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Original Research

Disparities in Patient Portal Access and Their Association with Perceived Health Care Quality Among U.S. Adults: A Population-Based Cross-Sectional Study

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ABSTRACT

Introduction. Patient portals are designed to improve transparency, engagement, and satisfaction with health care. However, disparities in access and encouragement to use portals persist, and their relationship with perceived care quality is not well understood. Authors of this study examined whether being offered access to a patient portal, and being encouraged to use it, were associated with higher perceived quality of care among United States adults.

Methods. The authors analyzed data from the 2024 Health Information National Trends Survey 7 (HINT 7), a nationally representative cross-section of United States adults aged ≥18 years. Weighted analyses assessed associations between portal access offers, encouragement, and self-rated care quality in the past 12 months, adjusting for sociodemographic characteristics.

Results. Among 7,278 respondents (mean [SD] age, 49.0 [18.0] years), 78.6% rated their care as good, very good, or excellent. Overall, 73% had portal access and 69.0% were encouraged to use a portal. The number of respondents offered access to patient portal was significantly lower among older adults ≥75 years (10.6%; χ^2_8=108.2, p <0.0001), women (27.9%; χ^2_4=31.7, p <0.0001), those with lower income (8.3%; χ^2_{10}=158.0, p <0.0001) or education (13.6%; χ^2_6=107.9, p <0.0001), and rural residents (10.0%; χ^2_2=12.1, p = 0.0024). In adjusted analyses, being offered portal access was associated with higher odds of rating care as excellent (aOR 2.47, 95% CI 1.21-5.07).

Conclusions. Being offered portal access independently was associated with higher perceived care quality. Addressing disparities in portal access; especially among older, lower-income, and rural populations; may improve equity in patient experience.

INTRODUCTION

The proliferation of digital health technologies has transformed how patients interact with their health care professionals and personal health information. Patient-facing electronic health record (EHR) portals, sometimes described as online medical record access tools or patient portals, are becoming more available and promoted by healthcare organizations to improve transparency, engagement, and ultimately quality of care.[1,2]

Prior research indicates that portal use may be associated with greater patient satisfaction, improved communication, and enhanced perceptions of care team interaction.[3,4] For example, in a survey of 504 portal users, post-adoptive use of a portal had a positive effect on three dimensions of patient satisfaction (care team interaction, atmosphere, and instruction effectiveness) through the mediators of gratification, health self-awareness, and health perceptions.[4] Similarly, in a large academic medical center study linking portal account status to Clinician and Group Consumer Assessment of Healthcare Providers and Systems (CG-CAHPS) and Hospital CAHPS (HCAHPS) responses, activation of an outpatient and inpatient portal account was associated with significantly higher patient satisfaction across several domains of care coordination and transitions.[3]

Despite these promising findings, systematic reviews indicate that the relationship between portal use and patient satisfaction remains inconsistent, influenced by differences in portal design, patient health literacy, and sociodemographic disparities.[2,5] Importantly, the mere availability of a portal is not sufficient to improve satisfaction. Provider encouragement appears to be a key determinant of portal engagement, with national data showing that patients who are both offered access and encouraged to use a portal significantly are more likely to engage with features such as test results and clinical notes.[6,7] Despite this, inequities in portal access persist. Older adults, individuals with lower income or education, and those living in rural areas are less likely to be offered or to use patient portals.[8-10]

Understanding whether being offered access and encouraged to use a patient portal translates into higher satisfaction or perceived quality of care is important. Patient experience is a central component of care quality, and a driver of value-based reimbursement and system-level performance metrics.[11-13]

Authors of this study examined whether adults in the United States who reported being offered online access to their medical records (via a patient portal) and being encouraged to use it are more likely to rate the quality of their health care as *excellent*. We also explored disparities in who is offered portal access and how these disparities might influence care perceptions.

METHODS

Target Population and Sample Design. The 2024 Health Information National Trends Survey 7 (HINTS 7),[14] a nationally representative survey of United States adults, was a self-administered mail and web survey of United States civilian, non-institutionalized adults (≥18 years) conducted from March 25 to September 16, 2024. A two-stage, stratified design was used: residential addresses were sampled, and one adult was randomly selected per household. Sampling strata from prior cycles (high- vs. low-minority areas) were expanded into four categories by further dividing them into rural and urban areas. The final sample included 7,278 respondents (response rate: 27.3%), representing a weighted population of 262,266,460

adults.[15] Unweighted sample sizes for weighted estimates are shown in Table 1.

