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AOA Critical Issues in Education

Teaching of Cost-Effective Care in Orthopaedic Surgery Residency Training

A Survey of Residency Programs in the US

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Background: Costs of healthcare in the US continue to rise at rates that are unsustainable. Prior studies, most of which come from non-surgical specialties, indicate that a variety of strategies to teach this material are utilized but without consensus on best practices. No studies exist regarding the teaching of cost-effective care in orthopaedic residency training programs. The goal of this study was to assess the landscape in this area from the perspective of program leadership.

Methods: A survey was developed that was sent to orthopaedic residency program leadership via email through their interaction with the COERG. Additional programs were included to enhance diversity of responding programs. The survey, based on those published from other areas of medicine, included questions about the experiences of the respondents in learning about cost-effective care, as well as how faculty and residents learned about this topic.

Results: Seventy one percent (30) of respondents noted that their faculty did not receive formal training in cost-effective care, and education in this area was likely to come from the department, especially review of practice data (12, 44%). Only 19% (8) of respondents agreed with the statement that "the majority of teaching faculty in our program consistently model cost-effective healthcare to residents". Few of the programs (10, 24%) had formal curricula for residents regarding cost-effective care, and the primary mode of education in cost-effective care was through informal discussions with faculty (17, 43%). Few residents (3, 13%) were able to easily find the costs of tests or procedures.

Discussion: There is not consistent education in cost-effective care for orthopaedic surgery program leadership, faculty, or trainees. The results of this survey demonstrate a need for discussion of best practices, including increasing access to cost data at a local level, and engaging with the AOA, CORD, and the American Academy of Orthopaedic Surgeons more broadly in the development of standard education modules for faculty and residents, to improve the current and future delivery of cost-effective musculoskeletal care.

Disclosure: The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article (http://links.lww.com/JBJSOA/A515).

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Introduction

Costs for medical and surgical care in the US continue to rise at rates that are unsustainable. Healthcare spending in the US was approximately 20% of the GDP in 2020[1]. Shrank et al. in 2019[2] estimated that the cost of waste in the US health care system accounted for approximately 25% of total health care spending. Given this, the topic of cost-effectiveness within healthcare is receiving increased attention.

Prior studies on this topic, which have predominantly come from non-surgical specialties, indicate that physicians, including academic faculty, have variable levels of knowledge of factors affecting cost[3-5]. It is not surprising that this lack of knowledge extends to trainees: Hines et al.[6] found that residents were less likely than faculty to rate various scenarios as representing low-value testing or to consider costs of care, despite no differences between residents and faculty in self-reported cost-consciousness. Residents' decisions when providing patient care can be improved, but this requires intentional effort on the part of training programs to teach[7,8] and faculty to model utilizing this information . While prior studies have indicated the effectiveness of various models of teaching cost effective care[9], there is no consensus on how best to teach this topic[7].

The emphasis on training on this topic is reflected in the question on the Accreditation Council on Graduate Medical Education (ACGME) resident surveys regarding teaching of cost-effective care. While the discussion about the benefits of providing residents with education about cost-effective healthcare has been ongoing across specialties, there are currently no studies that describe whether cost effective care is taught in a coordinated fashion in orthopaedic residency training and, if so, in what format this information is presented. This study aims to evaluate the exposure of current orthopedic residency program leadership, faculty, and trainees to cost-effective healthcare education.

