Title
Reducing Unnecessary Lab Orders with Cost Displays

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Abstract

Ordering unnecessary medical tests can be harmful to patients and increases the cost of healthcare. Research has shown that provider awareness of medical test pricing at the time of ordering can reduce ordering expenditures and volume. To promote high-value, cost-conscious medical care at UCSD, we are building a price display for common labs for Epic ordering screens that is due to launch in the near future. We used presentations and other education modalities such as flier postings to help raise awareness and stimulate culture change regarding attitude toward excessive lab ordering. After analysis of data from implementation of our price display, future considerations for project direction include expanding the reach of current interventions to include other order types and practice settings, and/or to develop new complementary interventions.

Background

Excessive medical testing is a burden to patients and healthcare at large. Tests that are unlikely to change management subject patients to unnecessary risks. While routine phlebotomy is relatively low risk, it is still dangerous because it is performed frequently and the harms are cumulative. Some risks that are well known but often not considered when ordering labs are pain; hematoma; infection; thrombi; bleeding; vasovagal reactions\(^1\); vein exhaustion requiring central line placement with its own well-known risks (e.g., clots, pneumothorax\(^2,3\)); sleep loss potentially contributing to delirium, increased pain sensitivity, poor mood, poor immunity, and increased sedative use\(^4,5\); or hospital acquired anemia (which is associated with increased mortality in certain patient populations\(^6,7\) and may necessitate transfusion). Perhaps the greatest danger to patients that excessive lab ordering poses is in the form of false positives or irrelevant findings which can lead to even more invasive testing, improper treatment, and patient anxiety and fatigue. Due to associated risks and frequent lack of utility after results have been stable for 1-2 days, excessive ordering of complete blood counts and chemistry panels have been a target of the American Board of Internal Medicine’s Choosing Wisely Initiative aimed at reducing wasteful medical care.\(^8\) Other wasteful scenarios have been similarly targeted by Choosing Wisely as a means of reducing excessive lab ordering.

In addition to health risks, unnecessary tests increase healthcare costs. The American healthcare system is notorious for its high healthcare expenditures. Relative to other developed nations, US healthcare arguably delivers much less dollar for dollar. For instance, the US spent roughly 1.5-2 times what every other individual G7 nation spent on healthcare relative to their respective GDPs for 2013 (or nearest year available), but had a below average life expectancy among Organisation for Economic Co-operation and Development (OECD) nations.\(^9\) Unsustainable increases in healthcare spending, and the financial impact of high costs on insurers and individuals, have made increasing the value of healthcare spending a priority. As stewards of the patient’s/healthcare system’s money, physicians have a responsibility to make cost-effective ordering decisions. However, to order in a cost-effective way, one must possess knowledge of
both cost and the effectiveness of the item/service being ordered. Although physicians spend much of their careers refining their knowledge of the diagnostic effectiveness of each test they order, they receive relatively little training in cost-conscious ordering.\textsuperscript{10} In retail, such training is unnecessary as pricing information is readily available and expected during the ordering process. In contrast, when ordering tests at medical institutions including UCSD, the physician is left to guess at the price tag of any given test. As such, price awareness, a required element of cost-effective decision-making, is missing. Because readily available information on price is lacking, in the busy environment of medicine providers have an impaired ability to rapidly make cost-effective ordering decisions and presumably order tests of limited value as a result, ultimately increasing the cost of patient care. As an academic medical center, UCSD has an added responsibility to implement measures that are likely to improve stewardship over medical resources because research suggests that the medical spending habits learned during residency persist for years after training.\textsuperscript{11}