Study Design and Data Source. This population-based, cross-sectional study used public data from HINTS 7. We included respondents aged ≥18 years who answered the question on quality of health care received in the past 12 months. The study followed STROBE (Strengthening the Reporting of Observational Studies in Epidemiology)[16] and PRICSSA (Preferred Reporting Items for Complex Sample Survey Analysis)[17] guidelines. Because the data were publicly available and de-identified, institutional review board (IRB) approval was not required. The National Institutes of Health Office of IRB Operations issued a "Not Human Subjects Research" determination to HINT 7 on February 8, 2024 (IRBID: IRB002042).[18]

Outcome Variable. The outcome was the perceived quality of health care, measured by the question: "*Overall, how would you rate the quality of health care you received in the past 12 months?*" Response options were: "*Excellent,*" "*Very good,*" "*Good,*" "*Fair,*" or "*Poor.*"

Predictors. Two medical record variables used to describe the study population were based on respondents' ratings of the perceived quality of health care they received in the past 12 months. These clinically relevant predictors were used in the study based on a pre-specified complete model, an approach in multivariable prediction modeling in which predictors are selected and included *a priori* based on clinical knowledge or existing evidence.[19,20]

Offered Access to Patient Portal was assessed with the question: "*Have you ever been offered online access to your medical records (for example, a patient portal) by a health care provider?*" (response options: "*Yes,*" "*No,*" "*Don't know*".

Encouraged to Use Patient Portal was assessed with the question: "*Have you ever been encouraged by a health care provider (e.g., doctor, nurse, or office staff) to use an online medical record or patient portal?*" (response options: "*Yes,*" "*No*").

Covariates. Sociodemographic characteristics included age (18-34, 35-49, 50-64, 65-74, ≥75 years), sex (male, female), and race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian, non-Hispanic Other). The Non-Hispanic Other included American Indian or Alaska Native, Native Hawaiian, Guamanian or Chamorro, Samoan, and Other Pacific Islander. Additional covariates were education (≤high school, some college/post-high school, college graduate, postgraduate), household income (<$20,000; $20,000-$34,999; $35,000-$49,999; $50,000-$74,999; ≥$75,000), and place of residence as stratified in HINT 7 as urban and rural). Covariates were adjusted for to reduce confounding and improve precision of effect estimates.[21,22]

The rural/urban classification was based on the 2013 United States Department of Agriculture Economic Research Service Rural-Urban Continuum Codes (RUCC). The RUCC distinguishes metropolitan (metro) counties by the population size of their metro area and nonmetropolitan (nonmetro) counties by degree of urbanization and proximity to a metro area. Addresses in counties with RUCC codes 1-3 were classified as urban, while those with codes 4-9 were classified as rural.[23]

Missing Data. To address small-sample bias and outcome imbalance, we used Firth's bias-reduced logistic regression.[22] Missing data were assumed to be missing at random (MAR) and handled through maximum likelihood estimation.[24,25] Under MAR, nonresponse may depend on observed characteristics but not unobserved variables, a common assumption in survey-based research. Since the data cannot empirically identify a Missing Not at Random (MNAR) mechanism, MAR provides a transparent framework, helping to minimize bias and stabilize parameter estimates and standard errors.

Statistical Analysis. A three-stage, survey-weighted analytic approach was used. First, a survey-weighted univariate analysis described distributions of study variables using survey-weighted frequencies and percentages for categorical variables, and survey-weighted means for continuous variables. Second, a survey-weighted bivariate analysis examined associations between reported patient portal access and covariates (age, sex, educational level, race/ethnicity, residence). For these analyses, to account for the complex survey design, Rao-Scott adjusted Chi-square tests were utilized for 2*2 and r*c contingency tables. Bonferroni or False Discovery Rate approaches were applied to counteract the multiple comparisons problem.

Third, we used survey-weighted multivariable logistic regression to identify independent predictors associated with reported perceived quality of health care, adjusting for potential confounders. All categorical predictors were modeled using reference cell coding, with reference categories specified *a priori*. Models accounted for the complex survey design through incorporation of sampling weights, stratification, and clustering. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were reported. Model fit was evaluated using receiver operating characteristic (ROC) curve analysis. A two-sided p-value <0.05 was considered statistically significant. Analyses were conducted in SAS® version 9.4 (SAS Institute Inc., Cary, NC) using PROC SURVEYLOGISTIC with the glogit link function in October 2025.

RESULTS

Demographic Information. As Table 1 shows, respondents (N = 7,278) had a mean age of 49.0 years (SD 18.0); 55.2% were men, 48.7% were non-Hispanic White, 48.2% had a college education or less, 51.3% (n = 3,737) reported an annual household income less than $75,000, and 87.1% lived in urban areas. Most respondents (78.6%, n = 5,720) rated the quality of their health care in the past 12 months as good, very good, or excellent.

As shown in Table 2, 73.3% reported being offered access to patient portal, and 69.0% said they were encouraged by a health care professional to use a patient portal.

Table 1. Respondent characteristics (N = 7,278).