Methods

To assess the status of education in cost-effective care across programs, a survey was created based on a review of studies that surveyed residency program leaders in other fields of medicine[10,11]. To determine if what is currently being taught in cost-effective care is publicly available, the senior author (KT) assessed the websites of 15 random programs invited to participate in the survey. For those programs that included mention of curricula, only subspecialty areas within orthopaedics or lectures about conditions or related procedures were noted. No program specifically mentioned cost-effective care education or discussions of the costs of care. It is possible that cost-effectiveness is included within lectures regarding specific conditions or procedures, and faculty may be teaching this material but may not label it as such. In addition, informal teaching of cost-effective care at the bedside would not be listed as part of formal curricula. It was thought that surveying residency program leadership, as has been published from other areas of medicine[10,11], would best identify if and where this is taught. Questions used in these prior studies were incorporated into the development of the current survey, including questions regarding demographics of the program, background of the participant in cost-effective care, and curricula used in the training program (Table 1). Questions were also included regarding awareness of national cost-effectiveness initiatives, including ChoosingWisely[12] and the American College of Physicians High Value Care toolkit[13]. The former was of particular interest, given its inclusion of recommendations regarding some musculoskeletal conditions. The final survey was finalized by a consensus of the senior authors (BP, JP, KT), and the link to the survey was tested by the senior author.

The study was discussed with representatives to the Collaborative Orthopaedic Education Research Group (COERG) and sent to those program directors expressing interest in the topic. Additional programs were then identified by the authors (KT, BP, BW, JP) to ensure diversity in program size and location. The survey was distributed electronically via REDCap to 94 program directors using the email address made available through the Council of Orthopaedic Residency Program Directors (CORD) or found on-line, with the intent for this to be completed by the person in the program most involved with developing the resident curriculum (program directors, department chairs, or assistant program directors). Participation in the study was voluntary, and there were no incentives to participate. Participants were informed that the data would be de-identified.

The study was approved by the COERG executive committee, as well as by the University of Kansas Medical Center Institutional Review Board.

Results

Surveys were received from 43 programs (45% response rate) (Table 2), including responses from 37 program directors (3 of whom also noted that they were chairs) and 6 associate program directors. The majority of programs (36/43, 84%) were allopathic, and 72% (31/43) of programs were classified as academic, with the remainder defined as community/privademic (12/43, 28%). Roughly 72% (31/43) of responding programs match 4-8 residents per year. Those programs that did not respond to the survey had an average number of residents matched per year similar to those of responding programs (4-8 residents per year 77% vs 72%), although they were more likely to represent larger programs (>8 residents matched per year 10% vs 2%).

Twenty-six percent (11/42) of respondents had personally received no education in cost effective care (Table 3), while 33% (14/42) had learned about this through didactics or online modules, and 38% (16/42) through independent reading materials. The most common source of education in cost-effective care was informal discussions (24/42, 57%), while the least common were electronic displays at point of care (7/42, 16%) or other (1/42, 2%). The majority (35/42, 83%) of respondents had discussed cost effective care with other faculty, leadership, or administration at their institutions, and 67% (28/42) had discussed this with residents in their programs. The majority (25/42, 60%) noted that these discussions were informal, while 38% (16/42) noted that both formal education and informal discussions had occurred. No

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TABLE I Cost-effectiveness education survey questions

Demographics
1. Position (select all that apply) a. Chair b. Program director c. Assistant program director 2. Years in practice 3. Total number of residents matched per year (<4, 4-8, >8) 4. What is the classification of your program? (select one of the following) a. Allopathic b. Osteopathic 5. Type of residency program (select all that apply) a. Community/privademic b. Academic/university c. Military
Cost-Effective Healthcare Background Demographics
6. In your opinion, what does the term cost-effective healthcare mean? (select all that apply) a. Cost-conscious care b. Regulated care c. Value-based care d. Patient-centered care e. Other (please explain) 7. Have you ever received training regarding cost-effective healthcare? 7A. How did you receive cost-effective healthcare training? (select all that apply) a. Didactics or online modules b. Informal discussions c. Independent reading material d. Electronic display of cost information at the point of care e. Other (please explain) 8. With whom have you discussed cost-effective healthcare? (select all that apply) a. Faculty/leadership/administration at my institution b. Faculty/leadership/administration at other institutions c. Residents at my institution d. None 8A. Are these cost-effective healthcare discussions formal or informal? (select all that apply) a. Formal b. Informal c. Both 8B. How often do you have these cost-effective healthcare discussions? a. Daily

continued

TABLE I (*continued*)

