

ORIGINAL ARTICLE

Physician Perceptions Regarding Antimicrobial Use in End-of-Life Care

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BACKGROUND. The decision to utilize antimicrobials in end-of-life situations is complex. Understanding the reasons why physicians prescribe antimicrobials in this patient population is important for informing the design of antimicrobial stewardship interventions.

METHODS. A 51-item survey containing both closed and open-ended questions on end-of-life antimicrobial use was administered to physicians affiliated with the University of Pennsylvania and Children's Hospital of Philadelphia from January through April 2017. A mixed-methods approach was used to analyze responses.

RESULTS. Of 637 physicians surveyed, 283 responses (44.4%) were received. Most (86.2%) physicians believed that respecting a patient's wish to continue antimicrobials was important. Approximately half of physicians (49.8%) believed that antimicrobial use at the end of life contributes to resistance. A higher proportion of pediatricians would often or always continue antimicrobial treatment for active infections and for hospice patients whose death was imminent compared to adult physicians ($P < .001$). Analysis of free-text responses revealed additional reasons why physicians may continue antimicrobials at end of life, including meeting family expectations, wanting to avoid the perception of "giving up," uncertainty about prognosis, and reducing patient pain or discomfort.

CONCLUSIONS. Physician decision making concerning antimicrobial use in patients at the end of life is multifactorial. Clinicians may overweigh the benefits of antimicrobial therapy in end-of-life situations and view the importance of adhering to stewardship policies differently. Pediatric and adult clinicians have different approaches to this patient population. Better understanding of the complex decision making that occurs in the end-of-life patient population can help guide antimicrobial stewardship policies and improve patient care.

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The overuse of antimicrobials has been linked to the rise of antimicrobial-resistant organisms, which are a cause of significant morbidity, mortality, and healthcare spending.^{1,2} Of equal importance, unnecessary antimicrobial use increases the risk of patient harm due to adverse events and drug side effects. In response, antimicrobial stewardship programs (ASPs) were developed to optimize antimicrobial use.^{1,3–7} Despite some progress,^{7,8} unnecessary antimicrobial prescribing continues to occur at high rates in the United States.⁷

Antimicrobial use is particularly common among patients in end-of-life settings, with some studies noting use as high as 87%.⁹ Patients at the end of life often have multiple comorbidities present in addition to their primary illness, and these patients may be more susceptible to infections due to contributing factors such as medications, immunosuppression, malnutrition, and the presence of catheters or wounds.^{10,11} Prior studies have noted that many end-of-life patients receive antimicrobials in the days or weeks prior to death.^{9,12,13} Furthermore, some patients receive antimicrobials in the absence of adequate clinical symptoms to

support the presence of a bacterial infection.¹⁴ Although quality of life is often cited for continuation of antimicrobials in this patient population, the literature supporting its use for this purpose is conflicting.^{10,15,16}

Given the medical complexity of patients at the end of life, it can be difficult to apply ASP guidelines to this population. The decision to prescribe antimicrobials in end-of-life patients thus becomes both individualized and multifactorial, often requiring complex clinical decision making. In these situations, physicians may balance an awareness that antimicrobial resistance and an increased risk of adverse drug effects is linked to unnecessary prescribing¹⁷ with potentially competing interests of patients, patients' families, or the healthcare system.^{2,17–20}

Characterizing physician attitudes toward end-of-life antimicrobial prescribing is integral to understanding how physicians approach infections in this patient population and to optimizing antimicrobial use for patients at the end of life. The objectives of this study were (1) to examine the reasons why physicians continue or discontinue antimicrobials at the

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end of life and (2) to determine whether physicians prefer to continue antimicrobial use in specific end-of-life situations.

METHODS

Study Design and Participant Recruitment

A cross-sectional study of attending physicians and fellows with appointments at either the University of Pennsylvania or Children's Hospital of Philadelphia (CHOP) was conducted from January 15 to April 10, 2017. Physicians with appointments at the University of Pennsylvania could work at the University of Pennsylvania Health System (UPHS), the Philadelphia Veterans Affairs Medical Center, or in a community or public health setting. These institutions are situated in a large urban area. The UPHS served as the coordinating site. In this study, physicians at CHOP and UPHS are referred to as pediatric and adult physicians, respectively.