Characteristics	Measure[a]
Sex	
Male	4017 (55.2)
Female	2646 (36.4)
Don't know (a response option in the survey)	44 (0.6)
Missing	571 (7.8)
Age, years	
Mean (SD), y	49.0 (18.0)
Median	48.3
Minimum	18
Maximum	102
Age group	
18-34	1080 (14.8)
35-49	1355 (18.6)
50-64	1728 (23.7)
65-74	1466 (20.1)
≥75	1036 (14.2)
Missing	613 (8.4)
Educational level	
Up to high school	1564 (21.5)
Post high school/some college	1941 (26.7)
College graduate	1863 (25.6)
Postgraduate	1327 (18.2)
Missing	583 (8.0)
Household income	
< $20,000	1123 (15.4)
$20,000 to < $35,000	802 (11.0)
$35,000 to < $50,000	782 (10.7)
$50,000 to < $75,000	1030 (14.2)
≥75,000 to <$100,000	785 (10.8)
≥100,000	1857 (25.5)
Missing	899 (12.4)
Race/Ethnicity	
Non-Hispanic White	3548 (48.7)
Non-Hispanic Black or African American	968 (13.3)
Hispanic	1323 (18.2)
Non-Hispanic Asian	342 (4.7)
Non-Hispanic Other	257 (3.5)
Missing	840 (11.5)
Place of residence	
Rural	1008 (12.9)
Urban	6270 (87.1)
Overall, how would you rate the quality of health care you received in the past 12 months?	
Excellent	1620 (22.3)
Very good/good	4100 (56.3)
Fair/poor	640 (8.8)
Missing	918 (12.6)

[a]Unweighted values. Data are presented as the No. (%) of respondents unless otherwise indicated.

Forty percent accessed the portal 1-5 times in the past 12 months, and 40% accessed it through a website. The most common uses were viewing test results (59.6%) and reviewing clinical notes (52.0%). Additionally, 58.0% found it somewhat or very easy to understand the health information in their portal, and 56.1% reported having a portal with multiple health care organizations.

Results of Bivariate Analysis. As shown in Table 3, the proportion of respondents who were offered access to patient portal was significantly lower among certain groups, including women

Table 2. Proportion of patients who used online medical record or patient portal, HINTS 2024 (N = 7,282).[a]

Variables	N (%)
Have you ever been offered online access to your medical records (for example, a patient portal) by your health care provider?	
Yes	5338 (73.3)
No	1154 (15.9)
Don't know	542 (7.4)
Missing	244 (3.4)
Have any of your health care providers, including doctors, nurses, or office staff ever encouraged you to use an online medical record or patient portal?	
Yes	5023 (69.0)
No	5023 (27.5)
Missing	250 (3.4)
How many times did you access your online medical record or patient portal in the last 12 months?	
0 times	2264 (31.1)
1-5 times	2913 (40.0)
>5 times	1880 (25.8)
Missing	221 (3.0)
How did you access your online medical record or patient portal?	*n* = 5187
App	970 (18.7)
Website	2076 (40.0)
Both App and Website	1593 (30.7)
Don't know	123 (2.4)
Missing	425 (8.2)
In the past 12 months have you used your online medical record or patient portal to look up test results?	
Yes	4340 (59.6)
No	475 (6.5)
Not applicable	2047 (28.1)
Missing	416 (5.7)
In the past 12 months have you used your online medical record or patient portal to view clinical notes (a health care providers written notes that describe your visit)?	
Yes	3781 (52.0)
No	1017 (14.0)
Question answered in error (Commission Error)	199 (2.7)
Inapplicable	2065 (28.4)
Missing	216 (3.0)
How easy or difficult was it to understand the health information in your online medical record or patient portal?	
Very/somewhat easy	4221 (58.0)
Very/somewhat difficult	556 (7.6)
Question answered in error (Commission Error)	143 (2.0)
Inapplicable	2121 (29.1)
Missing	237 (3.3)
Which of the following organizations/providers do you have an online medical record or patient portal with?	
My primary care provider's office only	1138 (15.6)
Other health care provider(s) such as a specialty pvider, counselor, or dentist only	223 (3.1)
My insurer(s) only	123 (1.7)
Clinical laboratory that performs lab tests only	86 (1.2)
Pharmacy only	38 (0.5)
Multiple providers	4081 (56.1)
Hospital only	108 (1.5)
I do not have any online medical records or patient portals only	1160 (15.9)
Missing	321 (4.4)

[a]Unweighted values.

Note: HINTS, Health Information National Trends Survey.

(27.9%; χ^2_4=31.7, p <0.0001), adults aged ≥75 years (10.6%; χ^2_8=108.2, p <0.0001), non-Hispanic Other individuals (2.9%; χ^2_8=76.1, p <0.0001), those with up to high school diploma education (13.6%; χ^2_6=107.9, p <0.0001), respondents with household incomes of $20,000 to <$35,000 (8.3%; χ^2_{10}=158.0, p <0.0001), and those living in rural areas (10.0%; χ^2_2=12.1, p = 0.0024).

