Nonpharmacist Health Care Providers' Knowledge of and Opinions Regarding Medication Costs in Critically Ill Patients

Hospital Pharmacy
2018, Vol. 53(3) 188–193
© The Author(s) 2017
Reprints and permissions:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0018578717739005
journals.sagepub.com/home/hpx

Drayton A. Hammond¹, Tiffany Chiu², Jacob T. Painter³,
and Nikhil Meena³

Abstract

Purpose: Medication cost is frequently overlooked when treating critically ill patients. Stewardship of health care resources in high-utilization settings is imperative. This study was conducted to determine nonpharmacist health care providers' knowledge and perceptions of medication costs in a medical intensive care unit (MICU). **Methods:** Nonpharmacist health care providers in a MICU completed a 27-item survey. The survey queried perceptions regarding medication cost, cost-limiting strategies, and most/least expensive medications in 8 classes, medication price ranges, and intravenous-to-oral comparisons for commonly prescribed medications. Responses were analyzed using descriptive statistics and compared between providers using Fisher exact tests. **Results:** Among 98 health care providers (76 medical trainees, 5 attending physicians, 17 nurses), when ordering a medication, 49% consider its cost. Few (15%) providers considered themselves knowledgeable regarding medication costs with no difference between providers ($P = .174$). Attending physicians were more aware of the most/least expensive medications than residents (correct out of 16: 9.6 vs 8.5, $P = .044$). The correct price ranges for select medications (11%-36%, $P = .373$) and intravenous-to-oral relative costs (3%-49%, $P = .596$) were similarly low. Most (59%) believed pharmacists limit expensive medication use, particularly senior physicians (58% resident vs 100% attending, $P = .007$). **Conclusion:** In spite of a goal of cost consideration, most nonpharmacist health care providers are unaware of medication costs and fail to include them in decision making. These knowledge gaps and perceptions should inform future efforts to improve knowledge and attitudes regarding medication costs.

Keywords

cost, critical care, pharmacist/physician issues

Introduction

The consistent growth in health care expenses remains a national concern. In 2015, health care expenses accounted for approximately 18% of the United States' gross domestic product, representing a greater contribution than any other country.¹ Health care expenditures increase substantially when a patient receives care in the intensive care unit (ICU),^{2,3} with costs for inpatient care in the final 30 days of life showing a more than 15-fold increase compared with the first 30 days of the final year of life.⁴ When prescribing medications, many factors are evaluated, but too often is the cost of medication overlooked with the financial burden ultimately falling on the patients or their family. Currently, there are many physician associations (eg, American College of Physicians, American Board of Internal Medicine, and Alliance for Academic Internal Medicine) providing educational programs on cost-conscious, high-value care.^{5,6} A key feature to providing cost-conscious care is improving health care providers' awareness of the relative and absolute costs

of medications. Although pharmacists have a unique skill set that includes an awareness of the costs of most medications used in their patients, neither of these programs addresses the pharmacist as a resource in the process of providing cost-conscious care.

Knowledge transmission, reflective practice, and a supportive environment were found to aid in the development of future physicians who were trained to provide high-value, cost-conscious care.⁷ In organizations where a culture of high-value, cost-conscious care is not engrained in its employees, an early step in the process of changing the

¹Rush University Medical Center, Chicago, IL, USA

²CoxHealth, Springfield, MO, USA

³University of Arkansas for Medical Sciences, Little Rock, USA

Corresponding Author:

Drayton A. Hammond, Clinical Pharmacy Specialist, Medical Intensive Care, Department of Pharmacy, Rush University Medical Center, 1653 W Congress Parkway, Chicago, IL 60612, USA.
Email: drayton_hammond@rush.edu

culture is to identify where gaps in knowledge exist and what the attitudes are toward high-value, cost-conscious care.

When ordering and administering medications, many factors are evaluated. At our institution, pharmacists perceived that nonpharmacist health care providers often overlooked or were unaware of the absolute and relative costs of medications ordered for use in critically ill patients. This study was conducted to assess the extent to which physicians, nurses, and medical students were aware of the costs of medications commonly used in critically ill adults and to identify perceptions of nonpharmacist health care professionals regarding medication costs and the pharmacist's role in limiting the use of expensive medications.