Demographics
b. Weekly c. Monthly d. Yearly e. Never 9. Of which of the following specific cost-effective healthcare initiatives are you aware? (select all that apply) a. Choosing wisely b. Top-5 c. American College of Physicians Cost-Effective Healthcare Initiative d. Other (please explain) e. None
Cost-Effective Healthcare Resident Curriculum
10. Do your residents currently receive formal training curriculum on cost-effective healthcare? a. Yes b. No c. Uncertain 10A. At what level do the residents receive this training? (select all that apply) a. Departmental b. Institutional/GME c. Both departmental and institutional/GME 10B. How is this curriculum implemented? (select all that apply) a. Didactics b. Online modules c. Informal discussions with faculty d. Independent reading material recommended by leadership e. Independent reading material recommended by peer residents f. Review of patient medical chart, billing, or costs/expenses provided by the institution g. Electronic display of cost information at the point of care h. Other (please explain) 11. Of the following methods to teach cost-effective healthcare, which do you think is the most effective for resident/fellow education? (select one of the following) a. Didactics b. Online modules c. Informal discussions with faculty d. Independent reading material recommended by leadership e. Independent reading material recommended by peer residents f. Review of patient medical chart, billing, or costs/expenses provided by the institution g. Electronic display of cost information at the point of care h. Other (please explain)

continued

TABLE I (*continued*)

Demographics
12. What is the level of importance of teaching cost-effective healthcare? a. Low b. Medium c. High
13. What is the status of cost-effective healthcare curriculum at your institution? a. Currently being taught b. Currently being developed c. Not currently being developed with plans to develop d. Not currently being developed with no plans to develop
14. Were you aware before receiving this survey that the 2021 ACGME Resident and Faculty Surveys both included specific questions about teaching cost-effective healthcare? a. Yes, aware of both b. Yes, aware of resident survey content c. Yes, aware of faculty survey content d. Not aware that this was a focus area
Cost-Effective Healthcare Faculty Curriculum
15. Does your faculty currently receive formal training curriculum on cost-effective healthcare? a. Yes b. No c. Uncertain
15A. At what level does your faculty receive this training? (select all that apply) a. Departmental b. Institutional/GME c. Both departmental and institutional/GME
15B. How is this curriculum implemented? (select all that apply) a. Modules b. Decision support tools c. Grand rounds or resident conferences d. Resource stewardship programs e. Review of departmental/institutional data f. Other (please explain)
16. Please rate your level of agreement with the following statement: Most teaching faculty in our program consistently model cost-effective healthcare to residents. a. Strongly agree b. Agree c. Neutral d. Disagree e. Strongly disagree f. Uncertain

continued

TABLE I (*continued*)

Demographics
Institutional Cost-Effective Healthcare Initiatives
17. Are residents provided information on costs of tests and procedures they order? a. Yes b. No c. Uncertain
17A. Are residents able to gain access to information on costs of tests and procedures? a. Yes–easily access without difficulty b. Yes–access with difficulty c. No d. Uncertain
18. Does your program participate in quality improvement projects regarding costs and/or value-based care? a. Yes b. No c. Uncertain
19. How often do you discuss the cost with residents as part of individual patient care? a. Daily b. Weekly c. Monthly d. Yearly e. Never
Opinions Toward Cost-Effective Healthcare
20. In the US healthcare system, what percent of medical care that patients receive is considered unnecessary? a. 5%-10% b. 10%-20% c. 20%-40% d. 40%-60%
21. Please rate your level of agreement with the following statements (1-10 and 10 is highest): a. Physicians' decisions have little impact on the costs of care that patients receive b. Reducing the cost of healthcare is beyond the control of physicians c. Faculty have a responsibility to teach trainees about costs d. I know the costs of tests/equipment that I order e. Our department consistently encourages residents to consider costs when making clinical decisions f. Our institution has provided adequate education and access to data about cost of care to current and past residents

ACGME = Accreditation Council on Graduate Medical Education, GME = Graduate Medical Education.