One proposed approach to reducing medical expenditures is to adapt certain methods used by internet retail to help shoppers make informed ordering decisions.\textsuperscript{12} In a manner similar to that of internet retail, we are in the process of implementing an evidence-based approach to reducing unnecessary test ordering at UCSD by displaying the cost of common labs during the ordering process on Epic’s Computerized Physician Order Entry (CPOE). In their systematic review of research spanning 3 decades, Silvestri and colleagues examine 19 studies relevant to the impact of price display on provider ordering.\textsuperscript{13} The studies reported data on different types of physician orders including lab and imaging tests, medication orders and more, from a variety of healthcare settings (inpatient, outpatient, ED, and operating rooms). Some were pre- versus post-intervention analyses and others were randomized trials. Such studies generally support the idea that price awareness can reduce costs from tests ordered and may also decrease the volume of tests ordered. For instance, one study at Johns Hopkins randomly assigning different test types for CPOE price display found a roughly 10\% decrease in order volume and related charges for the display group.\textsuperscript{14} Overall, 9 out of the 12 studies reviewed where cost data was statistically tested showed a statistically significant cost decrease.\textsuperscript{13} In studies where patient safety or physician satisfaction with implementation of price display was analyzed, no substantial evidence was found suggesting adverse patient safety outcomes from price awareness and providers generally reacted positively toward price awareness interventions.\textsuperscript{13} A similar conclusion regarding the effectiveness of price awareness in reducing lab ordering and/or costs can also be found in a separate contemporary systematic review by Goetz, et al.\textsuperscript{15} Altogether, such findings suggest that adding a price display to the CPOE process for common lab tests at UCSD may encourage cost-effective ordering and reduce ordering volume (thus subjecting patients to less testing and related risks) with no adverse impact on patient safety or negative response from providers.

In addition to price display, education interventions may also reduce unnecessary lab draws.\textsuperscript{16,17} Such interventions inherently promote competency in the practice of high-value medical care, a value that some regard as a foundational component of medical training.\textsuperscript{18,19} Therefore, an educational approach that raises awareness of the harms of excessive lab ordering may not only help fulfill UCSD’s commitment to patient safety and high-value care, but also its mission to provide high-quality, practical medical education.
Methods and Accomplishments

Key elements of project execution were as follows:

General

- **Project committee**: ISP committee members were approached based on necessary expertise, interest, and/or authority relevant to the project’s success, including:
  - Dr. Ian Jenkins (ISP Chair), UCSD hospitalist, chair of UCSD’s Patient Safety Committee, extensive QI experience and course chair for Principles to Practice, the capstone course that prepares MS4s for internship in part by training them to place orders for mock patients.
  - Dr. Brian Clay (ISP committee member), UCSD hospitalist and Health Sciences Chief Medical Informatics Officer who has the authority and ability to work with the Health Sciences Information Services Team and UCSD leadership to implement a CPOE price display and lead the query of data for analysis of outcomes.
  - Dr. Sunny Smith (ISP Committee member), Co-Medical Director of the UCSD Student-run Free Clinic Project and co-director for pre-clinical and clinical Family Medicine courses. The Free Clinic is currently where medical students are often first (and perhaps most significantly) exposed to the importance of resource/cost-conscious medical care through the practical experience obtained by practicing in an underserved environment.

- **Institutional Review Board (IRB) proposal**: A Quality Improvement Project Narrative for IRB review proposing implementation of a price display for commonly ordered labs and educational interventions was written with Dr. Jenkins and approved by the UCSD Human Research Protections Program.

- **Project proposal to hospital administration**: The student worked Dr. Jenkins to help create a brief PowerPoint presentation for describing the proposed project to UCSD’s Medical Staff Executive Committee. The project was presented by Dr. Jenkins and subsequently approved.

- **Informal clinical lab workflow analysis**: The student toured the workflow of UCSD Hillcrest’s clinical lab and discussed the project at length with clinical lab scientists, phlebotomists, and lab supervisors with the goal of better understanding the various costs and resources required to process a lab order. A few key insights were gained through the tour and conversations. First, much of the cost of running any given common lab is volume-independent, meaning that regardless of how many times a particular lab is ordered, there is a basic minimum resource investment that is required. This investment is primarily composed of durable equipment (machinery, refrigeration, etc.), quality control testing (which must be run every 8 hours on some automated machinery regardless of whether any actual specimens are processed), and a minimum amount of lab personnel that is required to be on site. Volume-dependent costs include reagents, tubes and other consumable equipment, and potentially an increase in the amount of durable equipment and lab personnel required if test volumes exceed certain thresholds. As would be expected, reagent costs per order tend to be cheaper for commonly ordered labs such as basic metabolic panels, and more expensive for rarer labs. When asked what improvements providers might make to reduce phlebotomy, a few suggestions were made by lab personnel. Phlebotomists recommended delaying orders to be effective at the next...
scheduled blood draw for any given patient (e.g., at morning labs) unless a more urgent draw is absolutely necessary. Lab supervisors recommended caution when repeating orders for Center for Advanced Laboratory Medicine (CALM) labs that providers feel may not have been sent out for processing. Because such labs take longer to process, providers may feel their order did not get sent and mistakenly repeat an order that is already being processed. It was also communicated that when considering whether an “add-on” is possible, many tests are valid on samples that have been drawn even up to 24 hours prior and that the lab retains all samples under refrigeration for days. Such suggestions were disseminated during presentations described below.