Methods

This study was an investigational review board–approved, cross-sectional survey of nonpharmacist health care professionals who worked in or rotated through a medical ICU at a tertiary care, urban, academic medical center. All surveys were distributed as paper copies by the authors and completed anonymously and voluntarily by nurses on day and night shifts, pulmonary/critical care medicine attending physicians, pulmonary/critical care medicine fellows in the institution's 3-year fellowship program, and medical residents and students who staffed the medical ICU between January and May 2015.

The survey instrument was developed through a methodical, stepwise process. The 3 survey sections dedicated to determination of participants' knowledge and the section dedicated to perceptions of medication costs were chosen based on common themes of cost-related questions that the authors encountered in clinical practice. Specific medications within each medication class and survey section were selected from the institutions' formulary by the authors to represent those most commonly used in the medical ICU. Following initial construction of the survey tool, a total of 10 physicians, nurses, and pharmacists who were not included in the participant cohort validated the survey tool content and provided written feedback. This written feedback was incorporated into the revised, final survey tool that was provided to all survey participants.

The 3 knowledge-related sections assessed the participant's awareness of the most and least expensive medications in 8 medication classes from a list of 4 or 5 medications, the price range for a select medication in the same 8 medication classes, and the relative cost of an intravenous and oral dosage form for a medication in 4 of the medication classes. Costs for all medications were the institution's purchase price without any discounts or other price modifiers. The perception-related section included 5 questions and used a 6-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = somewhat agree, 5 = agree, and

6 = strongly agree) for each question. These questions were designed to assess the participant's opinions regarding self-awareness of medication costs, frequency that cost and cost-effectiveness were discussed on patient care rounds, and the pharmacist's role in limiting the use of expensive medication.

Participant demographics, correct responses for each of the 3 knowledge-related sections, and responses for the perception-related section were described descriptively using counts and percentages. Responses on the 6-point Likert scale that were marked as strongly disagree, disagree, or somewhat disagree were coded as "disagree," and responses that were marked as strongly agree, agree, and somewhat agree were coded as "agree." Following dichotomization, the percentage that agreed with each statement was compared between groups using the Fisher exact test. The percentage of correct responses in each of the knowledge-related sections was compared between all groups using the Fisher exact test. STATA 14 (StataCorp LP, College Station, Texas) was used for all analyses, and a $P < .05$ was deemed to be statistically significant.

Results

Demographics

In total, 98 of an available 169 (58%) nonpharmacist health care professionals completed the survey in full. The majority of these were physicians in training: 3 medical students (of 4, 75%), 66 medical residents (of 108, 61.1%) across various years (24 first year, 19 second year, 19 third year, and 4 fourth year), and 7 pulmonary/critical care medicine fellows (of 9, 77.8%). In addition, 5 attending physicians (of 8, 62.5%) and 17 nurses (of 40, 42.5%) participated.

Relative Cost of Medications

Nonpharmacist health care professionals indicated the most and least expensive medications from 4 or 5 choices in each of the 8 medication classes; number and percentage of correct responses are depicted in Table 1. A copy of the questionnaire is available in Online Appendix 1. There were 8 questions each for the most and least expensive medications within a class. The average total correct was 3.3 (41.5%) and 5 (62.5%), respectively, for an average total correct of 8.4 (52.6%) questions out of 16. Attending physicians answered the most total questions correctly (9.6 questions, $P = .044$). Attending physicians were more frequently correct in their choice of the most expensive antibiotic for a gram-positive organism (80%, $P = .042$) and the least expensive antibiotic for a gram-negative organism (80%, $P = .002$). There were no other differences in the percentage of correct responses between participant groups.

Table 1. Most and Least Expensive Medications Per Class.