Results of Multivariable Analysis. In the survey-weighted unadjusted logistic regression comparing respondents who rated the quality of health care received in the past 12 months as *excellent* versus *fair/poor*, being offered portal access (versus *don't know*) by a health care professional was significantly associated with higher odds of rating care as *excellent* (OR 2.87; 95% CI 1.63-5.04). This association remained significant after adjusting for the covariates (Table 4). Similarly, being encouraged to use portal was significantly associated with an excellent rating of care quality (OR 1.52; 95% CI 1.24-1.87). However, this association no longer was significant after adjusting for covariates (Table 4).

In the survey-weighted multivariable logistic regression comparing respondents who rated the quality of health care received in the past 12 months as *excellent* versus *fair/poor* (Table 4), adults aged 18-34 years (aOR 0.50; 95% CI 0.25-0.98), women (aOR 0.02; 95% CI 0.01-0.13), college graduates (aOR 0.43; 95% CI 0.23-0.80), and individuals with household incomes of $20,000 to <$35,000 (aOR 0.47; 95% CI 0.24-0.94) had significantly lower odds of rating their health care as *excellent*.

Conversely, being offered portal access (versus *don't know*) by a health care professional (aOR 2.47; 95% CI 1.21-5.07) was associated with higher odds of rating quality of health care as *excellent*.

Table 3. Distribution of patients offered online access to their medical records by their health care professional, HINTS 2024 (N = 6,655).[a]

	Have you ever been offered online access to your medical records by your health care provider?[b]				
Measure	**Yes**	**No**	**Don't know**	**Rao-Scott χ^2 (*df*)**	***P* value**
Sex				31.7 (4)	<.0001
Male	3213 (48.3)	540 (8.1)	236 (3.6)		
Female	1854 (27.9)	513 (7.7)	255 (3.8)		
Don't know	18 (0.3)	10 (0.2)	16 (0.4)		
Total	5085 (76.4)	1063 (16.0)	507 (7.6)		
Age category				108.2 (8)	<.0001
18-34	778 (11.8)	256 (2.4)	144 (2.2)		
35-49	1097 (16.6)	162 (2.5)	92 (1.4)		
50-64	1377 (20.8)	256 (3.9)	87 (1.3)		
65-74	1117 (16.9)	241 (3.6)	94 (1.4)		
≥75	698 (10.6)	237 (3.6)	77 (1.2)		
Total	5067 (76.6)	1052 (15.9)	494 (7.5)		
Race/Ethnicity[c]				76.1 (8)	<.0001
Non-Hispanic White	2958 (46.3)	381 (6.0)	186 (2.9)		
Non-Hispanic Black	716 (11.2)	184 (2.9)	60 (0.9)		
Hispanic	850 (13.3)	300 (4.7)	160 (2.5)		
Non-Hispanic Asian	250 (3.9)	49 (0.8)	40 (0.6)		
Non-Hispanic Other	185 (2.9)	41 (0.6)	30 (0.5)		
Total	4959 (77.6)	955 (15.0)	476 (7.5)		
Educational level				107.9 (6)	<.0001
Up to high school	901 (13.6)	438 (6.6)	199 (3.0)		
Post high school/some college	1452 (21.9)	326 (4.9)	150 (2.3)		
College graduate	1550 (23.3)	189 (2.9)	114 (1.7)		
Postgraduate	1173 (17.7)	109 (1.6)	40 (0.6)		
Total	5076 (76.4)	1062 (16.0)	503 (7.6)		
Household income				158.0 (10)	<.0001
< $20,000	621 (9.8)	343 (5.4)	144 (2.3)		
$20,000 to < $35,000	526 (8.3)	183 (2.9)	85 (1.3)		
$35,000 to < $50,000	579 (9.1)	132 (2.1)	68 (1.1)		
$50,000 to < $75,000	788 (12.4)	154 (2.4)	78 (1.2)		
≥75,000 to <$100,000	669 (10.6)	74 (1.2)	39 (0.6)		
≥100,000	1684 (26.6)	109 (1.7)	64 (1.0)		
Total	4867 (76.8)	995 (15.7)	478 (7.5)		
Place of residence				12.1 (2)	0.0024
Rural	705 (10.0)	202 (2.9)	67 (1.0)		
Urban	4633 (65.9)	952 (13.5)	475 (6.8)		
Total	5338 (75.9)	1154 (16.4)	542 (7.7)		

[a]Data are presented as the No. (%) of respondent.
[b]The frequencies and proportions presented in the table are unweighted values. Conversely, the reported Chi-square and corresponding p-values reflect the results of the Rao-Scott first-order adjustment.
[c]Non-Hispanic Other included American Indian or Alaska Native, Native Hawaiian, Guamanian or Chamorro, Samoan, and Other Pacific Islander.

Table 4. Factors Associated with Perceived Quality of Care, HINTS 2024 (N = 6,665).