**Price Display Arm**

- **Lab Pricing:** A decision to use absolute pricing was made after weighing the pros and cons of absolute vs relative ($, $$, $$$) pricing. Though relative pricing may offer less regular maintenance/updating of data as pricing fluctuates, there is less literature available regarding the effects of relative pricing on ordering behavior and it was felt an absolute price display would be more informative (and therefore impactful) to the ordering provider. After resolving to use absolute pricing, we decided to use outpatient average Medicare reimbursement rates for labs rather than lab costs. Though cost reflects actual resources used to perform any given test, the actual cost of performing a lab would be variable and too complicated to determine because of the costs of lab personnel, machinery, tubes, reagents, phlebotomists and other factors involved in cost calculations. Outpatient average Medicare reimbursement rates are readily available and better reflect what patients might actually pay under certain circumstances.

- **Labs chosen:** A report was generated to include the top 95% most frequent non-medication orders at UCSD Hillcrest and La Jolla hospitals between 1/1/16 to 6/30/16; non-lab orders were then excluded. Price display was limited to commonly ordered labs (vs. all possible studies) to facilitate rollout of the intervention. As adding a price display to each individual Epic order set would be cumbersome and require excessive use of IT resources, order sets are not currently planned to feature a price display. Commonly ordered labs were specifically targeted for the present project because they are reasoned to be ordered by providers outside of Epic order set contexts more frequently than rare labs, thus making order set inclusion less necessary.

- **Status of price display intervention:** A price display as described above is currently being built for Epic by UCSD Medical Informatics (Fig. 1), to be launched upon completion in the near future.

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* Unnecessary repeats might be avoided by checking for pending labs by going to the “Lab” tab under “Chart Review” in Epic to quickly check the current status of the lab. If “pending” or “in process” is written after selecting the lab to be queried, then this may reassure the provider that the lab has been sent for processing.
Educational Arm: The “Labs Hurt” Campaign

- **Campaign**: To help promote a culture of consciousness among UCSD residents and students regarding the problem of excessive lab ordering and practical steps that can be implemented to reduce unnecessary lab ordering, a campaign titled the “Labs Hurt” was launched which disseminated information through presentations and printed displays.

- **Presentations**: After researching relevant literature, a slide deck for a longer (30 min; see Appendix) and shorter (10 min) presentation was developed on PowerPoint and delivered to residents and students. Appropriate faculty and/or chief residents were approached for time slots for presentation delivery. The 30 minute version was given at the family medicine resident afternoon didactics on 1/4/2017. The 10 min version was presented to 2 different sets of internal medicine interns during their noon training (on 1/12/17 and 3/2/17) and also to the 4th year medical student class during their “Principles to Practice” block (on 2/24/17). Contents of the talk included an introduction to the campaign, a discussion of potential harm associated with excessive lab ordering, an introduction to the impending price display launch on Epic, and some practical tips for reducing unnecessary lab orders based off of Choosing Wisely recommendations and other sources. Following resident talks, pocket cards (discussed below) were distributed to each resident to help remind them of the talk’s key points.

- **Printed Displays**: To reach providers beyond a presentation format and to supply a more lasting reminder of the information discussed during each presentation, fliers and pocket cards were posted primarily on medical-surgical floors at UCSD hospitals and distributed to residents following presentations as mentioned above. A simple blood draw syringe graphic was purchased for association with the campaign’s aim of reducing unnecessary phlebotomy (see graphics below). Campaign fliers (Fig. 2) were created with a clean, mostly black-and-white design with a color image of a large arm hematoma to draw provider attention to the flier. Pocket cards were made with a simple, attention-grabbing design containing a thought-provoking question in large letters aimed at evoking the reader’s curiosity to lead him/her to read further about the campaign’s key message in smaller print. One card appeals more to the provider’s sense of empathy (Fig. 3) while the other appeals to their sense of reason/logic (Fig. 4). Each has the campaign’s key points on the back side (Fig. 5). To create a professional look, pocket cards were printed in 2 sizes: business card (for posting at computers that providers use) and postcard (for other locations in physician work areas). Altogether, a rough total of 30 fliers were posted, 80 business cards were placed at work stations, and 80 post cards were either posted or handed to residents directly. Fliers and cards were posted at multiple locations on roughly 15 floors at UCSD hospitals including Hillcrest, Thornton, Jacobs, and Sulpizio.
Labs Hurt!

