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Temporal association of palliative care consultation with the trajectory of broad-spectrum antibiotic use at the end of life in advanced cancer: A nationwide linked cohort study

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ABSTRACT

Objectives: We examined the temporal association between palliative care (PC) consultation and broad-spectrum antibiotic use near end-of-life trajectory.
Methods: This retrospective cohort study used nationwide linked data to assess adults with advanced cancer (2018-2022) who died by June 2023. Broad-spectrum antibiotic use was evaluated using propensity score-matched analyses of prescription proportion (odds ratios [OR]) and days of therapy (DOT) per 1000 patient-days (relative risks [RR]) across predefined end-of-life intervals within the last six months of life.
Results: Among 12,012 matched patients, 4102 received PC consultation. The PC group consistently showed lower prescription proportions than the non-PC group, from 6 to 3 months before death (58.3% vs 61.1%; OR, 0.89; 95% confidence interval [CI], 0.82-0.96) to the final week (13.8% vs 19.4%; OR, 0.66; 95% CI, 0.60-0.74). DOT differences emerged later, with significantly lower DOTs in the PC group during the final two weeks of life (113.7 vs 146.8; RR, 0.77; 95% CI, 0.61-0.99) and the final week (79.0 vs 116.0; RR, 0.68; 95% CI, 0.51-0.91).
Conclusion: PC consultation was associated with reduced broad-spectrum antibiotic use during end-of-life, suggesting that integrating PC into stewardship frameworks may mitigate antimicrobial selection pressure in patients with advanced cancer.
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Introduction

Patients with advanced cancer are frequently prescribed broad-spectrum antibiotics during the end-of-life period, owing to heightened vulnerability to infections from immunosuppression and cancer-related complications [1]. Common end-of-life symptoms such as fever, dyspnea, or altered mental status may also mimic infection without a confirmed microbial source [2]. This symptomatic overlap often prompts empirical broad-spectrum antibiotic use, leading to frequent and prolonged treatment courses. However, the clinical benefits in this setting remain unclear, with no consistent evidence of improved survival or meaningful symptom relief [3,4]. Given the risks of adverse effects—including *Clostridioides difficile* infection, hepatotoxicity, and nephrotoxicity—and the potential for reduced quality of care due to multidrug-resistant organisms [5–7], as well as broader public health

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concerns related to antimicrobial resistance, broad-spectrum antibiotic use near the end-of-life should be approached with caution.

Nevertheless, many clinicians perceive broad-spectrum antibiotics use in this population as relatively benign, in contrast to their views on other life-sustaining interventions such as mechanical ventilation or hemodialysis [8–10]. Antibiotics are frequently regarded as low-burden or morally neutral interventions, which may further contribute to their exclusion from explicit goals-of-care discussions. As a result, broad-spectrum antibiotics are often continued during transitions to comfort-focused care, particularly when the scope and goals of ongoing treatments are not explicitly revisited. In addition, a substantial portion of antibiotic use in this population arises from clinicians' emotional discomfort with withholding or withdrawing treatment rather than from clear clinical indications [11].

Consequently, a conventional antimicrobial stewardship program (ASP), which primarily focuses on clinical guidelines and pharmacological appropriateness, often struggles to address these complex psychosocial barriers inherent in end-of-life care. This gap highlights the need for an integrated approach that incorporates communication-based interventions to navigate the ethical dilemmas of antibiotic de-escalation [11,12]. Palliative care (PC) consultation provides clinicians with a structured framework to align medical decisions with patients' values and preferences, while also supporting more appropriate use of intensive or burdensome interventions [13,14]. While a growing body of research has suggested an association between PC consultation and reduced antibiotic use in patients with advanced cancer, existing studies have been largely limited by small sample sizes or focused on narrow windows immediately preceding death [15–17], leaving the evidence base insufficient to inform the integration of PC into ASP frameworks. Therefore, using nationwide linked data, this study evaluated whether PC consultation was associated with reduced broad-spectrum antibiotic use across multiple intervals of the end-of-life trajectory, by comparing patients who received any PC consultation with those who did not.