	Overall, how would you rate the quality of health care you received in the past 12 months?		
	Excellent vs Fair/poor		
Variable	**aOR (95% Confidence Limits)**	**Standard Error**	***P* value**
Intercept		0.61	0.0028
Have you ever been offered online access to your medical records (for example, a patient portal) by a health care provider?			
Yes vs Don't know	2.47 (1.21-5.07)	0.36	0.0136
No vs Don't know	0.54 (0.25-1.14)	0.38	0.1034
Have you ever been encouraged by a health care provider (e.g., doctor, nurse, or office staff) to use an online medical record or patient portal?			
Yes vs No	0.54 (0.25-1.14)	0.29	0.3367
Age, y			
18-34 vs ≥75	0.50 (0.25-0.98)	0.34	0.0441
35-49 vs ≥75	0.53 (0.28-1.01)	0.33	0.0546
50-64 vs ≥75	0.69 (0.36-1.29)	0.32	0.2448
65-74 vs ≥75	0.90 (0.47-1.69)	0.32	0.7320
Sex			
Male vs Don't know	1.58 (0.96-2.58)	0.25	0.0707
Female vs Don't know	0.02 (0.01-0.13)	0.87	<.0001
Educational level			
Up to high school vs postgraduate	0.65 (0.29-1.45)	0.41	0.2914
Post high school/some college vs postgraduate	0.51 (0.27-0.96)	0.32	0.0361
College graduate vs postgraduate	0.43 (0.23-0.80)	0.32	0.0083
Race and ethnicity			
Non-Hispanic Black vs Non-Hispanic White	0.62 (0.35-1.13)	0.30	0.1165
Hispanic vs Non-Hispanic White	0.85 (0.43-1.69)	0.35	0.6411
Non-Hispanic Asian vs Non-Hispanic White	1.58 (0.49-5.07)	0.59	0.4392
Non-Hispanic other vs Non-Hispanic White	0.55 (0.24-1.23)	0.41	0.1450
Annual income, $			
<20,000 vs >100,000	0.70 (0.38-1.31)	0.32	0.2637
20,000 to < 35,000 vs >100,000	0.47 (0.24-0.94)	0.35	0.0321
35,000 to < 50,000 vs >100,000	0.62 (0.33-1.17)	0.32	0.1387
50,000 to < 75,000 vs >100,000	0.88 (0.48-1.62)	0.31	0.6744
≥75,000 to >100,000	0.79 (0.44-1.42)	0.30	0.4198
Place of residence			
Urban vs Rural	1.20 (0.65-2.21)	0.31	0.5636

Note: HINTS, Health Information National Trends Survey; aOR, adjusted odds ratio.
c-Statistics: 0.64. This measured the model's ability to discriminate between observations with different outcomes.

DISCUSSION

Findings from this study provide insight into United States adults who are offered access to patient portals and encouraged to use them, highlighting disparities in access and their relationship with perceived quality of care. Most respondents (78.6%) rated their care in the past 12 months as good, very good, or excellent. A large majority reported being offered portal access (73.3%) and encouraged to use a portal (69.0%). Being offered portal access was associated with significantly higher odds of rating care as *excellent*, suggesting that provider-facilitated portal access may positively influence patients' perceptions of care quality. This finding is consistent with prior studies and reviews showing that portal access and well-implemented portal features (e.g., timely test results, access to notes) are linked to greater patient satisfaction, engagement, and perceptions of care quality.[3,26]

Mechanisms that may explain this association include improved information access (patients can view test results and clinician notes), clearer communication about care plans, and increased patient activation; all of which can increase trust and perceived responsiveness of health care teams. In our sample, viewing test results (59.6%) and reviewing clinical notes (52.0%) were common portal uses, which aligns with qualitative and survey research showing that access to results and notes improves recall, understanding, and confidence in care.[27-30]

However, the bivariate results reveal persistent disparities in who is offered portal access (lower offers among women, the oldest adults, non-Hispanic Other groups, lower-income and respondents with lower educational attainment, and rural residents). These patterns mirror recent reports of inequities in portal activation and use by age, income, health literacy, and rurality, indicating that offering access alone may not be sufficient, targeted efforts are needed to close gaps in both offer and uptake.[26,31]

In adjusted analyses, several groups had significantly lower odds of rating their care as *excellent*. Younger adults often report lower satisfaction, consistent with evidence that they have higher expectations for convenience and communication in health care.[32] Women's substantially lower odds align with research showing more frequent experiences of dismissiveness, bias, and unmet communication needs in clinical encounters.[33,34] College graduates may have higher expectations for shared decision-making and clarity, which can heighten perceived shortcomings in care.[35,36] Lower-income respondents also reported poorer experiences, reflecting well-documented structural barriers and financial strain that undermine perceptions of care quality.[37,38]

By contrast, being offered online portal access was associated with higher odds of rating care as excellent. This finding is consistent with evidence that access to patient portal enhances transparency, trust, and patient engagement, contributing to improved patient experience.[39]

Collectively, the results imply two actionable implications for practice and policy: (1) Health systems and clinicians should consistently offer and actively encourage portal access, since being offered access is associated with markedly better ratings of health care, and (2) implementation strategies must address access barriers such as digital literacy, broadband, language, shared-access workflows, and culturally appropriate outreach, to ensure equitable benefits across age, race/ethnicity, income, and rural/urban groups.