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TABLE II Demographics of respondents and their training programs

Demographics	
Position	
Chair	3 (7%)
Program Director (PD)	37 (86%)
Assistant PD	6 (14%)
Years in practice	
Average	16.1
Minimum	6
Maximum	39
#Residents matched per year	
<4	11 (26%)
4-8	31 (72%)
>8	1 (2%)
Classification of program	
Allopathic	36 (84%)
Osteopathic	7 (16%)
Type of program	
Community/privademic	12 (28%)
Academic/university	31 (72%)
Military	0 (0%)
Background	
Cost-effective healthcare meaning (select all that apply)	
Cost-conscious care	33 (79%)
Regulated care	5 (12%)
Value-based care	33 (79%)
Patient-centered care	14 (33%)
Other	0 (0%)
Training received regarding cost-effective healthcare (select all that apply)	
None	11 (26%)
Didactics/online modules	14 (33%)
Informal discussions	24 (57%)
Independent reading material	16 (38%)
Electronic display of cost information at the point of care	7 (16%)
Other (symposium at national meeting)	1 (2%)
Participants in discussions about cost-effective healthcare (select all that apply)	
Faculty/leadership/administration at home institution	35 (83%)
Faculty/leadership/administration at other institutions	19 (45%)
Residents at home institution	28 (67%)
None	2 (5%)

continued

TABLE II (*continued*)

Demographics	
Types of discussions about cost-effective healthcare	
Formal	0 (0%)
Informal	25 (60%)
Both	16 (38%)
NA	1 (2%)
Frequency of cost-effective healthcare discussions	
Daily	1 (2%)
Weekly	5 (12%)
Monthly	19 (45%)
Yearly	16 (38%)
Never	1 (2%)
Awareness of specific cost-effective healthcare initiatives (select all that apply)	
Choosing wisely	12 (29%)
Top-5	7 (17%)
American College of Physicians Cost-Effective Healthcare Initiative	6 (14%)
Other	0 (0%)
None	23 (55%)
Cost-Effective Healthcare Resident Curriculum	
Existence of formal training curriculum for residents on cost-effective healthcare	
Yes	10 (24%)
No	31 (74%)
Unknown	1 (2%)
Level at which residents receive this training	
Departmental	8 (20%)
Institutional/GME	1 (3%)
Both departmental and institutional/GME	4 (10%)
None	28 (70%)
Implementation of this curriculum (select all that apply)	
Didactics	9 (23%)
Online modules	2 (5%)
Informal discussions with faculty	17 (43%)
Independent reading material recommended by leadership	5 (13%)
Independent reading material recommended by peer residents	1 (3%)
Review of patient medical chart, billing, or costs/expenses provided by the institution	1 (3%)
Electronic display of cost information at the point of care	0 (0%)

continued

TABLE II (*continued*)

Demographics	
Other	0 (0%)
NA	23 (58%)
Most effective method of teaching cost-effective healthcare for resident/fellow education	
Didactics	12 (29%)
Online modules	4 (10%)
Informal discussions with faculty	9 (21%)
Independent reading material recommended by leadership	2 (5%)
Independent reading material recommended by peer residents	0 (0%)
Review of patient medical chart, billing, or costs/expenses provided by the institution	6 (14%)
Electronic display of cost information at the point of care	7 (17%)
Other (combination of daily rounds, grand rounds, didactics, and journal club)	2 (5%)
Level of importance of teaching cost-effective healthcare	
Low	6 (14%)
Medium	22 (52%)
High	14 (33%)
Status of cost-effective healthcare at home institution	
Currently being taught	7 (17%)
Currently being developed	3 (7%)
Not currently being developed with plans to develop	17 (41%)
Not currently being developed with no plans to develop	15 (36%)
Awareness that the 2021 ACGME Resident and Faculty Surveys both included specific questions about teaching cost-effective healthcare before receiving this survey	
Yes, aware of both	29 (69%)
Yes, aware of resident survey content	3 (7%)
Yes, aware of faculty survey content	1 (2%)
Not aware that this was a focus area	9 (21%)
Cost-Effective Healthcare Faculty Curriculum	
Whether faculty currently receives formal training on cost-effective healthcare	
Yes	6 (14%)
No	30 (71%)
Uncertain	6 (14%)

continued

TABLE II (*continued*)