Participants were selected for inclusion if they were physicians or fellows working in specialties commonly involved in medical decision making for patients at the end of life. Nonphysician providers who responded to this survey were excluded. Divisions targeted included critical care, hematology/oncology, hospice/palliative care, hospital medicine, immunology, infectious diseases, neonatology, and pulmonology. Physician contacts within the selected departments agreed to distribute the survey and send one reminder email during the study period. The survey instrument was administered electronically utilizing the REDCap system.²¹ Participants were informed in an introductory paragraph that the survey was created to study physician attitudes and decision making regarding antimicrobial use in end-of-life care. Participation in the survey was both voluntary and anonymous. No financial incentives were offered for participation. The University of Pennsylvania Institutional Review Board deemed this study exempt from review.

Survey Instrument

The study team drafted the initial survey, which was subsequently reviewed by a convenience sample of 3 physicians at both CHOP and UPHS in different specialties for readability, appropriateness, and length. Feedback from face-to-face sessions with these physicians was incorporated into the survey. The final instrument included 51 items (see Appendix). Demographic information was collected regarding respondents' institution, age, gender, practice setting, and medical specialties. Physicians were asked about their attitudes regarding antimicrobial stewardship and antimicrobial resistance. Respondents were then asked to consider a patient who is at the end of life. "End of life" was defined based on the respondents' own judgment and their clinical practice setting. A series of 5-point Likert-scale items followed, which asked survey participants to rate the relative importance of a given set of reasons for continuing or discontinuing antimicrobials. The last section of the survey instrument asked respondents how likely they were to continue an antimicrobial regimen for a

series of infection types and clinical scenarios. Finally, 3 optional, open-ended questions were included in the survey to allow respondents to reflect on additional reasons to continue or discontinue antimicrobials, as well as on the topic of antimicrobial use in end-of-life care.

Statistical Analysis

Answers to 5-point Likert-scale items were condensed into a 3-point scale: (1) agree, neutral/not sure, disagree, (2) important, neutral/not sure, not important, and (3) often/always, sometimes, and rarely/never for descriptive analysis. Likert-scale items were further condensed into a binary scale for statistical testing. Data were analyzed using SPSS version 24.0 statistical software (IBM, Armonk, NY). Statistical tests performed included the 2-sample Z test, χ^2 test, and Fisher exact tests. The level of significance for all statistical tests was $\alpha = 0.05$.

Free-text responses were analyzed for recurrent themes with the NVivo Suite version 11 software (QSR International, Melbourne, Australia) using standard methods of qualitative data analysis.²² All comments were reviewed in a 2-stage coding process by author J.E.S., a sociologist with expertise in qualitative data analysis. First, comments were reviewed for recurrent themes, which were identified and defined as analytic nodes in NVivo. Second, all responses were read line by line, and nodes were attached to relevant passages of data that represented that theme. While J.E.S. led node development and application, all authors participated in regular meetings throughout the analysis process to ensure reliability and to resolve any discrepancies by consensus.

RESULTS

Respondent Characteristics

Of the 637 physicians who were invited to participate in the survey, 283 completed it, for an overall response rate of 44.4%. The response rate was 37.5% (136 of 363) among CHOP physicians and 53.6% (147 of 274) among University of Pennsylvania physicians ($P < .01$). Approximately half of respondents were male (51.9%). The mean age of respondents was 43.2 years (standard deviation [SD], 11.1 years; interquartile range [IQR], 34.0–50.0 years). Common practice settings for survey participants included inpatient non-intensive care unit (non-ICU; 49.1%), followed by outpatient (26.9%) and inpatient ICU (17.3%). The most common specialties reported by respondents included pediatrics ($n = 74$), infectious diseases ($n = 52$), hematology/oncology ($n = 46$), pulmonary ($n = 41$), and critical care or ICU ($n = 40$).

Physician Beliefs About Antimicrobial Use and Stewardship

Most respondents agreed with the following 2 statements: "The overuse of antibiotics contributes to antibiotic resistance" (96.1%) and "Medical practitioners have a responsibility to reduce the use of unnecessary antibiotics" (99.3%). In response to the statement: "Antimicrobial use in end of life

care contributes to antibiotic resistance,” only 49.8% of physicians agreed, although this differed significantly between adult physicians and pediatric physicians (60.5% vs 38.2%; $P < .001$). More than one-third of physicians ($n = 108$, 38.2%) were neutral or unsure of the relationship between end-of-life antimicrobial use and resistance, and among them, more than half were pediatricians ($n = 63$, 58.3%).

