unintended consequences due to these in-office payment reduction policies through shifting the performance of these procedures to the hospital environment, with the associated hospital outpatient department payment formula, at a substantial increase in cost to the CMS.

White and Wu[2] have examined Medicare hospital cost reports for the period 1996-2009 and concluded that Medicare price cuts yield revenue reductions that are even larger than the Medicare payment reductions—in other words, other payers also reduce payments and affect downstream revenues. In addition, Wu and Shen[3] have demonstrated that drastic reductions in Medicare payments can potentially have an adverse effect on quality of patient care. Lindrooth and colleagues[4] studied 30-day mortality from Medicare databases for the years 1997, 2001, and 2005 and have reported an inverse relationship between changes in profitability and mortality across 21 service lines. Many would view that it is speculative to suggest that reducing payments will lead to an adverse effect on quality of care, but the analyses of Wu et al and Lindrooth et al at least beg the question of whether better strategies for imaging cost containment could be implemented by the CMS.

The current health care delivery challenges and resultant changes to the practice landscape demand creative and workable solutions to meet the needs of new practice models as well as help current private practitioners maintain viability while simultaneously promoting high value in health care delivery. These changes include a renewed focus on new payment models, education around evolving models of care, developing and using quality tools to ensure evidence-based care, and promoting the appropriate use of stretched resources. In particular, addressing the problem of overuse of unnecessary tests and procedures by implementing payment models that encourage appropriate testing while discouraging inappropriate testing is a more rational approach for controlling Medicare costs than across-the-board decreases in reimbursement. Physicians will need to assume leadership in new delivery systems and health care policy to encourage all specialties to practice cost-effective medicine. We agree with Fuchs and Milstein[5]: "There is not much that physicians can do directly to change the behavior of insurance companies, employers, or other stakeholders, but physicians are the most influential element in health care. The public's trust in them makes physicians the only plausible catalyst of policies to accelerate diffusion of cost-effective care."

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## Reduction of Central Venous Catheter Use in Medical Inpatients Through Regular Physician Audits Using an Online Tool

Central venous catheters (CVCs) facilitate secure access in critically ill patients and allow for the administration of caustic substances. Potential harms include bloodstream infections[1] and thromboembolism.[2] A recent study showed that 21.2% of physicians were unaware that their patient had a CVC[3] and therefore were incapable of making judicious decisions about catheter retention. At our center, we suspected that physicians were frequently unaware of the CVCs; therefore, we created a system to ensure that CVCs were regularly reevaluated.

Editor's Note page 1234

**Methods** | The study was conducted in two 26-bed internal medicine clinical teaching units in a 517-bed hospital. Baseline data were collected from January 21, 2013, through March 27, 2013. Thereafter, we implemented the intervention from June 1, 2013, through December 1, 2014.

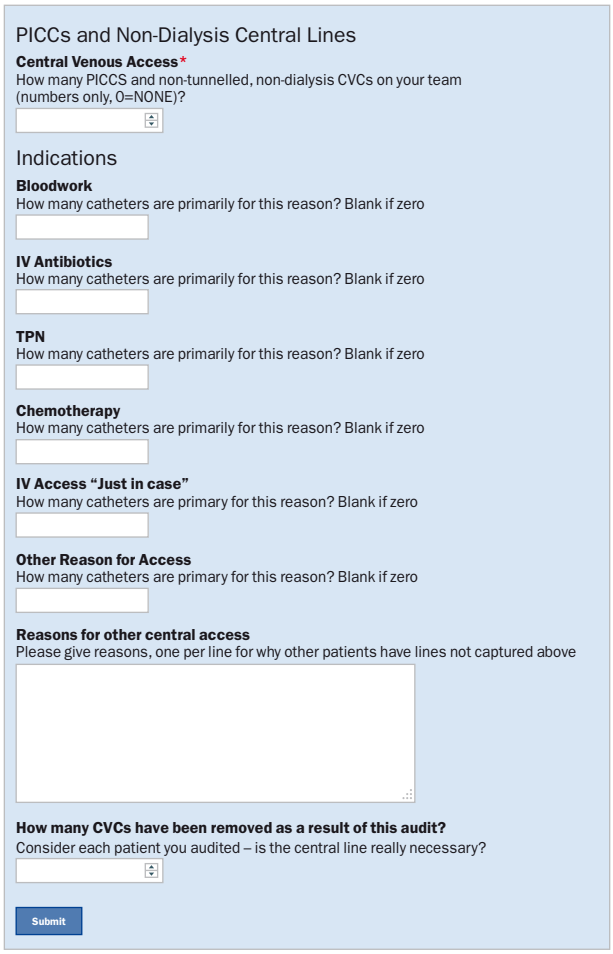
Senior residents evaluated all their patients once weekly for the presence of CVCs and anonymously recorded the number and their respective indications (starting August 1, 2013) using an online tool (**Figure**). The tool prompted residents to consider whether each CVC was necessary and to discuss with their teams whether to retain the CVC. Overall auditing adherence was 70%. The prevalence of CVCs and their indications were discussed with the teams monthly.