Class of medication ^a	Expense category	Nurse (n = 17)	Medical student (n = 3)	Medical resident (n = 66)	Fellow (n = 7)	Attending (n = 5)	Total (n = 98)	P value
Sedatives and analgesics (continuous infusion)	Most	12 (71)	1 (33)	53 (80)	6 (86)	5 (100)	77 (79)	.267
	Least	7 (41)	1 (33)	23 (35)	7 (100)	5 (100)	43 (44)	.849
Analgesics (noncontinuous infusion)	Most	12 (71)	1 (33)	39 (59)	4 (57)	4 (80)	60 (61)	.661
	Least	15 (88)	3 (100)	59 (89)	7 (100)	5 (100)	89 (91)	.863
Antibiotics for gram-positive organisms	Most	4 (24)	1 (33)	23 (35)	0 (0)	4 (80)	32 (33)	.042
	Least	9 (53)	0 (0)	19 (29)	2 (29)	3 (60)	33 (34)	.231
Antibiotics for gram-negative organisms	Most	9 (53)	1 (33)	23 (35)	2 (29)	3 (60)	38 (39)	.555
	Least	3 (18)	1 (33)	41 (62)	3 (43)	4 (80)	52 (53)	.002
Antifungal agents	Most	11 (65)	1 (33)	39 (59)	3 (43)	2 (40)	56 (57)	.653
	Least	14 (82)	1 (33)	54 (82)	6 (86)	5 (100)	80 (82)	.181
Stress ulcer prophylaxis	Most	2 (13)	1 (33)	10 (15)	0 (0)	0 (0)	13 (13)	.666
	Least	3 (19)	1 (33)	9 (14)	0 (0)	0 (0)	13 (13)	.518
Prophylaxis for venous thromboembolism	Most	9 (53)	1 (33)	31 (47)	5 (71)	1 (20)	47 (48)	.532
	Least	15 (88)	3 (100)	56 (85)	7 (100)	5 (100)	86 (88)	.999
Respiratory inhalers	Most	0 (0)	0 (0)	1 (2)	0 (0)	0 (0)	1 (1)	.999
	Least	14 (82)	3 (100)	56 (85)	7 (100)	5 (100)	85 (87)	.999
Average "most expensive" correct (out of 8)		3.4 (43)	2.3 (29)	3.4 (43)	2.9 (36)	3.8 (48)	3.3 (41)	.235
Average "least expensive" correct (out of 8)		4.8 (60)	4.3 (54)	5.1 (64)	4.7 (59)	5.8 (73)	5.0 (63)	.616
Average correct (out of 16)		8.3 (52)	6.7 (42)	8.5 (53)	7.6 (48)	9.6 (60)	8.4 (53)	.044

^aAll data are number of correct responses (%), except for P values.

Table 2. Correct Responses for a Range of Costs for Selected Medications.

Medication ^a	Nurse (n = 17)	Medical student (n = 3)	Medical resident (n = 66)	Fellow (n = 7)	Attending (n = 5)	Total (n = 98)	P value
Fluconazole IV	4 (24)	2 (67)	21 (32)	4 (57)	4 (80)	35 (36)	.089
Daptomycin	3 (18)	0 (0)	23 (35)	3 (43)	0 (0)	29 (30)	.236
Cefepime	4 (24)	1 (33)	13 (20)	3 (43)	1 (20)	22 (22)	.572
Famotidine IV	3 (18)	1 (33)	16 (24)	2 (29)	0 (0)	22 (22)	.747
Dexmedetomidine	1 (6)	1 (33)	11 (17)	3 (43)	0 (0)	16 (16)	.171
Acetaminophen IV	3 (18)	0 (0)	9 (14)	0 (0)	2 (40)	14 (14)	.347
Heparin SQ	3 (18)	0 (0)	6 (9)	2 (29)	0 (0)	11 (11)	.397
Budesonide/formoterol	5 (29)	0 (0)	5 (8)	1 (14)	0 (0)	11 (11)	.141
Average correct (out of 8)	1.5 (19)	1.7 (21)	1.6 (20)	2.6 (32)	1.4 (17)	1.6 (20)	.373

Note. IV = intravenous; SQ = subcutaneous.

^aAll data are number of correct responses (%), except for P values.

Price Range for Select Medications

Table 2 shows that nonpharmacist health care professionals chose the correct cost range for 1.6 out of 8 medications commonly used in critically ill patients. The cost range for each medication was selected correctly between 11% and 36% of the time, depending on the specific medication. An intravenous dose of fluconazole was categorized correctly more often than other medications (36%). The 2 medications that were least frequently categorized correctly according to their price range were subcutaneous heparin and one inhaler of budesonide/formoterol (11%). There were no differences in the percentage of correct responses between participant groups.

Relative Cost of Intravenous and Oral Dosage Forms

Out of 4 questions that compared the relative cost of intravenous and oral dosage forms of frequently used medications in critically ill patients, nonpharmacist health care professionals answered 1 question correctly on average. There were no differences in the percentage of correct responses between professions or level of training. The most frequently identified correct relative cost was intravenous acetaminophen, with 49% of respondents aware that the intravenous dosage was 21 to 1000 times more expensive than the oral dosage equivalent. However, only 3% of those surveyed were aware that intravenous levofloxacin was less expensive than its oral dosage form (Table 3).