Demographics	
Level at which faculty receives this training (select all that apply)	
Departmental	7 (18%)
Institutional/GME	2 (5%)
Both departmental and institutional/GME	1 (3%)
NA	30 (77%)
Implementation of this curriculum (select all that apply)	
Modules	4 (15%)
Decision support tools	2 (7%)
Grand rounds or resident conferences	8 (30%)
Resource stewardship programs	3 (11%)
Review of departmental/institutional data	12 (44%)
Other (involvement in contracting decisions about implants or none of the above)	7 (26%)
Level of agreement with the following statement: Most teaching faculty in our program consistently model cost-effective healthcare to residents	
Strongly agree	0 (0%)
Agree	8 (19%)
Neutral	23 (55%)
Disagree	8 (19%)
Strongly disagree	1 (2%)
Uncertain	2 (5%)
Cost-Effective Healthcare Initiatives	
Whether residents are provided information on costs of tests and procedures ordered	
Yes—easily accessible without difficulty	3 (13%)
Yes—accessible with difficulty	11 (46%)
No	8 (33%)
Uncertain	2 (8%)
Participation of home program in quality improvement projects regarding costs and/or value-based care	
Yes	19 (79%)
No	4 (17%)
Uncertain	1 (4%)
Frequency of discussion of cost with residents as part of individual patient care	
Daily	2 (8%)
Weekly	7 (29%)
Monthly	12 (50%)
Yearly	3 (13%)
Never	0 (0%)

continued

TABLE II (*continued*)

Demographics	
In the US healthcare system, what percent of medical care that patients receive is considered unnecessary?	
5%-10%	1 (4%)
10%-20%	4 (17%)
20%-40%	17 (74%)
40%-60%	1 (4%)

ACGME = Accreditation Council on Graduate Medical Education, GME = Graduate Medical Education.

respondents indicated that this topic was addressed only with formal didactics. The majority (23/42, 55%) of respondents were unaware of national cost-effectiveness initiatives.

Seventy-one percent (30/42) of respondents noted that faculty do not currently receive formal training on cost-effective healthcare (Table 4). Any education in this area is more likely to come from the department, especially from review of departmental or institutional data (12/27, 44%) or conferences (8/27, 30%), rather than efforts from the institution or Graduate Medical Education (GME) (2/39, 5%).

Respondents tended to agree that faculty have a responsibility to teach trainees about costs, as all answered between 4-10, with 10 being the highest degree of responsibility. 69% (29/42) of respondents recognized that questions about cost-effective care were part of the ACGME annual surveys (Table 4). All respondents noted that they or other faculty discussed costs with residents as part of individual patient care, with 8% (2/24) doing this daily, 29% (7/24) doing this weekly, and half (12/24, 50%) doing this monthly. These discussions, usually informal, were the most common means of education about cost effective healthcare (17/40, 43%). However, only 19% (8/42) of respondents agreed with the statement that "the majority of teaching faculty in our program consistently model cost-effective healthcare to residents". Seventy four percent of programs (31/42) noted that they do not have a standardized resident curriculum on cost effective care. If such training exists, it more commonly comes from the department (8/40, 20%), rather than from the institution or GME (1/40, 3%). Despite the current reliance primarily on individual patient-based or informal discussions to educate residents on this topic, only 21% (9/42) thought that informal discussions with faculty were effective. The majority (20/24, 83%) of programs noted that residents are not provided adequate access to information and education regarding costs (Table 5). Only 13% of respondents (3/24) thought that residents have easy access to the costs of tests and procedures ordered, while residents in one third of programs (8/24, 33%) cannot access this information (Table 6). Fifty-five percent (13/24) of programs indicated lower levels of agreement regarding the statement that "our department consistently encourages residents to consider costs when making clinical decisions".