Interventions that simplify portal interfaces, proactively release easy-to-understand test results and visit notes, and provide support for portal enrollment and use, including family or care-partner access when appropriate, are supported by the literature as effective strategies for extending the quality-of-care benefits of patient portals to a broader population.[40-42] Prior studies have shown that simplifying navigation and enhancing usability can reduce disparities in portal engagement.[26,31,40] Likewise, patients report greater understanding, recall, and confidence when they receive clear test results and access to visit notes.[28,30] Providing technical assistance and shared-access options for family or caregivers also has been shown to improve adoption among older adults and those with limited digital literacy.[41,42]

Strengths and Limitations. This study has several strengths. Authors used nationally representative data from HINTS 7, allowing for generalization of findings to the United States adult population. The large sample size (N = 7,278) and use of survey weights ensured appropriate representation across key demographic groups. The inclusion of multiple sociodemographic covariates and use of survey-weighted multivariable logistic regression improved control for confounding and enhanced the validity of the observed associations. Additionally, adherence to STROBE and PRICSSA reporting guidelines strengthened methodological transparency and reproducibility.

However, several limitations should be noted. First, the cross-sectional design precludes causal inference; the observed associations between online portal and perceived quality of care may be bidirectional. Second, all measures were self-reported and subject to recall and social desirability biases. Third, residual confounding is possible because variables such as digital literacy, health status, and patient-provider communication quality were not included. Fourth, although the model demonstrated acceptable discrimination, the c-statistic of 0.64 indicates only modest ability to distinguish between respondents who rated their care as *excellent* versus *fair/poor*, suggesting that additional unmeasured factors likely influence perceptions of care quality.

Fifth, while we assumed that missing survey responses were MAR, we acknowledge this may not fully reflect reality given our low response rate. It is possible that individuals unfamiliar with patient portals or dissatisfied with their care were less likely to respond. However, our data do not allow us to verify this, and assuming missingness is not at random (MNAR) would require untestable assumptions about nonresponse. Thus, while MAR is a practical and testable working assumption, we recognize it as a limitation when interpreting our results. Finally, survey nonresponse (27.3%) may have introduced selection bias if individuals with differing levels of digital engagement were underrepresented.

Future Directions. Future research should explore targeted strategies to reduce disparities in patient portal access and use, particularly among older adults, rural residents, and lower-income populations. Mixed-methods studies could help identify barriers unique to these groups and evaluate interventions such as simplified portal design, caregiver-assisted access, and culturally tailored education. Additionally, longitudinal studies are needed to assess whether increased portal engagement leads to sustained improvements in perceived quality of care and clinical outcomes.

Conclusions

Offering patients online access to their medical records was associated with higher perceived quality of care. Persistent disparities in portal access among women, older adults, lower-income, and rural populations highlight the need for targeted interventions to promote equitable engagement. Enhancing usability and accessibility of patient portals may help extend the benefits of digital health tools to a broader population.

ARTICLE INFORMATION
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Original Research

The Meaning of Community Characteristics in the Recruitment and Retention of Rural Health Care Professionals

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ABSTRACT

Introduction. Rural communities face shortages of health care professionals, leading to reduced access to care and increased patient mortality. While prior studies have identified factors that positively influence recruitment and retention, limited research has examined how community characteristics shape these experiences. Authors of this study aimed to better understand the role of community characteristics in recruiting and retaining rural health care professionals in Kansas.

Methods. In-depth interviews were conducted with physicians, advanced practice providers (APPs), and nurses working at University of Kansas School of Medicine Summer Training Option in Rural Medicine (STORM) sites. Interviews explored the meaning of community characteristics and their influence on recruitment and retention experiences. Participants were recruited via email. Interviews were digitally recorded, transcribed, and coded inductively. Thematic network analysis was used to develop global themes and inform conclusions.

Results. Seventeen rural health care professionals (6 physicians, 5 APPs, and 6 nurses) participated. The average interview length was 18.6 minutes. Five global themes emerged: (1) predisposing factors, (2) community ability to meet basic needs, (3) workplace satisfaction and sense of purpose, (4) fulfillment through social connections and environment, and (5) challenges in rural health care. Although these themes were consistent across professions, each profession described their impact differently.

Conclusions. Factors influencing recruitment and retention of rural health care professionals in Kansas were similar across professions; however, their meaning and impact varied by profession. Recognizing these differences is important for developing strategies to improve recruitment and retention in rural communities.