Excessive labs harm patients:
- Pain, hematomas
- Anemia (with transfusion risks)
- Sleep disturbance (delirium, increased pain sensitivity, poor mood, fatigue)
- Vein exhaustion (requiring central line placement)
- False positives
- Irrelevant findings resulting in further unnecessary studies
- Financial burden borne by patients

What you can do:
- Consider the value of every order: price, indications, risks, effect on management
- Put yourself in your patient's shoes: what would you want ordered?
- Avoid "default mode": reassess your repeat orders every day
- Avoid orders that are best deferred to outpatient
- Avoid ordering throughout the day on the same patient when possible (helps prevent multiple sticks)
- Attempt “add-ons” for new orders if labs have already been drawn
- Keep up-to-date with Choosing Wisely® recommendations

Figure 2. Campaign flier highlighting key educational points.
When it’s 5 AM and it’s your arm

What labs would you want ordered?

Excessive labs hurt patients:
Anemia, sleep disturbance, pain, financial burden, and more

Figure 3. Front side of pocket cards appealing to provider empathy.

Was that 5th stable CBC really necessary?

Excessive labs cause harm:
anemia, sleep disturbance, pain, financial burden, and more

Figure 4. Front side of pocket cards appealing to provider reason/logic
What **YOU** can do:

- **Consider the value of every test ordered**: price, indications, risks, effect on management
- **Put yourself in your patient’s shoes**: What would you want ordered?
- **Avoid “default mode”:** reassess your repeat orders every day
- **Avoid orders that are best deferred to outpatient**
- **Avoid ordering throughout the day on the same patient** when possible (helps avoid multiple sticks)
- **Attempt “add-ons” for new orders** if labs have already been drawn
- **Keep up-to-date with *Choosing Wisely®* recommendations**

**Figure 5.** Back side of pocket cards with the campaign’s key points.
Discussion

Successes, challenges and lessons learned

Though the project met numerous challenges, it has been a valuable undertaking. When initially conceived, the primary arm of the project was the implementation of a price display on Epic followed by a post-intervention analysis of ordering trends to assess impact. There were a few obstacles met along the way that contributed to a delay in the launch but also provided the student with practical insight regarding common restraints that may be encountered when developing any QI project.

One challenge was an inability to carry out major project goals without the help and expertise of others. Implementation of a price display was impossible without help from Medical Informatics, a department with an already large to-do list. One major competing project among many was the opening of Jacobs Medical Center which was understandably a much higher priority requiring significant resources. The student checked in regularly with Dr. Clay, Chief Medical Informatics Officer and ISP committee member, but the displays could not be launched in time for a pre-post-analysis. There were a couple clear practical lessons learned through this process. First, having the right team on board enables one to accomplish much more than could ever be anticipated in isolation. Although there have been delays, the intervention would not be possible at all working alone. Second, working with others requires being flexible with one’s timeline and respect for others’ overwhelming competing obligations. As such, it seems generally safe to anticipate implementation of similar projects in the future also requiring more time than one might expect.

Another related challenge that faced the project was administrative. Because the project required additional expertise and resources, administrative endorsement was crucial. To this end the student worked with the committee chair on a slide deck which the chair presented at a Medical Staff Executive Committee meeting. Part of receiving approval however, meant being flexible and prioritizing goals. Though the student had initially envisioned targeting a larger scope of tests for price display, the intervention had to be limited to common labs in order to proceed with administrative approval.

A third challenge was considering how the project may affect other parties within the health system. It had also initially been envisioned that the price display would also be available in the outpatient setting, but this was a more sensitive issue than originally anticipated. Outpatient labs are paid for differently than inpatient labs: they are generally reimbursed per lab ordered whereas inpatient labs, generally being funded by a Diagnosis-Related Group reimbursement structure, are not. Consequently, the outpatient reimbursement structure creates less incentive to reduce excessive lab orders as money is not being saved by the institution when there is a reduction in lab orders that are reimbursed. Rather, laboratories processing outpatient samples may actually lose revenue if lab volume decreased. As such, for the time being, implementation of a price display in UCSD’s outpatient system had to be set aside until the issue is further championed by representative outpatient providers. Ultimately, it was learned that one sometimes has to accept project limitations set by other competing interests in order for a project to continue moving forward.