Table 3. Correct Responses for Relative Costs of Intravenous and Oral Dosage Forms.

Medication ^a	Nurse (n = 17)	Medical student (n = 3)	Medical resident (n = 66)	Fellow (n = 7)	Attending (n = 5)	Total (n = 98)	P value
Acetaminophen 1000 mg	9 (56)	1 (33)	33 (51)	2 (29)	3 (60)	48 (49)	.775
Linezolid 600 mg	2 (13)	2 (67)	17 (26)	4 (57)	1 (20)	26 (27)	.096
Pantoprazole 40 mg	3 (19)	0 (0)	14 (22)	0 (0)	3 (60)	20 (20)	.164
Levofloxacin 750 mg	1 (6)	1 (33)	1 (2)	0 (0)	0 (0)	3 (3)	.101
Average correct, n (out of 4)	0.9 (22)	1.3 (33)	1 (25)	0.9 (22)	1.4 (35)	1 (25)	.596

^aAll data are number of correct responses (%), except for P values.

Table 4. Perception of Practice and Knowledge.

Statements ^a	Nurse (n = 17)	Medical student (n = 3)	Medical resident (n = 66)	Fellow (n = 7)	Attending (n = 5)	Total (n = 98)	P value
Consider medication cost when ordering/using	7 (44)	0 (0)	33 (50)	3 (43)	4 (80)	47 (48)	.161
Cost of medication discussed on rounds	6 (35)	1 (33)	14 (21)	1 (14)	3 (60)	25 (26)	.624
Medication benefits and efficacy versus cost discussed on rounds	5 (29)	1 (33)	22 (33)	2 (29)	2 (40)	32 (33)	.669
Pharmacists limit use of expensive medications	8 (47)	1 (33)	38 (58)	6 (86)	5 (100)	58 (59)	.007
Consider myself knowledgeable on medication costs	2 (12)	1 (33)	9 (14)	0 (0)	3 (60)	15 (15)	.174

^aAll data are number of agree responses (%), except for P values.

Perceptions of Practice and Knowledge

Slightly less than half (48%) of respondents indicated that they consider a medication's cost when ordering or using a medication in a critically ill patient. Approximately one-quarter (26%) of respondents reported that the costs of medications were discussed during patient care rounds. One-third (33%) of nonpharmacist health care professionals felt that medication benefits and efficacy in conjunction with medication cost were discussed on patient care rounds. Only 15% of these individuals believed themselves to be knowledgeable about the costs of medications. The majority (59%) of nonpharmacist health care professionals believed pharmacists try to limit the use of expensive medications in critically ill patients. More attending physicians felt this way than nurses (100% vs 47%, $P = .007$; Table 4).

Discussion

Cost-effective care emphasizes preserving and utilizing finite resources in the most optimal way in accordance with the best available evidence.^{8,9} Half of the nonpharmacist health care professionals who practice in the medical ICU at our institution consider a medication's cost when ordering or using that medication in a critically ill patient; however, only 15% consider themselves knowledgeable about medication costs. Participants knew on average 41% of the most and

63% of the least expensive medications in therapeutic classes, less than 40% of the relative costs for commonly used medications, and less than 50% of the relative costs between intravenous and oral dosage forms for commonly used medications. Physicians who are aware of the price of a medication are more likely to support cost-effective prescribing policies.¹⁰⁻¹² Each health care professional working in an ICU can play a vital role in decreasing the rising expenditures in critical care medicine; however, increasing this responsibility begins with identifying perceptions and deficits in knowledge.^{13,14}

Our findings are similar to those in other studies. In a study of medical students, residents, and intensive care physicians, only 29% of their estimates for costs of medications used in critically ill patients were within 50% of the actual medication cost.¹⁵ In 2 studies that evaluated physicians' knowledge of costs of medications used in acutely ill patients, the estimated medication cost was within 25% of the actual cost in less than 15% and 31% of instances.^{16,17} When costs of medications were evaluated upon a transition of care from the hospital setting to home, nonpharmacist health care professionals accurately assessed the relative price of a medication less than half of the time.¹⁸