INTRODUCTION

Shortages of primary care physicians have been a long-standing challenge in the United States, particularly in rural communities. Approximately one-fifth of the United States population lives in rural areas, yet fewer than 10% of physicians practice there.[1] This shortage limits access to care, contributes to poorer health outcomes, and increases mortality.[2] Historically, difficulties in recruiting and retaining health care professionals have contributed to rural health care workforce shortages.[3]

Previous research has identified key factors and strategies that influence rural recruitment and retention. Early rural exposure during training and economic incentives have been associated with improved recruitment, although these strategies may primarily support short-term retention.[4-6] Non-economic factors, including rural background, sociocultural integration, community appeal, and personal support, are associated with improved recruitment and long-term retention.[3,4,7] Although these factors are known to be important, less is understood about why they matter, whether their influence differs by profession, and how they can be leveraged to strengthen the rural workforce.

In Kansas, 92 of 105 counties (88%) are partially or wholly medically underserved.[8] These counties include approximately 33% of the state's population, who directly experience the consequences of health care workforce shortages.[8] Despite the implementation of multiple workforce development resources and educational initiatives, the urban-rural access gap persists.[9,10] Because long-term retention is associated with community-based factors, such as strong social connectedness,[3] questions remain about how community characteristics and perceptions of community meaning influence successful recruitment. Authors of this qualitative study examined the role of community in recruitment and retention and aimed to address gaps in the literature that may inform more effective strategies for strengthening the rural health care workforce.

METHODS

This cross-sectional, qualitative study used semi-structured interviews to explore the recruitment and retention experiences of rural health care professionals employed at The University of Kansas School of Medicine Summer Training Option in Rural Medicine (STORM) sites across Kansas. Interview sites were selected using the most recent Kansas Hospital Association Statistics (KHA-STAT) annual report to construct a sample with wide variation across geographic location, hospital size, and presence of an intensive care unit (ICU).[11]

We approached the impact of community on health care professional recruitment and retention with a constructivist paradigm, understanding that the meanings of community characteristics are created by those experiencing them. This paradigm influenced our decision not to merely list community characteristics, but instead to purposefully sample and conduct interviews with rural health care professionals to understand the meanings they construct around the community characteristics they experience.[12,13]

Study participants were purposefully recruited from three groups of professionals: physicians (MD/DO), advanced practice providers (PA/APRN/NP), and nursing staff (RN/LPN). This allowed for comparisons between types of health care professionals. Study participation was solicited via email, and the goals of the study were disclosed in writing to all participants in advance of interviews. Medical students then scheduled and conducted interviews in-person and privately at their respective STORM sites (participants' workplaces), using Zoom to digitally record.

No other individuals were present during interviews, and no participants were interviewed more than once. Medical student interviewers received training in interviewing from the senior author, who is an experienced qualitative researcher. They agreed to assist in conducting interviews due to an interest in the study subject matter and a desire to gain experience in data collection. They took minimal field notes, but those taken were shared with the first author. Peer debriefing was offered, but interviewers did not utilize it.

The interview guide was designed with five domains reflecting the Community Apgar Questionnaire (CAQ): 1) demographic, 2) geographic, 3) economic, 4) scope of practice, and 5) community support. The interview guide was designed to reflect the CAQ because it was specifically designed to help rural communities describe community characteristics and address challenges in recruitment and retention.[14,15] We asked questions regarding the participants' background, recruitment experiences, and perspectives on their community, including factors relating to economic circumstances, scope of practice, and general community support. The guide was not pilot-tested due to its basis in an established instrument, the senior author's previous experience in the field, and the short timeframe of the data collection period.

Interview recordings were professionally transcribed verbatim to ensure accuracy. Member-checking was not used due to the short timeframe of the study (the six weeks of the STORM program in summer 2023). Two coders were involved; the first author conducted initial inductive coding and discussed codes with the senior author, who assisted in coding to iterate the codebook. The authors met regularly and constructed a final codebook by consensus. Thematic analysis was conducted using Kiger's approach.[16] The Kiger approach does not offer guidance related to saturation; however, it directs researchers to move from codes to themes. In this process of constructing themes, the authors also applied the principles of thematic network analysis[17] to construct global themes and draw conclusions. Demographics were treated as quantitative data, and basic summary statistics were calculated using Microsoft® Excel® to further characterize the study sample. Participants have not yet received the study findings; we plan to share them after publication. This study was approved by The University of Kansas Medical Center Institutional Review Board (IRB), and we utilized the consolidated criteria for reporting qualitative research (COREQ) standards in the reporting.[18]

Reflexivity statement. These medical students also were working with participants during this time as trainees in their respective clinical settings and as such may have brought their perceptions of the interviewees into the interview. Similarly, the first author was training at a STORM site during the study period, and their perspective was shaped by their observations of the local health care professionals. The senior author has conducted previous research on this topic, and as such brought their knowledge and preconceived notions to the study. The first and senior authors acknowledged their potential biases to each other during debriefs throughout the data analysis stage.

RESULTS

A total of 21 health care professionals received study information and were invited to participate. Seventeen professionals from seven STORM sites completed interviews, including 6 physicians, 5 APPs, and 6 nursing staff. The average interview length was 18.6 minutes. Four invited participants declined participation. The mean participant age was 37.6 years, and 76% identified as female. Additional sample characteristics, including race, marital status, and parental status, are presented in Table 1. Five global themes emerged: (1) predisposing factors, (2) community ability to meet basic needs, (3) workplace satisfaction and sense of purpose, (4) fulfillment through social connections and environment, and (5) challenges in rural health care.