Materials and methods

Study design, setting, and population

This retrospective cohort study used clinical records from Seoul National University Hospital (SNUH), a major tertiary referral center in South Korea that provides high-volume oncologic care. After oncologic treatment and, in many cases, advance care planning discussions at SNUH, patients often transition to community hospitals or hospice facilities for end-of-life care. To address the resulting limitations of single-institution follow-up, we linked SNUH records with the National Health Insurance Service (NHIS) claims database, a nationwide single-payer system providing universal coverage and comprehensive data on healthcare utilization. This integration enabled complete tracking of antibiotic prescribing and deaths across care settings throughout the end-of-life trajectory [18].

Adult patients (aged ≥19 years) diagnosed with advanced stages of lung, stomach, colorectal, liver, or pancreatobiliary cancer, which were the leading causes of cancer-related mortality in South Korea [19], and who received care at SNUH between January 1, 2018, and December 31, 2022, were screened. These five major cancer types were specifically selected because palliative care consultations are most consistently utilized for these groups in our clinical setting, ensuring a sufficient and representative sample size for a reliable comparison of longitudinal antibiotic trajectories. Cancer diagnoses were identified using *International Classification of Diseases, 10th Revision* (*ICD-10*) codes: C34 (lung), C16 (gastric), C18-C20 (colorectal), C22 (liver), and C23-C25 (pancreatobiliary). Patients were eligible for inclusion if a verified date of death was available by June 23, 2023. Individuals were excluded if medical records were incomplete or unmatched with NHIS linkage.

Palliative care consultation

In South Korea, cultural norms strongly influence end-of-life care, as families often avoid directly conveying poor prognostic information to patients and defer open discussions until death is imminent [20]. Within this context, PC consultation is not routinely integrated into oncologic care but occurs only when explicitly requested. At SNUH, this approach was formalized as a consultation-based service, initiated by attending physicians and delivered in both inpatient and outpatient settings, as previously described in a study conducted at our center [16]. Patients were categorized into the PC group if they received at least one PC consultation during the illness trajectory before death; others were categorized as non-PC, without restricting classification by timing given the unpredictability of disease progression.

The multidisciplinary PC team included physicians, nurses, and social workers, and provided comprehensive assessments and end-of-life discussions to support goal-concordant care. Recommendations were shared with attending physicians, who retained authority over medical decisions, including antibiotic prescribing. When patients transitioned to outside facilities, detailed PC recommendations were not systematically transferred, although discharge summaries or consultation notes occasionally conveyed key points, and discussions with patients and families could continue to shape decisions. Once initiated, PC consultation typically involved longitudinal follow-up rather than a single encounter, with ongoing reassessment and adjustment of care plans according to patients' clinical course. A routine antimicrobial stewardship programme has not been formally integrated into PC services.

Outcomes

The primary outcome of interest was the use of broad-spectrum antibiotics, defined according to the World Health Organization Anatomical Therapeutic Chemical (ATC) classification system (J01, antibacterials for systemic use). We specifically focused on broad-spectrum intravenous antibiotics because these agents represent the highest priority for antimicrobial stewardship, are closely linked to the acquisition of multidrug-resistant organisms, and frequently act as a clinical barrier to timely transition to hospice care. Oral and narrow-spectrum antibiotics were not included, as they are used for heterogeneous indications that are difficult to interpret in claims-based data and may introduce noise. For this analysis, broad-spectrum antibiotics were operationalized as four classes within J01 available in South Korea: antipseudomonal penicillins, antipseudomonal cephalosporins, carbapenems, and glycopeptides (Supplementary Table 1). A composite indicator was also constructed to capture exposure to any of these four classes.

To evaluate broad-spectrum antibiotic use across the end-of-life trajectory, the 6-month period before death was divided into five intervals: T1 (180 to 91 days before death), T2 (90 to 31 days before death), T3 (30 to 15 days before death), T4 (14 to 8 days before death), and T5 (last 7 days). Antibiotic use was standardized as days of therapy (DOT) per 1000 patient-days to account for differences in interval length. This stratification was based on both clinical understanding that patients with advanced cancer typically experience accelerating functional decline as death approaches and prior evidence demonstrating distinct temporal patterns of broad-spectrum antibiotic use during the end-of-life tra-

jectory [21]. Antibiotic exposure was measured using two complementary metrics. First, the prescription proportion was defined as the percentage of patients who received at least one dose of broad-spectrum antibiotics during each interval. Second, days of therapy (DOT) per 1000 patient-days was calculated as the total number of antibiotic treatment days during each interval, divided by the product of the number of patients and the number of days in that interval [21].

