, particularly in dialysis patients who often have suboptimal veins. Although drawing with dialysis is unquestionably less expensive than peripheral venipuncture, our costing estimates are based on internal costs and may not be precisely generalizable. We were also unable to assess safety metrics such as delayed laboratory results or effects on length of stay, though qualitatively these issues did not arise. It is possible that additional "with dialysis" blood draws occurred outside of our pathway through ad hoc communication with dialysis staff. Finally, the single-center setting limits the generalizability of our results.

The prevention of unnecessary peripheral venipuncture in hospitalized patients with kidney failure is a promising quality improvement target, especially in health systems with laboratory testing and dialysis procedure ordering housed within the same EHR. Although the pain of venipuncture may seem insignificant in the larger context of hospitalization, the effect of repeated pain on a patient's well-being is substantial, and reasonable efforts to eliminate or reduce this pain should be undertaken. The additional benefits to peripheral vein preservation and cost make it difficult to ignore this problem.

## ARTICLE INFORMATION

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