In theory, competing interests may also be expressed by inpatient lab personnel in the future if the project is successful at curbing excessive lab ordering. If the project yields a significant and lasting reduction in lab order volume, such could potentially lead to a reduction in lab personnel work hour requirements (though this would likely be modest at best). One would
have to consider accommodating the reduction in staff requirements in an ethical manner, perhaps through attrition, if such an issue presented.

In addition to the above challenges, there were also practical barriers that limited the design of the project. For instance, to reduce the complexity of programming, obtaining IRB approval, and other aspects of project execution, plans by the student to design the project as a randomized control trial had to be abandoned. Such situations demonstrated to the student the need to adapt and evaluate priorities in reference to what is practical.

Though a price display has not yet been launched, much has been accomplished amidst the challenges mentioned above. The groundwork has been laid as presented in our Methods to reach the current build phase of the price display prior to its anticipated launch in the near future. Furthermore an educational campaign has been launched raising awareness of the issue of excessive lab ordering among residents and a medical school class of “soon-to-be” residents. As a consequence, our patients likely will be subjected to less low-value medical tests in the future, sparing them the potential harm of undergoing such tests. Better knowledge of order costs and improved understanding of the harms of excessive lab ordering may have a lasting positive impact on the careers of affected residents and medical students. On an individual level, through rigorous consideration of the project’s themes, the student has undoubtedly become more value-conscious in his approach to patient care. He not only better appreciates the importance of high-value care, but has also gained some practical insight for enhancing the value of care he provides in the future. Furthermore, he has also gained in-depth knowledge of barriers to providing high-value care and strategies for helping others overcome those barriers through the use of different educational mediums and technology. In the end, the student’s learning was enhanced rather than impeded by obstacles faced during project execution and such experience gained will doubtlessly benefit future endeavors.

**Future Directions**

There are numerous directions one could consider taking the current project into the future; most involve expanding the reach of the current interventions employed and/or increasing the effectiveness or the project’s aims through introduction of new types of interventions and potential collaborations.

The obvious first step will be to complete the launch of the planned price display and analyze the effectiveness of the intervention at UCSD. A fruitful analysis will likely include run charts evaluating pre- and post-intervention metrics. Amount of blood drawn would be one important parameter to assess. If average length of stay is found to be significantly different between pre- and post-intervention data, then one would have to control for length of patient stay when comparing changes in blood volume given most patients will have a significantly greater amount of blood drawn on their first hospital day compared to their fifth for instance. One potentially powerful means of controlling for length of stay might be to compare average milliliters of blood drawn per patient on Hospital Day 1 pre- and post-intervention, then for HD2, HD3, etc. This would also be informative as to whether the intervention has had a greater impact on repeat labs or initial labs. As another metric, one could also measure whether there would be a decrease in actual phlebotomy events to give one a sense of whether phlebotomy-related complications might actually be affected by the intervention, controlling again for days post admission. Trends in ordering specific labs would also prove interesting. For instance, would ordering of complete metabolic panels decrease in greater proportion than basic metabolic panels due to providers opting to order the test with the lower “price tag”? Price “savings” itself
would also be an interesting metric to consider in order to gain insight into the effect that price awareness has on provider ordering decisions, though one would have to be cautious to not confuse lab display price with operating cost when calculating the amount of money saved by the health system.

Other outcome measures that may be interesting to assess if practical from a health informatics perspective would be those related to specific patient outcomes associated with excessive phlebotomy, though such measures would likely be less sensitive and robust. One example would be an assessment of rates of hospital acquired anemia, perhaps by comparing hemoglobin on admission and then again at a predetermined date after admission, or indirectly by evaluating hospital transfusion requirements pre- and post-intervention. Other variables that could be assessed may include amount of central line placements in patients not requiring dialysis, rates of hospital-acquired delirium, and patient satisfaction.

Core safety control measures may include 30-day readmission rates, rates of increased level of care and/or ICU transfers, in-hospital mortality, and/or length of hospital stay. Length of hospital stay in particular may also double as a useful outcomes measure in that spurious results from unnecessary lab orders could delay discharge; therefore one might possibly see a reduction in length of stay secondary to a reduction in excessive lab ordering.