Covariates of interest

Baseline characteristics relevant to healthcare utilization and clinical context were extracted from institutional electronic medical records and the linked NHIS database. Demographic variables included age, sex, insurance type, household income level (in quartiles), residential region (capital area or not), and disability status. Clinical variables included primary cancer type, year of death, timing of receiving PC consultation, time from cancer diagnosis to death, and comorbidity burden measured by the Charlson Comorbidity Index (CCI), excluding cancer diagnoses.

Statistical analysis

Group comparisons used the *t*-test for continuous and chi-square test for categorical variables. Propensity score matching (1:2 nearest neighbor without replacement) was performed to reduce selection bias, with scores estimated by logistic regression including age, sex, insurance type, income, region, disability status, non-cancer CCI, time from diagnosis to death, and year of death. Balance was assessed using standardized mean differences, with values <0.1 considered acceptable. Longitudinal antibiotic use was evaluated across five predefined intervals (T1-T5) using prescription proportion and DOTs. Estimated effects with 95% confidence intervals (CIs) were derived in the matched cohort, with odds ratios (ORs) for prescription proportions and Poisson regression estimating relative risks (RRs) for DOTs. Descriptive comparisons were also stratified by antibiotic class. All tests were two-sided with significance at $P < 0.05$. Analyses used SAS (version 9.4; SAS Institute, Cary, NC, USA).

Results

This study initially identified 21,010 patients, and 18,048 met the eligibility criteria after excluding individuals with missing or mismatched data and ineligible cancer diagnoses. Among these, 4102 patients received PC consultations, and 13,946 did not, forming the PC and non-PC groups, respectively. After propensity score matching, 7910 patients were retained in the non-PC group, and covariate balance between the PC and matched non-PC groups was achieved for all variables except cancer type, with all standardized mean differences below 0.1 (Table 1). The median time from receiving PC consultation to death was 49 days (interquartile range, 22-94 days), and 68.9% of patients received PC consultation more than 1 month before death. The mean age of the matched population was 68.6 years, and 7750 patients (64.5%) were male. The most common cancer type was pancreatobiliary cancer in 3160 patients (26.3%), followed by lung cancer in 3100 patients (25.8%). Lung cancer was more common in the PC group (1456 patients [35.5%] vs 1644 [20.8%]), whereas liver cancer was more prevalent in the non-PC group (531 [12.9%] vs 2012 [25.4%]), largely accounting for the difference in cancer type distribution between the two groups.

Table 1
Baseline characteristics of matched cohort.

	Total (n = 12 012)	PC group (n = 4102)	Non-PC group (n = 7910)	SMD
Age, mean (SD)	67.68 (11.91)	66.45 (11.26)	68.32 (12.18)	0.046
<65, n (%)	4781 (39.8)	1695 (41.3)	3086 (39.0)	
≥65, n (%)	7231 (60.2)	2407 (58.7)	4824 (61.0)	
Sex, n (%)				0.021
Male	7750 (64.5)	2619 (63.8)	5131 (64.9)	
Female	4262 (35.5)	1483 (36.2)	2779 (35.1)	
Insurance, n (%)				0.011
National health insurance	11 513 (95.9)	3925 (95.7)	7588 (95.9)	
Medical aid	499 (4.1)	177 (4.3)	322 (4.1)	
Household income, n (%)				0.006
First quartile (lowest)	2661 (22.2)	911 (22.2)	1750 (22.1)	
Second quartile	1782 (14.8)	611 (14.9)	1171 (14.8)	
Third quartile	2481 (20.6)	845 (20.6)	1636 (20.7)	
Fourth quartile (highest)	5088 (42.4)	1735 (42.3)	3353 (42.4)	
Residence, n (%)				0.042
Seoul capital area	9285 (77.3)	3197 (77.9)	6088 (77.0)	
Non capital area	2727 (22.7)	905 (22.1)	1822 (23.0)	
Disability grade	1526 (12.7)	509 (12.4)	1017 (12.9)	0.013
Non-cancer CCI				0.009
0	1195 (10.0)	400 (9.8)	795 (10.1)	
1-2	5852 (48.7)	2015 (49.1)	3837 (48.5)	
3 or more	4965 (41.3)	1687 (41.1)	3278 (41.4)	
Clinical diagnosis				0.405
Lung cancer	3100 (25.8)	1456 (35.5)	1644 (20.8)	
Stomach cancer	1511 (12.6)	536 (13.1)	975 (12.3)	
Colorectal cancer	1698 (14.1)	580 (14.1)	1118 (14.1)	
Liver cancer	2543 (21.2)	531 (12.9)	2012 (25.4)	
Pancreatobiliary cancer	3160 (26.3)	999 (24.4)	2161 (27.3)	
Year of death				0.015
2018-2019	3705 (30.8)	1244 (30.3)	2461 (31.1)	
2020-2021	4921 (39.0)	1678 (40.9)	3243 (41.0)	
2022-2023	3386 (28.2)	1180 (28.8)	2206 (27.9)	
Time from diagnosis to death, days, mean (SD)	1015.4 (1125.4)	1085.8 (1069.5)	1144.7 (1263.1)	0.008