Hernu and colleagues surveyed medical students, residents, and intensive care physicians regarding the costs of medications, blood products, laboratory tests, and procedures that

could be employed when providing care for critically ill patients in one of 2 clinical situations: septic shock secondary to community-acquired pneumonia or hemorrhagic shock in a patient receiving a vitamin K antagonist. For medications used in critically ill patients, they found that physicians consistently underestimated the cost of more expensive medications by 67%.¹⁵ Similarly, our cohort correctly chose the most expensive medication in 8 therapeutic classes only 41.5% of the time. In studies that were focused on medications used in acutely ill patients, both Schutte et al and Allan et al found that physicians consistently underestimated the cost of expensive or branded medications.^{16,17}

Conversely, Schutte et al and Allan et al discovered that physicians consistently overestimated the cost of inexpensive or generic medications.^{16,17} In our cohort, participants were more likely to identify the least expensive medication in a therapeutic class (62.5%). This finding may be due to a greater familiarity with inexpensive medications due to many of them being in use for a longer period of time. Anecdotally, because the cost of a medication is more likely to be mentioned during patient care rounds if the medication is expensive, the infrequency at which the cost of inexpensive medications is mentioned during rounds may have affected participants' responses.

Most participants in our survey, other than attending physicians, did not consider themselves knowledgeable about medication costs. Schutte et al and Hernu et al observed similar differences in their cohorts. Schutte et al found that physicians had a higher self-perceived cost awareness than students but a nonsignificant difference in actual knowledge of medication costs.¹⁶ Hernu et al described that junior physicians had a significantly reduced perceived knowledge of medication cost than more experienced physicians.¹⁵ Because attending physicians felt more knowledgeable about medication costs but in most instances performed no different from other nonpharmacist health care professionals, they should be included in formal and informal education on medication costs and cost-effectiveness.

While half of our cohort considers medication cost when ordering or using a medication, only one-quarter reported that the cost of medications was discussed during patient care rounds, and only one-third believed the benefits and effects relative to medication costs were discussed. Consequently, 59% of participants believed that pharmacists try to limit the use of expensive medications. The extent to which pharmacists truly limit expensive medications in an effort to pursue cost-effective care strategies was not evaluated. Physicians in practice and in training appear to learn this topic through a combination of discussing specific information, reflecting on their prescribing behaviors, and practicing in a supportive and open environment that is intentionally focused on high-quality and cost-conscious care.⁷ Consequently, we encourage pharmacists, as the health care team member is most uniquely positioned to be aware of medication costs and cost-effectiveness, to support this

culture and act as educators on medication costs and cost-effective behaviors.

This study was unique in that it adequately represented the perceptions of multiple nonpharmacist health care professionals rather than just physicians and provided a multifaceted assessment of nonpharmacist health care professionals' knowledge of medication costs. This study was conducted in a single academic medical center in which pharmacists are present and actively engage in direct patient care rounds, which may not be transferable to a health system with a different pharmacy practice model. In addition, although the response rates in each cohort were acceptable, the small number of participants from all cohorts other than medical residents reduces the ability to draw generalizable conclusions to these cohorts. As paper surveys were passed out, there is the possibility for collaboration between survey participants. The choice of commonly used medications in the medical ICU in this survey was intentional but not all-inclusive; however, the survey tool was subjected to face and content validity testing to improve confidence in its use. This study focused on awareness of medication costs rather than cost-effectiveness of pharmacological interventions. Cost-effective studies in critically ill patients have become more prevalent in recent years.¹⁹⁻²² Nonpharmacist health care professionals should have their knowledge of and perceptions toward cost-effective practice evaluated to inform educational efforts on these practices.

Conclusion

In spite of a goal of cost consideration, most nonpharmacist health care professionals are unaware of medication costs and, thus, fail to include them in decision making. These knowledge gaps should inform future efforts focused on increasing knowledge of medication costs and development of a culture of cost-consciousness. The actual role of a pharmacist in the medical ICU with regard to limiting the use of expensive medications and pursuit of cost-effective care strategies should be evaluated.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

1. Miller G, Hughes-Cromwick P, Turner A, Daly M. *Health Sector Economic Indicators: Insights from Monthly National Health Spending Data through July 2015* (Altarum Institute Spending Brief #15-9: July 2015 data). <http://altarum.org/sites/default/files/uploaded-related-files/CSHS-Spending->