Following analysis of data from our initial price display for common labs, one could consider expanding the reach of the current display. For instance, if the initial display proves to be safe and effective, one might argue for an expansion in the breadth of tests that have an active display to rarer labs, imaging studies, and perhaps even tissue pathology. Research suggests price displays for medications may also significantly reduce expenditures, and as such, could be considered for inclusion in further related interventions. Other considerations could include price displays for consultations and procedures.

In addition to broadening the item types that have displays, one could expand the reach of displays to other EMR settings. As discussed earlier, expansion of price displays to the outpatient setting was initially planned. If data from our initial intervention is promising and outpatient providers supported implementation, a price display in this setting could benefit a large number of patients by reduction in harm from unnecessary testing and reduction in medical bills in a setting where patients are more likely to pay per test ordered. Alternatively, even if one couldn’t gain approval for broad-scale outpatient implementation, one could still consider a build for the UCSD Student-run Free Clinic Epic context. Because labs do not generate any revenue in this context, there would be less concern of opposing interests as previously discussed for other outpatient settings. Implementation in this context would also help the UCSD School of Medicine further incorporate education regarding high-value care into their undergraduate curriculum while improving care for underserved patients. Finally, if initial data suggests the effort is justifiable, expanding the availability of price displays to common order sets may also be fruitful in aiding provider decision-making.

Some research suggests that interventions targeting multiple behavioral factors may be more successful at changing behavior. In addition to expanding the reach of existing interventions, there are other technological interventions that may enhance the project’s effectiveness going forward. The student met with two faculty members, Drs. Molly Kantor and Robert El-Kareh, who are working on a complementary intervention that involves the creation of a computer application which makes provider-specific ordering data available to providers in order to receive personalized feedback on lab ordering habits and compare performance to peers.

‡ UCSD Health reported 636,000 outpatient visits in 2015 alone.
A tool with similar features has been used as part of a multifaceted intervention that was effective at reducing the volume of certain common lab orders and overall lab costs per patient. Further collaboration will be important for optimizing efficiency and cohesiveness of further efforts at reducing lab overuse. Other computer-based interventions could also enhance project effectiveness. It has been suggested that an EMR-based provider “shopping cart” similar to what one may find when shopping with online retailers may be helpful in promoting high-value care. Such shopping carts would give each provider a real-time big picture of his/her use of resources for each patient by tallying the dollar amount of all tests one is about to order, thus allowing the opportunity for adjustment in ordering before final “purchase”. Additionally, a shopping cart could abrogate the need to manually add price displays to individual order-sets one-by-one since a cart could communicate order pricing independently of context. Such shopping carts could also tally total lab draws and estimated blood loss from phlebotomy over the course of each patient’s hospital stay to help providers better monitor the amount of phlebotomy they subject each patient to. Computer-based interventions could also be used to reduce excessive repeat lab orders. One could eliminate lab orders with indefinite endpoints altogether, though this may encounter opposition from some providers who find this feature convenient. A less extreme (though likely also less effective) option might be to build a provider alert for lab orders that have indefinite endpoints. Effectiveness may be optimized by triggering the alert to show at a time when providers may be in a position to reassess such orders, such as when providers sign progress notes. Another possibility, though likely more complicated to build, would be a notification that appears anytime a recurring lab order is placed and the key components of that lab have been stable for a specified amount of time. For instance, if there is an order for a daily CBC, but platelets, white count, and hemoglobin have not fluctuated over the past two days by more than some predetermined value, then a notification will appear. This approach may help limit alarm fatigue by making notifications more likely to be clinically relevant. Lastly, a CPOE intervention could be used to limit excessive blood draws by optimizing the utilization of lab “add-ons”. This could be achieved by building an automatic prompt to query the provider whether he/she would like to designate an order as an add-on whenever the order is placed within say, 18 hours of a previously drawn compatible tube. Of course such a prompt would not make sense for time-specific labs such as cardiac enzymes, but would be appropriate for less time-specific labs such as an A1C or serologies. Appropriately limiting which labs could elicit a prompt would be critical for preventing alarm fatigue. A more low-tech means of aiding providers in their use of add-ons (suggested by an intern following one of the project’s presentations) would be to develop and distribute pocket cards that reference which tubes are used for specific lab orders in order to quickly assess if any new order might qualify as an add-on.