CCI, Charlson Comorbidity Index; SMD, standardized mean difference; SD, standard deviation.

Table 2
Comparison of broad-spectrum antibiotics exposure in the matched cohort.

	Prescription proportions (%)				DOT (per 1000 patient-days)			
	PC	Non-PC	OR (95% CI)	*P* value	PC	Non-PC	RR (95% CI)	*P* value
T1 (180 to 91 days before death)	58.3	61.1	0.89 (0.82-0.96)	0.001	128.1	135.8	0.94 (0.74-1.20)	0.636
T2 (90 to 31 days before death)	54.7	57.7	0.88 (0.82-0.95)	<0.001	154.6	163.2	0.95 (0.76-1.18)	0.630
T3 (30 to 15 days before death)	42.0	47.7	0.79 (0.73-0.86)	<0.001	158.8	182.6	0.87 (0.70-1.08)	0.198
T4 (14 to 8 day before death)	24.4	31.2	0.71 (0.65-0.78)	<0.001	113.7	146.8	0.77 (0.61-0.99)	0.041
T5 (last 7 days)	13.8	19.4	0.66 (0.60-0.74)	<0.001	79.0	116.0	0.68 (0.51-0.91)	0.009

CI, confidence interval; DOT, days of therapy; OR, odds ratio; PC, palliative care; RR, risk ratio.