Antimicrobial Continuation in End-of-Life Clinical Scenarios

Physicians were provided a set of clinical scenarios and asked to rate their likelihood of continuing antimicrobial treatment (Table 1). The infections with the highest proportion of physicians opting to often or always continue treatment were pneumonia (58.0%) and CNS infections (57.2%). Few physicians would continue antimicrobial prophylaxis (16.3%) or attempt to treat hardware or prosthetic infections (36.0%). For every infection in our survey, a higher proportion of pediatricians would often or always continue antimicrobial treatment compared to adult physicians. This difference in proportions was statistically significant for all infections ($P < .001$) as well as for antimicrobial prophylaxis ($P = .004$).

Most physicians would often or always continue antimicrobials for patients not in hospice whose care was not deemed medically futile (73.9%) or for stable patients enrolled in hospice (70.7%). Nearly one-fifth of pediatricians ($n = 27$, 19.9%) would continue antimicrobial therapy for hospice patients whose death was imminent, compared to few adult

physicians ($n = 4$, 2.7%; $P < .001$). Pediatric physicians differed significantly from adult physicians in their preference for continuing antimicrobials for stable patients enrolled in hospice ($n = 110$, 80.9% vs $n = 90$, 61.2%; $P < .001$) and for patients not in hospice who elect comfort care ($n = 56$, 41.2% vs $n = 37$, 25.2%; $P = .004$).

Reasons for Continuation or Discontinuation of Antimicrobials at the End of Life

A summary of physician attitudes toward reasons for continuing antimicrobial use in end-of-life care is provided in Table 2. Most physicians believed it was important to respect a patient's request to continue antimicrobial treatment for an infection at the end of life (86.2%) or to respect the request of a family member acting on behalf of the patient (74.6%). Relieving pain (87.3%) and work of breathing (76.3%) were also considered important by physicians. Adult and pediatric physicians differed significantly in their opinions regarding the importance of continuing antimicrobials for the progression of an infection ($n = 93$, 63.3%, vs $n = 107$, 78.7%; $P = .004$) or for reducing the external manifestations of an infection ($n = 62$, 42.2% vs $n = 82$, 60.3%; $P = .002$). A higher proportion of pediatric physicians considered respecting decision making made by prior medical staff ($n = 67$, 49.3% vs $n = 32$, 21.8%; $P < .001$) and respecting the primary team's wishes ($n = 74$, 54.4% vs $n = 44$, 29.9%; $P < .001$) important reasons to continue antimicrobial therapy.

TABLE 1. Physician Perceptions Favoring Continuation of Antimicrobials in End-of-Life Clinical Scenarios: Percentage Responding Often/Always

Clinical Scenario	All ($n = 283$), %	Pediatric Physicians ($n = 136$), %	Adult Physicians ($n = 147$), %	<i>P</i> Value ^a
Type of infection				
Urinary tract infection	50.5	64.7	37.4	<.001
Bone/joint infection	43.8	65.4	23.8	<.001
Endocarditis	45.9	59.6	33.3	<.001
Bacteremia	51.6	64.0	40.1	<.001
Pneumonia	58.0	69.9	46.9	<.001
Skin/soft tissue infection	46.6	60.3	34.0	<.001
Hardware/prosthetic infection	36.0	51.5	21.8	<.001
Intra-abdominal infection	50.2	64.7	36.7	<.001
CNS infection (includes abscesses, meningitis, encephalitis)	57.2	70.6	44.9	<.001
Surgical wound/site infection	52.3	69.1	36.7	<.001
Antimicrobial prophylaxis (eg Trimethoprim/sulfamethoxazole in immunosuppressed patients)	16.3	22.8	10.2	.004
End-of-life vignette				
Stable, enrolled in hospice, death not imminent	70.7	80.9	61.2	<.001
Enrolled in hospice, death imminent	11.0	19.9	2.7	<.001
Elects for comfort care, not enrolled in hospice	32.9	41.2	25.2	.004
Care deemed medically futile, not enrolled in hospice	30.7	36.0	25.9	.064
Care not deemed medically futile, not enrolled in hospice	73.9	77.2	70.7	.217

^aCalculated using χ^2 test. Bold values indicate significance.