There are also multiple avenues by which project effectiveness might be bolstered apart from computer-based interventions. One such avenue is the use of financial incentives for meeting certain benchmarks pertaining to lab ordering. Likely, a major contributor to misuse of healthcare resources is the fact that providers are spending “other people’s money”, a factor that can lead to greater carelessness when it comes to overuse of lab ordering. Offering reasonable financial incentives that can be lost if labs are over-utilized may supply providers with the feel that their own money is actually at stake. Some multi-modal projects that have included financial incentives to providers related to excessive lab reduction have reported favorable results. One project used phlebotomy reduction as a quality metric to determine eligibility for a $400 yearly compensation to individual resident physicians. Another reported sharing 50% of cost savings from the intervention with the Division of General Internal Medicine that could be used
to fund future QI projects. It is the opinion of the present author that individual financial incentives would be more effective than departmental incentives, though one would have to be cautious about unintentionally incentivizing underutilization of lab testing.

New education modalities may serve as additional means of further improving proper lab ordering. Integration of clinical vignettes highlighting examples of common forms of lab misuse at regular intervals into resident didactics is one potential method for maintaining awareness of the project’s aims among providers. The University of Colorado Department of Medicine has been actively using vignettes written by its trainees through a program titled “Do No Harm” to create discussion and awareness of issues of medical overuse. Choosing Wisely recommendations would be an excellent source for vignette topics as would cases from JAMA Internal Medicine’s Teachable Moments series. Another target for enhancing education on appropriate lab ordering would be to encourage regular attending physician discussion of the issue of excessive lab testing on rounds. One small study at Denver Health and the University of Colorado found that only 1 in 5 rounding encounters involved attending-led discussion of any of the five American College of Physicians test-ordering principles, suggesting perhaps that other residency programs should at least question the sufficiency of their own frequency of attending-led discussion on the subject. A survey of medicine and surgery residents from the University of Pennsylvania found that the most frequently endorsed reason why residents believe they order unnecessary labs (of the choices given) is that they are trained to order unnecessary labs. Some other factors frequently endorsed as contributory were discomfort with diagnostic uncertainty, fear an attending may ask for the lab, lack of role modeling, and institutional culture. If such factors are representative of those at other institutions, then it would seem reasonable that emphasizing regular attending discussion could significantly reverse the influence of such factors. One means of encouraging attending involvement might be to include a question on attending evaluations regarding the quality of their instruction on proper lab utilization. Altogether, developing clinical vignettes for resident didactics, encouraging attending-led discussion, and continuing to deliver presentations on the subject of excessive lab ordering such as the one presented here would be a means of accomplishing what a recent review of research on education in high-value care suggests: “learning [to deliver high-value, cost-conscious care] by practicing physicians, resident physicians, and medical students is promoted by combining specific knowledge transmission, reflective practice, and a supportive environment.”

Overall, each type of intervention has strengths and weaknesses. Computer-based interventions have the potential advantage of offering broad, consistent, and lasting exposure to providers with a relatively small maintenance requirement once the initial build is complete. Financial incentives require development of a quick and reliable means of evaluating quality benchmarks for each provider to assess eligibility for the incentive. Once such a method has been established, relatively little manpower would be required to maintain the program. Still, administrative buy-in may be challenging to obtain unless a clear case can be made that the value of the incentive to the hospital outweighs the cost. Educational interventions require minimal multidisciplinary expertise, but do require longitudinal effort to maintain. In the end, it will likely not be a deficiency of ideas that limits the project’s future direction, but rather the availability of time and resources. Therefore, the most successful steps into the future will be those taken after thorough consideration of not only the effectiveness of any given intervention, but also the required investment.
Works Cited


Appendix: Slide deck from 30 minute presentation.

Is it safe to order labs “just to be safe”?