TABLE III Background of respondent in cost-effective care

Training received regarding cost-effective healthcare (select all that apply)	
None	11 (26%)
Didactics/online modules	14 (33%)
Informal discussions	24 (57%)
Independent reading material	16 (38%)
Electronic display of cost information at the point of care	7 (16%)
Other (symposium at national meeting)	1 (2%)
Participants in discussions about cost-effective healthcare (select all that apply)	
Faculty/leadership/administration at home institution	35 (83%)
Faculty/leadership/administration at other institutions	19 (45%)
Residents at home institution	28 (67%)
None	2 (5%)
Types of discussions about cost-effective healthcare	
Formal	0 (0%)
Informal	25 (60%)
Both	16 (38%)
NA	1 (2%)
Frequency of cost-effective healthcare discussions	
Daily	1 (2%)
Weekly	5 (12%)
Monthly	19 (45%)
Yearly	16 (38%)
Never	1 (2%)
Awareness of specific cost-effective healthcare initiatives (select all that apply)	
Choosing wisely	12 (29%)
Top-5	7 (17%)
American College of Physicians Cost-Effective Healthcare Initiative	6 (14%)
Other	0 (0%)
None	23 (55%)

Discussion

Physicians play a significant role in addressing rising healthcare costs: it has been estimated that at least 60% of healthcare costs are influenced by decisions physicians make[14]. The current survey supports what has been demonstrated in other areas of medicine[10,11]: orthopaedic surgery faculty and residents receive little training regarding making cost-effective decisions, despite the emphasis placed on this by the ACGME.

Education in cost-effective healthcare can be provided in a variety of ways: didactic presentations/formal curriculum, informal patient-based discussions, or hands-on workshops. Cost-effectiveness education within orthopaedic surgery

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TABLE IV Cost-effective healthcare faculty education

Whether faculty currently receives formal training on cost-effective healthcare	
Yes	6 (14%)
No	30 (71%)
Uncertain	6 (14%)
Level at which faculty receives this training (select all that apply)	
Departmental	7 (18%)
Institutional/GME	2 (5%)
Both departmental and institutional/GME	1 (3%)
NA	30 (77%)
Implementation of this curriculum (select all that apply)	
Modules	4 (15%)
Decision support tools	2 (7%)
Grand rounds or resident conferences	8 (30%)
Resource stewardship programs	3 (11%)
Review of departmental/institutional data	12 (44%)
Other (involvement in contracting decisions about implants or none of the above)	7 (26%)
Level of agreement with the following statement: Most teaching faculty in our program consistently model cost-effective healthcare to residents	
Strongly agree	0 (0%)
Agree	8 (19%)
Neutral	23 (55%)
Disagree	8 (19%)
Strongly disagree	1 (2%)
Uncertain	2 (5%)

GME = Graduate Medical Education.

TABLE V Cost-effective healthcare resident curriculum

Existence of formal training curriculum for residents on cost-effective healthcare	
Yes	10 (24%)
No	31 (74%)
Unknown	1 (2%)
Level at which residents receive this training	
Departmental	8 (20%)
Institutional/GME	1 (3%)
Both departmental and institutional/GME	4 (10%)
None	28 (70%)
Implementation of this curriculum (select all that apply)	
Didactics	9 (23%)
Online modules	2 (5%)
Informal discussions with faculty	17 (43%)
Independent reading material recommended by leadership	5 (13%)
Independent reading material recommended by peer residents	1 (3%)
Review of patient medical chart, billing, or costs/expenses provided by the institution	1 (3%)
Electronic display of cost information at the point of care	0 (0%)
Other	0 (0%)
NA	23 (58%)
Most effective method of teaching cost-effective healthcare for resident/fellow education	
Didactics	12 (29%)
Online modules	4 (10%)
Informal discussions with faculty	9 (21%)
Independent reading material recommended by leadership	2 (5%)
Independent reading material recommended by peer residents	0 (0%)
Review of patient medical chart, billing, or costs/expenses provided by the institution	6 (14%)
Electronic display of cost information at the point of care	7 (17%)
Other (combination of daily rounds, grand rounds, didactics, and journal club)	2 (5%)
Level of importance of teaching cost-effective healthcare	
Low	6 (14%)
Medium	22 (52%)
High	14 (33%)
Status of cost-effective healthcare at home institution	
Currently being taught	7 (17%)
Currently being developed	3 (7%)