Central venous catheters were defined as nontunneled, nondialysis catheters in jugular, subclavian, or femoral veins, or peripherally inserted central catheters. Infections associated with the CVC were assessed using standard criteria[4] and standardized per 10 000 patient days. McGill University Health Centre Institutional Review Board approval was waived, as this process was considered best practice.

Rate differences between CVC use per 100 patient audit days and infections associated with the CVC per 10 000 patient days were compared before and after intervention using the $z$ test and inverse variance rates. Rates among junior (≤5 years' experience) and nonjunior (>5 years' experience) faculty were similarly compared.

**Results** | After the intervention, the rate of CVCs per 100 patient days decreased from 13.1 to 7.0 (51 CVCs in 390 patient days audited vs 167 CVCs in 2392 patient days audited, $P < .01$).

Figure. Online Tool




Online tool used for physician audits of central venous catheters (CVCs) and for data collection. IV indicates intravenous; PICC, percutaneous inserted central catheter; and TPN, total parenteral nutrition.

Overall, junior faculty had lower weighted mean CVC rates than did nonjunior faculty (4.8 vs 8.9 per 100 patient audit days, $P < .01$) (**Table**). There was no difference in the annual rates of infections associated with the CVC before and after the intervention (2.9 vs 1.1 per 10 000 patient days, $P = .25$).

Of 161 postintervention CVCs, 107 (66.5%) had an indication recorded, including antibiotic administration (48.5%), ease of drawing blood for testing (20.6%), chemotherapy (12.1%), venous access in case of patient deterioration (11.2%), and parenteral nutrition (5.6%).

**Discussion** | We demonstrated a 46.6% reduction (95% CI, 27.0%-61.0%) in CVC use through regular auditing requiring minimal effort. There remains room for improvement, as audit adherence was imperfect and one-third of CVCs were indicated for ease of drawing blood for testing or venous access in case of deterioration. As the Choosing Wisely movement reduces unnecessary testing, and both point-of-care ultrasound and interosseous devices facilitate emergency venous access, we hope that fewer CVCs remain for these indications.

Table. Rates of CVC Use by Attending Physician

| Staff Member | CVCs per 100 Patient Audit Days, Rate | Junior Faculty[a] |
|---|---|---|
| A | 3.2 | Yes |
| B | 3.7 | Yes |
| C | 3.8 | Yes |
| D | 5.8 | No |
| E | 5.8 | No |
| F | 7.7 | No |
| G | 7.7 | No |
| H | 8.7 | Yes |
| I | 8.8 | No |
| J | 10.3 | Yes |
| K | 10.6 | No |
| L | 11.5 | No |
| M | 11.5 | No |
| N | 11.5 | No |
| O | 15.4 | No |

Abbreviation: CVC, central venous catheter.

[a] Junior faculty were defined as those with 5 years or less of experience.

The differences between junior and nonjunior faculty are interesting. We hypothesize that junior faculty may have had lower CVC rates because they may be more likely to instruct their senior residents to remove CVCs because of increased comfort with their own ability to subsequently reinsert them if necessary.

Our study was limited to medical inpatients in a single center; consequently, it may lack generalizability. We also implemented our program rapidly to limit harm and did not accrue sufficient baseline data to permit time-series analysis. Our results may consequently be biased by overuse during the baseline assessment. Despite these limitations, we describe a logical, inexpensive intervention that is without risk to the patient.

We suggest that such interventions, which involve the concept of medical mindfulness, can be one effective means of reducing use of CVCs. Our clinical teaching unit has successfully used a similar method of targeted reassessment to improve antibiotic use[5] and believes this method could be adapted to Foley catheters.[6,7] Through consciously striving to act as the stewards of iatrogenic risk, we believe physicians can optimize patient safety.