TABLE 2. Reasons for Continuing Antimicrobials at the End of Life: Percentage of Physicians Responding Important/Extremely Important

Reasons for Continuing Antibiotics	All (n = 283), %	Pediatric Physicians (n = 136), %	Adult Physicians (n = 147), %	P Value ^a
I believe an infection can be likely cured with treatment.	72.8	77.9	68.0	.061
I believe the progression of an infection can be prevented with treatment.	70.7	78.7	63.3	.004
I want to alleviate a patient's pain from infection.	87.3	89.0	85.7	.411
I want to alleviate a patient's work of breathing from infection.	76.3	79.4	73.5	.240
I want to reduce the external manifestations of a patient's infection (eg, ulcers, abscesses).	50.9	60.3	42.2	.002
The patient's life expectancy appears to be very short (days to 1–2 weeks) such that I do not wish to further alter the patient's medication regimen.	24.0	22.1	25.9	.456
The burden of treatment (eg, dosing frequency, route of administration) with antibiotics on the patient is not excessive.	65.0	72.1	58.5	.017
A culture exists at my institution that promotes continuation of antibiotics at the end of life.	21.9	22.1	21.8	.953
I wish to respect or continue the medical decision making made by other medical staff who were taking care of this patient prior to me.	35.0	49.3	21.8	<.001
I wish to respect the primary medical team's request to continue antibiotic treatment.	41.7	54.4	29.9	<.001
I wish to respect a patient's request to continue antibiotic treatment for an infection at the end of life.	86.2	86.0	86.4	.929
I wish to respect a family member's request to continue antibiotic treatment for a patient at the end of life.	74.6	79.4	70.1	.071

^aCalculated using χ^2 test. Bold values indicate significance.

Physicians were also queried regarding reasons for discontinuing antimicrobial use (Table 3). Many physicians believed it was important to respect a patient's request to discontinue antimicrobial treatment (97.5%) or to discontinue treatment if the antimicrobial was no longer treating the indicated infection (92.2%). Less than one-quarter of physicians (22.6%) believed that reducing the cost of antimicrobial use to the payor was an important reason for discontinuing treatment. The proportion of adult physicians who believed it was important to discontinue antimicrobial therapy due to concern for *C. difficile* infection differed significantly compared to pediatric physicians (n = 121, 82.3% vs n = 88, 64.7%; *P* = .001).

Open-Ended Questions

Overall, 73 respondents (25.8%) provided free-text answers to the open-ended questions included in the survey. Responses ranged in length from 17 to 128 words. Analysis of these responses revealed that decision making surrounding antimicrobial use is complex and based on multiple interacting factors that are difficult to generalize. Table 4 summarizes these reasons and provides exemplar verbatim quotations from the free-text responses.

Respondents focused on 3 overarching reasons for continuing antimicrobials at the end of life. First, respondents suggested that they continued antimicrobials at the end of life to ensure that families perceived the care team as doing everything possible for their loved one. Physicians were motivated to not be perceived by families as "heartless" or "the

final hatchet man" as a result of withholding treatment. Second, respondents suggested that knowing when a patient is near death is difficult and if a small possibility existed that therapy could prolong a patient's life by even a few days, they would continue antimicrobials. As one respondent explains, ". . . antibiotics can be palliative. The extra few days they can provide may be important to that person or their family." Third, respondents suggested that they continued antimicrobials to reduce physical pain or suffering from untreated infection (eg, decreasing dysuria by treating a urinary tract infection).

DISCUSSION

Unique considerations related to end-of-life care, including a focus on goals of care and improving quality of life,^{23,24} likely influence physician perceptions. Many physicians in our study considered palliation of pain and work of breathing important reasons to continue antimicrobials. The relationship between antimicrobial use and improvement in quality of life is controversial.^{10,15,16} A meta-analysis that explored symptom burden reduction with antimicrobial therapy in end-of-life patients noted marked variability; 60%–92% of patients with urinary tract infections and 0–53% with respiratory infections reported improvement.²⁵ Despite the lack of compelling evidence, many physicians may opt to try or continue antimicrobial therapy to palliate patient symptoms because they perceive the adverse consequences to be relatively low. Clinical guidelines, such as the Infectious Diseases Society of America's clinical guidelines on hospital-acquired and ventilator-associated

TABLE 3. Reasons for Discontinuing Antimicrobials at the End of Life: Percentage of Physicians Responding Important/Extremely Important