continued

training programs in this study was found to primarily occur with informal discussions, either alone or in combination with a more formalized curriculum. Only a minority of programs taught cost-effective care only though didactics, despite a plurality of respondents noting that didactics are more effective than informal discussions in communicating this material. While almost half of programs are or are planning to develop this curriculum, 1/3 of programs have no plans in this area. This is not an issue isolated to orthopaedic surgery training: Patel et al.[10] found that only 15% of internal medicine residency programs have formal curricula regarding cost-effective care, with others finding no change in the presence of curricula over time[15].

Faculty knowledge and behavior in this area have the potential to shape the future of cost-effective healthcare, as trainees tend to model behaviors after their mentors or preceptors. Most respondents in the current study thought that faculty have a responsibility to teach residents about cost, although orthopaedic faculty do not consistently receive

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TABLE V (*continued*)

Not currently being developed with plans to develop	17 (41%)
Not currently being developed with no plans to develop	15 (36%)
Awareness that the 2021 ACGME Resident and Faculty Surveys both included specific questions about teaching cost-effective healthcare before receiving this survey	
Yes, aware of both	29 (69%)
Yes, aware of resident survey content	3 (7%)
Yes, aware of faculty survey content	1 (2%)
Not aware that this was a focus area	9 (21%)

ACGME = Accreditation Council on Graduate Medical Education, GME = Graduate Medical Education.

education on this topic. This is similar to the results of a survey among pediatric faculty, in which most (81%) thought that they were qualified to teach cost-effective care, but only 22% reported receiving formal training[16]. Beyond informal or formal teaching, a survey of internal medicine program directors found that fewer than 30% of faculty were thought by program directors and residents to consistently model cost-conscious practice[17]. A lack of faculty with education in or who can successfully model cost-consciousness practice are likely barriers in preparing trainees to provide cost-effective care[18].

Awareness of costs may be determined, in part, by location or type of practice. Ryskina et al.[19] found training at a hospital which provides a higher acuity of care was associated with lower cost-consciousness among graduates. Johnson et al.[20] found that surgeons who considered themselves "cost-conscious" with rotator cuff repairs were more likely to be in a private practice group, rather than affiliated with a residency training program. This could impact the future of cost-effective care, as most residents train in hospital-based programs and may not get the passive exposure to cost-conscious decision-making that may be more common in private practice settings, unless they also have exposure to these experiences.

Variations in experiences emphasize the need for a more standardized curriculum, regardless of site of training or level of knowledge of faculty, that would provide the framework to residents for decision-making that will be relevant for their careers. Lack of curricular resources has been cited as a barrier to teaching cost effective care[11]. However, the ideal audience for this training is unclear. Having a formal resident curriculum was found by Patel et al. to have no impact on faculty modeling of cost-effective care[10], while Ryskina et al.[21] found that internal medical residents were more likely to report healthcare value discussions with faculty if they trained in programs that offered faculty development in this area. Given that most programs in the current study noted no formal faculty development in cost-effective care and only 17% of respondents agreed with the statement that "the majority of teaching faculty in our program consistently model cost-effective healthcare to residents", this may demonstrate areas of opportunity, with the focus of education shifting from a formal curriculum only for residents to one that includes faculty.