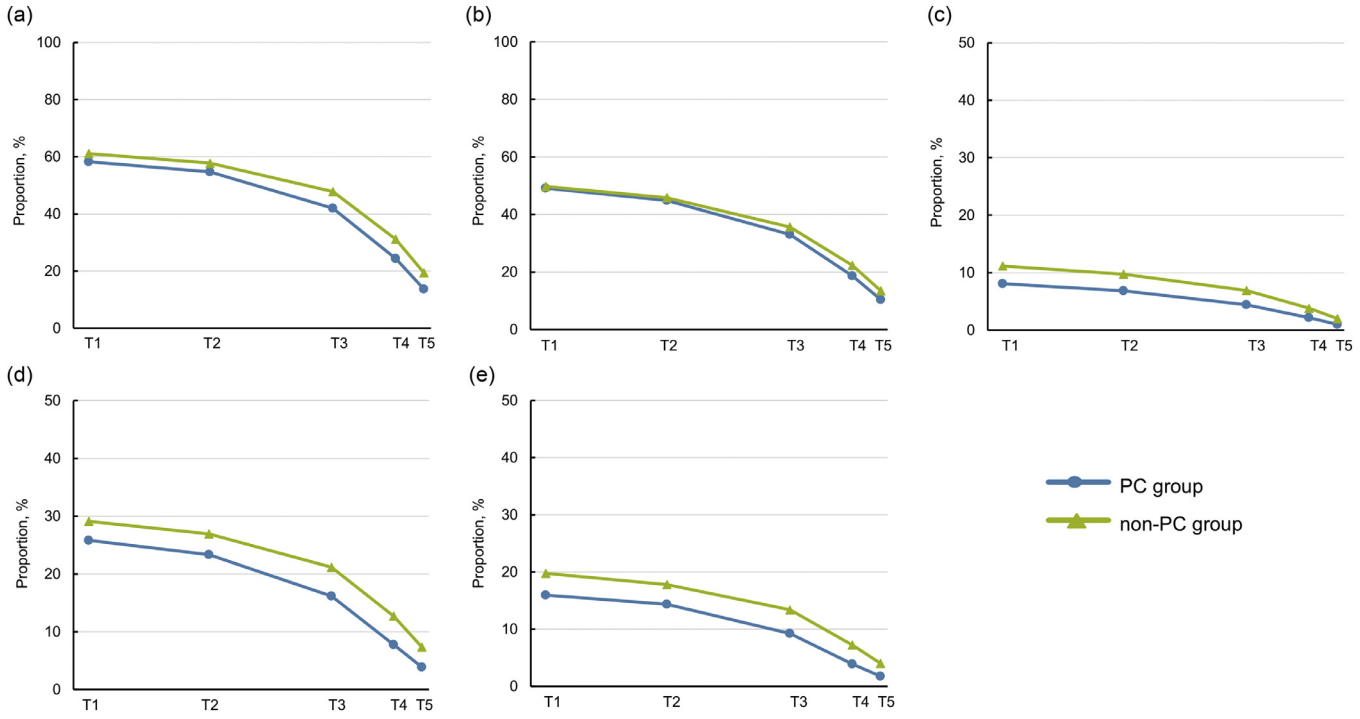


Figure 1. Broad-spectrum antibiotic prescription proportions across end-of-life intervals (T1-T5). This figure illustrates the proportion of patients who received broad-spectrum antibiotics during five end-of-life time intervals: T1 (180 to 91 days before death), T2 (90 to 31 days), T3 (30 to 15 days), T4 (14 to 8 days), and T5 (last 7 days). Bars represent the proportion of patients who received at least one dose of each antibiotic class during each end-of-life interval. Blue bars indicate the PC group, and green bars indicate the non-PC group. (a) composite, (b) antipseudomonal penicillins, (c) antipseudomonal cephalosporins, (d) carbapenems, and (e) glycopeptides.

Antibiotic use patterns based on prescription proportion

In the matched cohort, 2898 patients (70.6%) in the PC group and 5769 patients (72.9%) in the non-PC group received at least one prescription for broad-spectrum antibiotics during the last six months of life (OR, 0.89; 95% CI, 0.82-0.97, $P = 0.008$). Prescription proportions declined progressively across the five intervals (T1-T5) in both groups; however, the PC group consistently exhibited lower prescription proportions than the non-PC group, ranging from T1 (58.3% vs 61.1%, OR, 0.89; 95% CI, 0.82-0.96; $P = 0.001$) to T5 (13.8% vs 19.4%, OR, 0.66; 95% CI, 0.60-0.74; $P < 0.001$) (Table 2).

The reduction in prescription proportions was observed across all broad-spectrum antibiotic classes, with antipseudomonal cephalosporins, carbapenems, and glycopeptides exhibiting substantial reductions, whereas the reduction in antipseudomonal penicillins was relatively modest (Figure 1, Supplementary Table 2). Specifically, for carbapenems, the PC group consistently showed lower prescription proportions than the non-PC group throughout the trajectory, with the gap widening from T1 (25.8% vs 29.1%; OR, 0.84; 95% CI, 0.78-0.92; $P < 0.001$) to T5 (3.9% vs 7.4%; OR, 0.51; 95% CI, 0.43-0.61; $P < 0.001$). Similarly, glycopeptide utilization was significantly lower in the PC group across all intervals, decreasing from T1 (16.0% vs 19.8%; OR, 0.78; 95% CI, 0.70-0.86; $P < 0.001$) to T5 (1.8% vs 4.0%; OR, 0.43; 95% CI, 0.33-0.55; $P < 0.001$).