Excessive Labs Do Harm
• Patients
• Healthcare system

LABS HURT!
Doing your part to reduce the harm of unnecessary lab orders

Chris Walheim, MS4, MSc

UC San Diego Health System
The Problem

- **Direct risks**: pain, infection, hematoma (12.3%), thrombus, bleeding (blood-thinners), nerve damage, vasovagal reactions (5.3%), phlebotomist needle-stick

Anemia

- **100 ml ≈ 0.7 g/dl Hgb ≈ 5 days of labs**
  - (routine labs + acute anemia workup + CEAs x 3)

- Phlebotomy independently associated w/ hospital-acquired anemia in AMI patients
  - Every 50 ml ↑ RR mod-to-severe HAA by 18%
  - Mortality **doubled** in AMI patients with mod-to-severe HAA
Sleep Deprivation

- Physiological
  - ↑ pain sensitivity
  - ↑ sympathetic cardiac modulation
  - ↓ immunity
  - Endocrine, respiratory

- Psych/Behavioral
  - ↓ mood
  - ↑ fatigue
  - Delirium risk
  - ↓ patient satisfaction
  - ↑ PRN sedatives

Images: Bartick et al., 2010

Vein exhaustion

- Central lines (injury, infection, clots)
- Pneumothorax-/mediastinum risk up to 1%

Images: www.realspace.com

UC San Diego Health System
False Positives and Irrelevant Findings

“If each person has 20 tests performed then 66% of these healthy people will have one or more abnormal results.”

- Incorrect diagnoses
- Further unnecessary testing
- Delayed discharges
- The “Ulysses Syndrome”

And of course... Cost/Resources

- **Charge** to patients
  - CBC w/diff: $92
  - BMP: $116
  - CMP: $300
  - Lipid Panel: $141
  - TSH: $169

- **Staff time**, equipment, delays

Often borne by the health care system or underinsured patients
Concerns Over Stewardship of Healthcare Resources in the US

UCSD Health 2015 Stats

- **Discharges**: 28,000
- **Average Census**: 450
- **ED Visits**: 75,000
- **Outpatient Visits**: 640,000
- **Average Length of Stay**: 6 days
Price display: an approach to limit excess labs

Silvestri, et al., 2016

Price Display: a rough sample
Keeping an eye on the Mag

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Low-hanging fruit: Repetitive Lab Draws

- Most hospitalized patients, stable or not, get daily 5am labs
- ‘No CBC/Chem if patient and labs are stable’
- ‘Avoid “daily” labs; order according to clinical situation’

Blood tests when you’re in the hospital
Taking them every day may not be necessary

Choosing Wisely
An initiative of the ACP Foundation

Blood tests when you’re in the hospital
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ConsumerReportsHealth

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ConsumerReportsHealth
Low-hanging fruit:
Routine Pre-op Lab Draws

- “Avoid routine preoperative testing [e.g. CBC, PT, PTT, BMP and UA] for low risk surgeries without a clinical indication.”
  - Influences management in < 3% of patients
  - Almost no adverse outcomes in stable patients undergoing elective surgery regardless of preop testing

Low-hanging fruit:
Cardio/Pulm

- ‘Order troponins vs CK-MB/myoglobin for AMI’
  - More specific
  - Present in blood at least as early
  - Can equate to infarct size

- ‘Order D-dimer vs imaging for low Wells score’
Low-hanging fruit:  
Infectious/Inflammatory

- Order CRP vs ESR to detect acute phase inflammation  
  - more sensitive and specific for acute phase  
  - Rises early and decreases sooner

- “Avoid C. diff testing if no diarrhea.”  
  - C. diff positive w/o diarrhea = carriage, not disease  
    (unless C diff ileus suspected)  
  - Also consider laxatives

Other low-hanging fruit:

- Labs that can be deferred to outpatient

- Watching labs instead of a patient  
  - (down-trending WBC in a well patient with receding cellulitis)

- Duplicate studies  
  - (A1C, iron panels, serologies)

- NH3 for HE screening in chronic liver disease patients

- Clinically silly scenarios  
  - RPR in acutely delirious nun with UTI
What is wrong with this picture?

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Other practical suggestions

- **Consider urgency**
  - Can I wait until tomorrow to save the patient a stick?

- **Attempt add-ons** when possible

- **Avoid repeat orders on CALM labs**
  - CALM labs take much longer (lipids, LFTs, etc)

- **Avoid “that’s interesting” labs**
  - HCV VL or genotype for an inpatient
  - FENa, FEUr
Our Goals

- To promote a culture of resource stewardship for the safety and well-being of our patients
- Avoid ordering in “default mode”
- Consider the value of every test ordered by:
  - Knowing the price
  - Being aware of the risks
  - Questioning the indications
- With every order you might ask:
  - “What would I want ordered if I were in their shoes?”

What it all boils down to:

**When it’s 5 AM and it’s your arm**

what labs would you want ordered?
References