There are also hands-on methods of resident education in cost-effective care. One option is providing them with ready access to the costs of tests or procedures. Only 12.5% of respondents to this survey noted that residents were able to access information about the costs of tests and procedures without difficulty. This is substantially less than among internal medicine residency[10] or psychiatry[11] programs, for whom about a third have ready access to this data. Having access to this data can increase the likelihood of consideration of costs[8] or discussion with faculty regarding cost-effective care[21]. Moving forward, efforts should be made by departments to collaborate with their institutions to increase ease of access to this data to help inform education efforts. Another model of practical education was reported by Pei et al.[22] in which they implemented a workshop regarding surgical instrument standardization with general surgery residents. The participants in this workshop developed greater knowledge of costs, while also noting that standardization improved or did not change surgeon autonomy, resident training, and patient safety. This is something that could be adapted for orthopaedic training programs.

The lack of previous research evaluating the state of cost-effective healthcare education of either orthopaedic faculty or residents is a strength of this study. The survey was sent out to a wide variety of programs, with diversity in program location, and size. One limitation of this survey study involves the respondents: while the majority were program directors, a few

TABLE VI Access to cost data

Whether residents are provided information on costs of tests and procedures ordered	
Yes—easily accessible without difficulty	3 (13%)
Yes—accessible with difficulty	11 (46%)
No	8 (33%)
Uncertain	2 (8%)
Participation of home program in quality improvement projects regarding costs and/or value-based care	
Yes	19 (79%)
No	4 (17%)
Uncertain	1 (4%)
Frequency of discussion of cost with residents as part of individual patient care	
Daily	2 (8%)
Weekly	7 (29%)
Monthly	12 (50%)
Yearly	3 (13%)
Never	0 (0%)

(6) of the surveys were completed by assistant PDs, and there were 3 PDs who also served as department chairs. There may be different views of residency education content based on faculty leadership roles within a program. An additional limitation of this survey study is the 45% response rate. Results represent the input from a minority of orthopaedic training programs in the US and may not reflect or be representative of what is occurring in most, especially larger, programs. In addition, many of the programs that participated in the survey had expressed interest in this project through COERG, potentially leading to bias and an overestimate of cost-effectiveness education. However, given the diversity of programs that participated and the lack of data in this area, the findings from this survey can serve to spur additional discussion. In addition, this survey study focused on the input from residency program leadership. Given that cost-effective care can be taught through a variety of methods, the authors thought that this survey was better directed at program leadership, similar to studies in the literature from other areas of medicine[10,11], to help identify what currently exists (or is planned) at the faculty, trainee, and programmatic levels. Additional research is needed, including studies that investigate faculty views on what they are teaching, residents' perspectives on cost-effective healthcare during training, and the impact of this education on the costs of practice and patient outcomes.

Conclusion

The inclusion of a question on the annual ACGME resident/fellow and faculty surveys specific to the teaching of cost-effective care should be seen as a call to action. There is significant room for improvement in the way orthopaedic surgery residents are trained in the area of cost-effective care: the current status of orthopaedic resident education is reflected in respondents' lack of agreement with the statement that "our institution has provided adequate education and access to data about cost of care to current and past residents". With the information from this survey, we hope to foster collaboration and sharing of resources and best practices, potentially through AOA and CORD, to facilitate education in cost-effective care, while limiting the duplication of efforts among programs and assuring that education in this realm is orthopaedic-focused and practical for orthopaedic faculty and trainees. Given the differences in clinical experiences and resources available among programs, this area would also seem ripe for the development of a standardized curriculum, as has been done in internal medicine[23], defining what topics are to be covered, what mode of delivery is used, and how many hours are devoted to this during the curriculum, with involvement of the American Academy of Orthopaedic Surgeons, AOA, and CORD. Knowledge and provision of cost-effective care could be an additional focus for American Board of Orthopaedic Surgery certification. Given the burden of musculoskeletal conditions, efforts to expose residents to this area while still in training could ultimately help reduce costs of healthcare in the US.

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