Antibiotic use patterns based on days of therapy

Total DOT for broad-spectrum antibiotics during the last six months of life was 107.6 per 1, 000 patient-days in the PC group and 125.0 in the non-PC group (RR, 0.86; 95% CI, 0.67-1.11, $P = 0.254$). While the PC group generally exhibited lower DOTs across most antibiotic classes and intervals (Table 2, Figure 2), the temporal patterns of DOTs differed from those of prescription proportions. Instead of a progressive decline, DOTs in both groups peaked at T3 (158.8 in the PC group vs 182.6 in the non-PC group) before decreasing toward T5 (79.0 vs 116.0, respectively). For the composite indicator, differences became significant at later intervals, with lower DOTs in the PC group at T4 (113.7 vs 146.8; RR, 0.77; 95% CI, 0.61-0.99; $P = 0.041$) and T5 (79.0 vs 116.0; RR, 0.68; 95% CI, 0.51-0.91; $P = 0.009$). For carbapenems specifically, the PC group showed a significantly lower intensity of use during T5

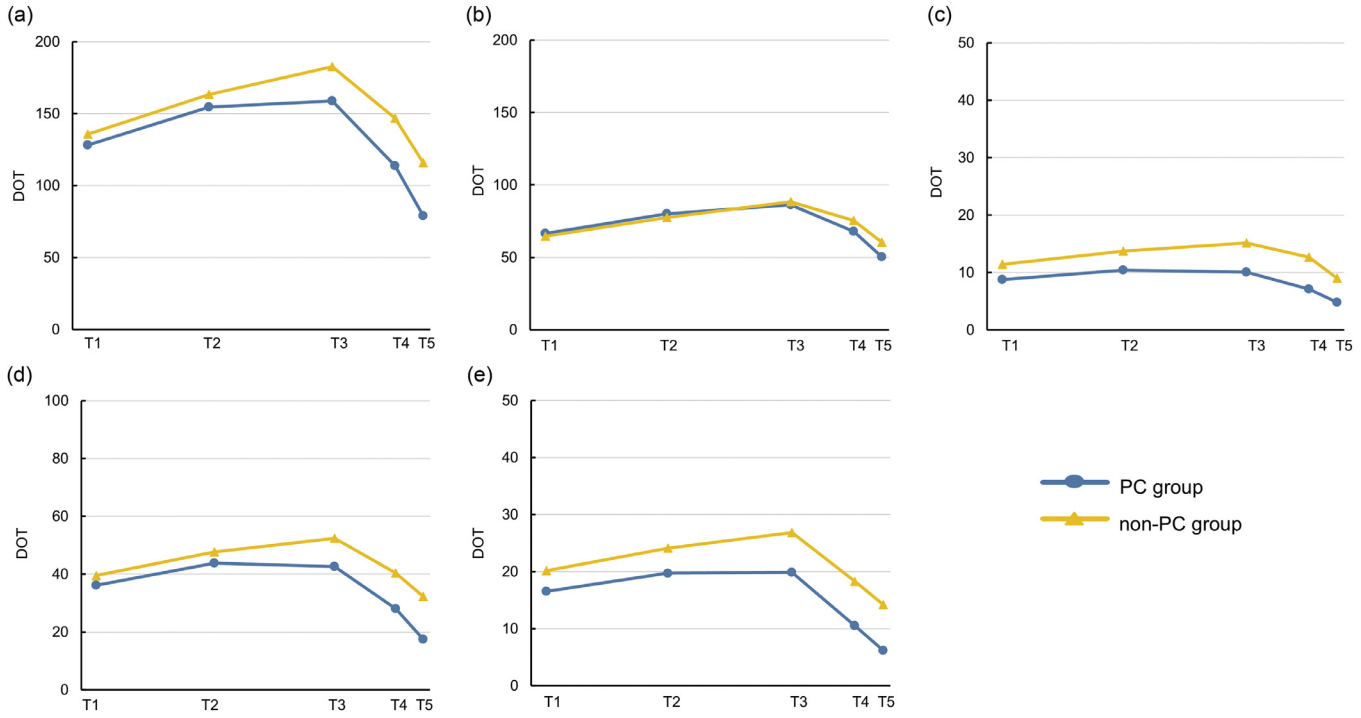


Figure 2. Days of therapy (DOT) for broad-spectrum antibiotics across end-of-life intervals (T1-T5). This figure shows DOT per 1000 patient-days for each antibiotic class across the five end-of-life intervals: T1 (180 to 91 days before death), T2 (90 to 31 days), T3 (30 to 15 days), T4 (14 to 8 days), and T5 (last 7 days). Bars represent antibiotic exposure intensity per class and time period. Blue bars represent the PC group, and orange bars represent the non-PC group. (a) composite, (b) antipseudomonal penicillins, (c) antipseudomonal cephalosporins, (d) carbapenems, and (e) glycopeptides.