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*Study concept and design:* All authors.
*Acquisition, analysis, or interpretation of data:* All authors.
*Drafting of the manuscript:* All authors.
*Critical revision of the manuscript for important intellectual content:* All authors.

*Statistical analysis:* Lee.
*Administrative, technical, or material support:* All authors.

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Editor's Note

## A Simple Approach to Reducing Inappropriate Use of Central Venous Catheters

Central venous catheters are commonly used in hospitalized patients. Many are not indicated, evidence of benefit is scant, and all put patients at risk for thrombosis and infection. In this issue, McDonald and Lee[1] describe a simple intervention—making inpatient teams aware that a patient has a central venous catheter and the probable indication for the catheter—that appears to have resulted in a major reduction in the prevalence of inappropriate use of central venous catheters. While we applaud this effort, additional evidence is needed, as this intervention took place at 1 hospital and there was no concurrent control group. But we hope the study will stimulate additional research, preferably randomized clinical trials, to document the efficacy of interventions to reduce the use of inappropriate central venous catheters.

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**1**. McDonald EG, Lee TC. Reduction of central venous catheter use in medical inpatients through regular physician audits using an online tool [published online May 4, 2015]. *JAMA Intern Med*. doi:10.1001/jamainternmed.2015.1292.

## Antibiotic Prescribing for Acute Respiratory Infections in Direct-to-Consumer Telemedicine Visits

Direct-to-consumer (DTC) telemedicine companies provide consumers with around-the-clock access to care for common nonemergent conditions through telephone and live video visits via personal computers and mobile phone apps. Approximately 1 million DTC telemedicine visits between patients and physicians serving these companies, without an established relationship, were delivered in 2014.[1]

DTC telemedicine is often more convenient and less expensive than in-person visits. However, concerns about the quality of these services have been expressed[2,3]: lack of a physician-patient relationship and access to medical records; limitations of the physical examination; and barriers to testing could lead to overuse of antibiotics.

There have been few evaluations of DTC telemedicine quality. Using health plan claims, we compared antibiotic prescribing rates for acute respiratory infection (ARI) between Teladoc, a large DTC telemedicine company, and physician offices.

**Table 1. Adult Teladoc Users and Nonusers With ARI Visits[a]**

| Characteristic | No. (%) of Users for ARI Visits | | *P* Value |
|---|---|---|---|
| | Teladoc (n = 1725) | Non-Teladoc (n = 64 099)[b] | |
| Sex | | | |
| Men | 629 (36.5) | 24 824 (38.7) | .06 |
| Women | 1096 (63.5) | 39 275 (61.3) | |
| Age, y | | | |
| 18-30 | 273 (15.8) | 11 756 (18.3) | <.01 |
| 31-50 | 912 (52.9) | 27 642 (43.1) | |
| ≥51 | 540 (31.3) | 24 701 (38.5) | |
| Chronic illness | | | |
| 0 | 1489 (86.3) | 49 870 (77.8) | <.01 |
| ≥1 | 236 (13.7) | 14 229 (22.2) | |
| Location | | | |
| Urban | 1579 (93.7) | 59 508 (94.6) | .10 |
| Rural | 107 (6.3) | 3411 (5.4) | |

Abbreviation: ARI, acute respiratory infection.

[a] Encompasses study period: April 2012-October 2014.

[b] Nonusers were limited to those with at least 1 visit to any site for care during the study period.

**Methods** | In April 2012, the California Public Employees' Retirement System first offered Teladoc as a covered benefit. We limited the study population to members aged 18 to 64 years, who were continuously enrolled from April 2012 to October 2013 who had 1 or more ARI visits. This study was approved by the institutional review board for RAND Corporation.

We identified ARI visits using *International Classification of Diseases, Ninth Revision* diagnosis codes based on prior methods.[4] We eliminated follow-up visits at any site within 21 days and visits with competing diagnoses that may have required antibiotics. We identified any oral antibiotic prescription within 3 days of the visit and defined broad-spectrum antibiotics as macrolides and flouroquinolones.

We compared antibiotic and broad-spectrum antibiotic prescribing rates for Teladoc and physician offices. In multivariate models, we adjusted for sex, age, chronic illness (using the Charlson Comorbidity Index), site of care, and ARI diagnoses. Using the predictive margin method, we report predicted prescribing rates, adjusting for covariates.[5]

**Results** | Teladoc users were less likely to be 51 years of age or older or have 1 or more chronic illnesses (**Table 1**). In both un-