- Brief_September_2015.pdf. Published September 11, 2015. Accessed March 20, 2017.
2. Halpern NA, Pastores SM, Greenstein RJ. Critical care medicine in the United States 1985-2000: an analysis of bed numbers, use, and costs. *Crit Care Med*. 2004;32:1254-1259.
 3. Moerer O, Plock E, Mgbor U, et al. A German national prevalence study on the cost of intensive care: an evaluation from 51 intensive care units. *Crit Care*. 2007;11:R69.
 4. Tanuseputro P, Wodchis WP, Fowler R, et al. The health care cost of dying: a population-based retrospective cohort study of the last year of life in Ontario, Canada. *PLoS One*. 2015;10(3):e0121759.
 5. Duke P. The ABIM Foundation's Choosing Wisely communication module. http://modules.choosingwisely.org/modules/m_00/. Published 2013. Accessed March 20, 2017.
 6. American College of Physicians. High value care curriculum. Date unknown. <https://hvc.acponline.org/curriculum.html>. Accessed March 20, 2017.
 7. Stammen LA, Stalmeijer RE, Paternotte E, et al. Training physicians to provide high-value, cost-conscious care: a systematic review. *JAMA*. 2015;314(22):2384-2400.
 8. Noseworthy TW, Konopad E, Shustack A, Johnston R, Grace M. Cost accounting of adult intensive care: methods and human and capital inputs. *Crit Care Med*. 1996;24:1168-1172.
 9. Garland A, Shaman Z, Baron J, Connors AF Jr. Physician-attributable differences in intensive care unit costs: a single-center study. *Am J Respir Crit Care Med*. 2006;174:1206-1210.
 10. Polinski JM, Maclure M, Marshall B, et al. Does knowledge of medication prices predict physicians' support for cost effective prescribing policies? *Can J Clin Pharmacol*. 2008;15:e286-e294.
 11. Shrank WH, Joseph GJ, Choudhry NK, et al. Physicians' perceptions of relevant prescription drug costs: do costs to the individual patient or the population matter most? *Am J Manag Care*. 2006;12:545-551.
 12. Hart J, Salman H, Bergman M, et al. Do drug costs affect physicians' prescription decisions? *J Intern Med*. 1997;241:415-420.
 13. Cooke M. Cost consciousness in patient care—what is medical education's responsibility? *N Engl J Med*. 2010;362:1253-1255.
 14. Reichert S, Simon T, Halm EA. Physicians' attitudes about prescribing and knowledge of the costs of common medications. *Arch Intern Med*. 2000;160:2799-2803.
 15. Hernu R, Cour M, de la Salle S, Robert D, Argaud L; Costs in French ICU Study Group. Cost awareness of physicians in intensive care units: a multicentric national study. *Intensive Care Med*. 2015;41(8):1402-1410.
 16. Schutte T, Tichelaar J, Nanayakkara P, Richir M, van Agtmael M. Students and doctors are unaware of the cost of drugs they frequently prescribe. *Basic Clin Pharmacol Toxicol*. 2017;120(3):278-283.
 17. Allan GM, Lexchin J, Wiebe N. Physician awareness of drug cost: a systematic review. *PLoS Med*. 2007;4(9):e283.
 18. Cogdill B, Nappi JM. Assessment of prescribers' knowledge of the cost of medications. *Ann Pharmacother*. 2012;46(2):200-207.
 19. Hammond DA, Kathe N, Shah A, Martin BC. Cost-effectiveness of histamine2 receptor antagonists versus proton pump inhibitors for stress ulcer prophylaxis in critically ill patients. *Pharmacotherapy*. 2017;37(1):43-53.
 20. Shah A, Shewale A, Hayes CJ, Martin BC. Cost-effectiveness of oral anticoagulants for ischemic stroke prophylaxis among nonvalvular atrial fibrillation patients. *Stroke*. 2016;47(6):1555-1561.
 21. Aljabri A, Huckleberry Y, Karnes J, et al. Cost-effectiveness of anticoagulants for suspected heparin-induced thrombocytopenia in the United States. *Blood*. 2016;128(26):3043-3051.
 22. Taylor C, Thompson K, Finfer S, et al; Crystalloid versus Hydroxyethyl Starch Trial (CHEST) investigators and the Australian and New Zealand Intensive Care Society Clinical Trials Group. Hydroxyethyl starch versus saline for resuscitation of patients in intensive care: long-term outcomes and cost-effectiveness analysis of a cohort from CHEST. *Lancet Resp Med*. 2016;4(10):818-825.