Reasons for Discontinuing Antibiotics	All (n = 283), %	Pediatric Physicians (n = 136), %	Adult Physicians (n = 147), %	P Value ^a
I believe that the incidence of antimicrobial resistance can be reduced.	64.0	64.0	63.9	.997
I am concerned about antibiotic side effects.	86.6	85.3	87.8	.544
I am concerned about <i>C. difficile</i> infection.	73.9	64.7	82.3	.001
The burden of treatment (eg, dosing frequency, route of administration) with antibiotics on the patient is excessive	82.0	84.6	79.6	.277
My facility lacks appropriate antibiotic monitoring for treatment effectiveness or safety (eg, vancomycin trough) if a patient is on a drug that requires therapeutic monitoring.	23.3	21.3	25.2	.445
In transfer situations, the facility or home to which the patient is to be transferred prohibits or is unable to continue administration of antibiotics.	63.3	58.8	67.3	.137
I am reasonably certain that the antibiotic is no longer treating the indicated infection.	92.2	95.6	89.1	.042
Input from a specialist in infectious diseases who believes that antibiotics are no longer indicated.	82.7	84.6	81.0	.423
I wish to reduce the cost of antibiotic use to the payor.	22.6	20.6	24.5	.433
I wish to respect a patient's request to discontinue antibiotic treatment at end of life.	97.5	97.8	97.3	1.000 ^b
I wish to respect a family member's request to discontinue antibiotic treatment at end of life.	91.9	95.6	88.4	.028

NOTE. *C. difficile*, *Clostridium difficile*^aCalculated using χ^2 test unless otherwise specified. Bold values indicate significance.^bCalculated using the Fisher exact test.

TABLE 4. Themes Identified from Free-Text Data With Illustrative Quotations

Theme	Illustrative Quotations
Family expectation for antimicrobials and wanting to avoid perception that one is "giving up" or not "doing everything possible" for a patient	<p>"Sometimes stopping antibiotics is a fight that is not worth fighting. I will decide if it is or not based on the entire patient and family interaction."</p> <p>"Stopping antibiotics can create a perception of stopping or quitting when families want to continue with care."</p> <p>"There is so much gray area around these cases that you do not want to be perceived as heartless. Sometimes trying to educate families and primary staff that it is easier to just not argue/educate and allow antibiotics to continue."</p> <p>"I do not want to find infection on autopsy of a patient not on antibiotics. The family may always wonder if patients were treated then maybe they wouldn't have died."</p> <p>"It is important for physicians to be able to say that they did everything possible, which often includes antibiotics."</p> <p>"We usually err on the side of giving something to not be the final hatchet-man."</p> <p>"Some of our families fear that we will limit or withhold care for their children. Stopping antimicrobials could be perceived as a limitation even if there is not a clear infection being treated at the end of life."</p>
Uncertainty about prognosis	<p>"It is not always clear when a patient is at the end of life...Often times aggressive care is continued until futility is established, at which point the predominance of care shifts to a more exclusively palliative strategy. Death often occurs very quickly after this, and so antibiotics have been given very proximally to the event. Furthermore, provider perceptions of patients who will survive an ICU course or not continue to only be somewhat concordant with actual outcomes and thus judgments about which patients will be refractory to antibiotic treatments should be used with caution."</p> <p>"The end of life is often nebulous and not so clear-cut decision- and timing-wise."</p> <p>"I believe that my judgment about when a patient is near end of life is poor, particularly in the pediatric setting. Thus, I would be hesitant to discontinue therapies unless this was in accordance with family wishes, not my judgment."</p> <p>"For me the driver of using antibiotics at end of life relates to degree of certainty and the cause of impending demise. In the NICU end of life is often marked by a general multi-organ failure that is difficult to differentiate from sepsis."</p>
To reduce pain and suffering	<p>"I stop antibiotics at the end of life except in situations that I think they may help prevent or reduce suffering or pain."</p> <p>"I mostly treat end stage cystic fibrosis with antibiotics to ease coughing and dyspnea. You could substitute loads of narcotics, but patients would not be responsive."</p> <p>"I would only consider continuing antibiotics if they are palliative and in some way relieving physical pain."</p>

pneumonia, stress clinical criteria in identifying infection as opposed to biomarkers,²⁶ which may influence a physician's decision making. The Infectious Diseases Society of America's pneumonia guidelines also recommend shorter antimicrobial courses and prompt de-escalation of therapy, given the lack of evidence of improved mortality or outcomes with prolonged treatment.²⁶

Most physicians considered it important to respect a patient's wish to continue antimicrobials at the end of life, and nearly all physicians considered it important to respect a patient's request to discontinue antimicrobials. Physician sentiment regarding patient wishes may reflect medicine's shift from a physician-driven to a shared decision making model.^{27,28} Furthermore, patients at the end of life often have little control regarding many aspects of their medical care or prognosis. Studies have demonstrated the importance of dignity in the dying process and its interrelationship with patient autonomy.^{24,29} A desire to promote a patient's or surrogate decision-maker's autonomy in such situations may contribute to a physician's consideration of patient wishes, especially with regard to minimally invasive interventions such as antimicrobial therapy.