(17.6 vs 32.3; RR, 0.68; 95% CI, 0.51-0.91; $P = 0.040$) (Supplementary Table 3).

Discussion

This nationwide record-linkage study found that the integration of PC into the end-of-life trajectory was associated with reduced broad-spectrum antibiotic use among advanced cancer patients during their last six months. Excessive use of broad-spectrum antibiotics in patients with advanced cancer near the end-of-life may increase the risk of avoidable harm at the individual patient level and facilitate the acquisition of multidrug-resistant organisms, with implications extending to broader public health [22]. Additionally, as aggressive end-of-life care has been strongly associated with emotional and ethical consequences [23], broad-spectrum antibiotic use in this context should be evaluated for its potential to exacerbate emotional burden and undermine comfort-focused goals. To our knowledge, this is the first study to use linked real-world and national insurance data to examine the longitudinal patterns of broad-spectrum antibiotic use across the end-of-life trajectory.

Near the end-of-life, antibiotics are frequently prescribed in response to systemic signs such as fever or elevated inflammatory markers, which may instead reflect cancer-related inflammation rather than infection [24]. However, the inability to definitively rule out infection could lead clinicians to continue or escalate antibiotic treatment even after several days without clear clinical improvement. Moreover, broad-spectrum antibiotic use in this context is driven not only by clinical factors but also by complex emotional, cognitive, and social dynamics. In particular, prescribing broad-spectrum antibiotics may serve as a less invasive alternative to life-sustaining treatments like mechanical ventilation or hemodialysis, allowing clinicians to maintain a sense of active care, especially during emotionally charged conversations with family members [9,11]. Previous studies have highlighted that such decisions are influenced by concerns about clinical deterioration, fear of litigation, hierarchical pressures within medical teams, and perceived expectations from families or other healthcare professionals [25]. These dynamics may drive clinicians to act in ways that reduce perceived risks or moral discomfort associated with inaction.

Within this setting, PC consultation may act as a behavioral intervention by reframing clinical priorities around goals of care and facilitating shared decision-making. These effects address the challenges of decision-making under uncertainty, where clinicians under stress or time pressure often default to habitual or seemingly 'safer' choices—such as continuing broad-spectrum antibiotics—rather than engaging in deliberate, patient-centered evaluations [26]. By clarifying patient preferences—such as prioritizing comfort over life-prolonging measures [27]— PC teams provide a structured framework that nudges physicians toward aligning treatment with individual values. This collaborative approach helps shift clinicians away from reflexive prescribing toward more intentional and goal-concordant care, ultimately reducing unnecessary escalation and promoting thoughtful de-prescribing [16].

Another possible explanation for the observed reduction in broad-spectrum antibiotic use is the well-documented association between PC consultation and the decreased use of aggressive end-of-life interventions. PC involvement consistently correlates with lower rates of intensive care unit (ICU) admission and mechanical ventilation [13], both of which are major drivers of empirical and prolonged broad-spectrum antibiotic therapy. Once a patient is admitted to the ICU, de-escalating or withholding such antibiotics becomes exceptionally challenging, even when the prognosis is poor [28]. Therefore, early advance care planning and the formal documentation of treatment preferences that prevent ICU admission may serve as a critical pathway through which PC reduces unnecessary exposure to broad-spectrum antibiotics.

Our findings suggest that PC consultation may serve as a critical, yet underutilized, component of ASP for patients with advanced cancer [11,12,29]. While conventional ASP primarily focus on pharmacological optimization, PC addresses the complex behavioral and communication-based drivers of antibiotic overuse. Recognizing that the prognosis of advanced cancer is often difficult to predict, integrating PC into ASP frameworks could facilitate time-based approaches, such as time-limited trials of antibiotics [30]. Rather than indefinite treatment, these approaches allow for a pre-defined period of antibiotic use with clear reassessment goals, aligning treatment intensity with the patient's evolving clinical status. Such a structured pathway not only ensures that care remains centered on patient values but also potentially mitigates the selection pressure for multidrug-resistant organisms by curbing unnecessary, prolonged escalation of broad-spectrum therapy.