Analysis of our free-text responses illustrated socio-behavioral reasons why antimicrobials might be continued at the end of life. Overall, the free-text responses in our study focused on the benefits of continuing antimicrobial therapy for end-of-life patients rather than the potential adverse effects of therapy. Respondents described a desire not to be perceived by families as withholding therapy for a patient. This finding is consistent with previous research, which notes that physicians are reluctant to pursue palliative care for dying patients. Reasons cited by physicians included feelings of personal failure,³⁰ fear of letting patients down, and a desire to avoid difficult conversations.³¹ Many of our respondents also described how decision making at the end of life is complicated; the uncertainty surrounding a patient's prognosis makes discontinuing antimicrobials difficult, especially when they may offer the opportunity to prolong life or palliate pain.

Approximately half of physicians agreed with the statement that antimicrobial use in end-of-life care contributed to resistance. The perception that antimicrobials would be used only for a short period of time or the relatively small number of patients at the end of life compared to other patient populations may be influencing physician attitudes. Physicians in our survey were also not as responsive to economic factors when making decisions regarding antimicrobial therapy; less than a quarter of respondents considered cost to the payor an important reason for discontinuing antimicrobials for end-of-life patients. Tension likely exists between physicians' sense of responsibility to the public and their sense of duty to individual patients and their families.^{18–20,32} Clinicians may weigh patient and societal factors differently in end-of-life care, which could encourage them to supersede antimicrobial stewardship in favor of patient-focused care.

Adult and pediatric physicians approached end-of-life antimicrobial use differently in our study. The proportion of pediatricians who considered respecting decision making made by prior physicians and respecting the primary team's wishes important in continuing antimicrobial therapy differed significantly from adult physicians. These differences may be related to variability in institutional and professional culture or prescribing etiquette.^{33–35} Previous work has examined how physician seniority and identification with a specific clinical group could influence prescribing behavior of physicians.³⁴ A prevailing culture of noninterference could prevent modification of prescribing practices of colleagues. Conversely, a collaborative culture may also lead to an emphasis of importance on the medical decision making of other physicians. The role of prescribing etiquette has not been thoroughly explored with regards to antimicrobial use in end-of-life patients; further study is needed to elucidate how it influences physician prescribing behavior and stewardship practices.

Pediatricians were more likely to elect to treat any infection at the end of life compared to their adult counterparts (Table 1). The decision to continue conventional treatments versus the pursuit of palliative care, hospice, or nonintervention is multifactorial and subject to both physician and patient values.^{36–38} Considerations unique to the pediatric setting may include children having decades of unrealized life compared to adults, parental or guardian pressure for medical intervention, and the general treatability of most pediatric infections. Such factors may contribute to an overall willingness of pediatric physicians to continue antimicrobial therapy in patients at the end of life.

This study has several limitations. Survey responses may not reflect real-time medical decision making performed by physicians. Physician decision making also may involve the simultaneous consideration of multiple variables presented in our study. The relationship between variables was not examined and is better captured using an alternative study design such as vignette studies of medical choice and judgment.³⁹ Physicians in different specialties may have discrepant exposure to terminally ill patients; meaningful subgroup analysis by specialty, which may identify attitudinal differences, was precluded by sample size. No information was collected on nonrespondents, so the degree of response bias could not be assessed. All survey participants were affiliated with large academic medical centers; the results of this study, therefore, may not be generalizable to other settings. Despite these limitations, our voluntary study yielded a robust response rate and captured meaningful responses from an array of physicians.

In conclusion, many factors, including patient-centeredness, workplace culture, and clinical considerations, contribute to the decision framework that physicians utilize when prescribing antimicrobials at the end of life. Adult and pediatric physicians approach antimicrobial use in their respective patient populations differently. Physicians may be overweighing the benefits of continuing antimicrobial therapy in patients at the end of life due to complex sociobehavioral

factors. Cost and population health benefits, which are common ethical justifications for antimicrobial stewardship, may not resonate with physicians caring for these patients. Further research is needed to assess physician and patient attitudes and the factors that shape decision making to better guide antimicrobial recommendations at the end of life.

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SUPPLEMENTARY MATERIAL

To view supplementary material for this article, please visit <https://doi.org/10.1017/ice.2018.6>.

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