The differing trajectories between prescription proportions and DOTs would reflect both methodological distinctions and clinical realities. While prescription proportions capture the binary presence of antibiotic use—showing significant reductions in the PC group across all intervals—DOTs quantify the intensity of cumulative exposure. Although DOTs were consistently lower in the PC group, statistical significance was reached only during the final two weeks (T4 and T5). This suggests that PC consultation is associated with a lower likelihood of initiating antibiotics, potentially reflecting a more selective approach to starting therapy in cases where use might be considered avoidable. However, it should be noted that since the median interval from PC consultation to death was 49 days, the direct influence of PC input on antibiotic prescribing during the earlier T1 and T2 intervals was likely marginal; therefore, the differences observed in these periods may reflect baseline clinical trajectories rather than the direct impact of the consultation itself.

Our study has the advantage of reflecting the specific cultural and systemic context of South Korea, where referral to PC is often delayed or limited. This environment allowed for a robust comparison between a large cohort of patients who received PC consultation and a comparable group who did not—an analysis that would be less feasible in settings where PC involvement is near-universal. However, our study also has several limitations. First, the retrospective design precludes definitive causal conclusions. Unmeasured confounders—such as patient or family preferences or the clinical predictability of death—likely influenced both PC referral and treatment intensity. Clinicians may have sought PC while simultaneously ceasing antibiotics for patients whose terminal status was clearly anticipated, a clinical nuance not fully captured in claims-based data. In addition, differences in cancer type distribution between groups may have contributed to residual confounding, as antibiotic use patterns can vary by cancer type. Second, as this study relies on claims-based utilization metrics, the lack of granular information on clinical indications, prescribing appropriateness, or hospital length of stay presents challenges in providing a more detailed perspective on how PC can be practically integrated into ASP frameworks. Third, while the use of a nationwide database mitigated the constraints of single-institution studies, the findings may not be generalizable to other clinical settings or geographic regions, as the study population was limited to patients within a specific healthcare system and cultural context. Fourth, because the timing of PC consultation varied and could not be strictly controlled in claims-based data, we defined exposure as any PC consultation received before death. This approach limits our understanding of how the exact timing of consultation affects outcomes, particularly during the earliest intervals (T1 and T2). Therefore, the observed associations between PC and reduced antibiotic use should be interpreted as most reliable during the final month of life, by which time more than 70% of the PC group had received formal consultation. Finally, our analysis focused exclusively on pre-defined systemic broad-spectrum antibiotics. Consequently, we did not evaluate potential changes in the prescribing patterns of narrower-spectrum antibacterials, including oral agents, or antifungal therapies. It remains possible that the observed reduction in broad-spectrum antibiotic use was accompanied by a compensatory increase in the use of narrower-spectrum agents.

In conclusion, PC consultation was associated with a reduction in broad-spectrum antibiotic use among patients with advanced cancer during their last six months of life. While further research is needed to clarify how the specific timing and clinical decision-making processes contribute to this association, our findings underscore that broad-spectrum antibiotic prescribing is a significant facet of medical management at the end-of-life, which may be further refined when integrated within a palliative care framework.

Declaration of competing interest

The authors have no competing interests to declare.

Ethical statement

This study was approved by the Institutional Review Board of Seoul National University Hospital (Number: H-2305–088–1431). The requirement for informed consent was waived due to the use of anonymized retrospective data, which were routinely collected as part of the health insurance process and linked to mortality data from the Korea National Statistical Office.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the authors used ChatGPT (GPT-5, OpenAI) to assist with grammar refinement and language editing. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Author contributions

S.H. Yoo, J.W. Yu, J.H. Kim, and J.A. Sim contributed to the concept and design of the study. Data acquisition, analysis, or interpretation was performed by all authors. S.H. Yoo, J.W. Yu, J.H. Kim, and J.A. Sim drafted the manuscript, and all authors critically reviewed it for important intellectual content. J.W. Yu and J.A. Sim conducted the statistical analysis. S.H. Yoo, J.H. Kim, and J.A. Sim provided administrative, technical, or material support. Supervision of the study was jointly shared by S.H. Yoo, J.H. Kim, and J.A. Sim. All authors have read and approved the final manuscript.

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Supplementary materials

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