Table 1. Sample characteristics.

Profession	MD/DO	PA/APRN/NP	RN/LPN
Participants	6	5	6
Average Age (years)	39.2	32.9	37.5
Gender*			
Female	3	4	6
Male	3	1	0
Race*			
White	6	4	6
Asian	0	1	0
Marital Status			
Married	6	4	4
Single	0	1	2
Have children			
Yes	5	4	5
No	1	1	1

*Race and gender self-reported by participants.

Predisposing factors and community ability to meet basic needs were most frequently discussed in relation to recruitment to rural communities. Workplace satisfaction, sense of purpose, and fulfillment through social connections and environment were most associated with successful long-term retention. Participants across professions also described challenges in rural health care that negatively influenced retention.

Although global themes were consistent across professional groups, their meaning and impact varied by profession. Table 2 illustrates the relationship between organizing and global themes across professions.

Predisposing Factors. Most participants described two key predisposing factors: rural background and financial incentives. All participants reported early exposure to rural environments, including being raised in rural communities, visiting family in rural areas, or experiencing rural settings during medical training.

Financial incentives played a larger role in recruitment for physicians and APPs than for nursing staff. The Kansas Medical Student Loan (KMSL) Program positively influenced recruitment for several physicians. For one physician, participation in the KMSL program enabled them to pursue a medical career and return to their home community to practice.

"I did the KMSL Program, so I knew from the get-go I was going to practice in Kansas […] But again, it was easy to sign up for because I was already planning on coming back to a town that fit the criteria." – MD5

For another physician, KMSL was a financial benefit that led them to choose rural practice.

"I signed up for KMSL my first year of medical school, and so I needed to go into a primary care specialty and practice in an underserved area." - MD1

One PA felt although their job had a lower salary compared to those offered to them in urban settings, receiving loan repayment was a beneficial tradeoff and led them to choose rural practice.

"…to me the most important thing is probably loan repayment. I mean, that is a huge pull. […] So, if I'm not getting a loan repayment to work in a rural community then maybe I need to look elsewhere because my loans are just so much." - PA1

This perspective highlights the impact of educational debt as a powerful motivator in workforce distribution.

Nursing participants noted proximity to family as an important factor in their decision to practice in a rural community. Some nursing participants felt being close to family enabled them to have a support system.

"…For me just in general, because this is where my family and support is […] Those types of things are important." – RN4

Other nursing participants noted that they chose a career in a rural community based off readily available jobs and the need to be in a rural location for their spouse's career.

These findings underscore the interplay between structural, financial, and personal factors that shape rural workforce recruitment and retention.

Ability of Community to Meet Basic Needs. When discussing recruitment, rural health care professionals emphasized the importance of communities being able to meet both their personal needs and those of their families. For some, this included financial stability. A lower cost of living in rural communities, compared to urban areas, also was viewed as appealing.

"The cost of living here isn't as expensive as, say, if you were to go to a larger city where houses are much more expensive, so that was kind of the appeal to here." - NP2

These findings suggest that economic sustainability contributes to recruitment, as perceptions of financial security may enhance the appeal of rural practice. Recruitment strategies may benefit from highlighting cost-of-living advantages alongside loan repayment opportunities.

For some participants, meeting basic needs also included access to local amenities such as restaurants and grocery stores. For those with children, the availability of schools, daycare, and extracurricular activities was an important factor in recruitment decisions.

"...it's activities for the kids, a good school, things to do, like our parks and the swimming pool, church. Those types of things are important. As far as nursing, especially when I was at the hospital and my kids were younger, daycare was a big deal." – RN3

Many people expressed a sense of safety that led them to a rural community. This was especially pertinent to those raising a family.

"I have kids. I like the small-town community to raise them, as it's safer. […] To me I feel like it's a safer place to be." – LPN1

The ability of a community to meet personal and family needs influenced many health care professionals' decisions to both relocate to and remain in rural communities, although specific needs varied by individual. These findings highlight the importance of strong physical and social infrastructure to support the well-being of health care professionals and their families.

Satisfaction and Sense of Purpose in Workplace. Many study participants felt satisfaction in the workplace and a sense of purpose in their work. For some, this meant caring for patients they knew and providing quality care to those in underserved, rural communities.

"I feel like we can provide care in this small environment and still bring quality care to the rural community. And you're taking care of people that are from all stretches of life." – APRN1

One physician mentioned they felt returning to their hometown and giving back to their community created a positive work experience.

"I really wanted to come back home and serve the community that had given so much to me to get me to where I was, and so to come back here was a pretty amazing experience." – MD2

These statements suggest that fulfillment is closely tied to community identity and a sense of social contribution. The opportunity to serve others reflects a commitment to service and indicates that emotional and moral connections may support long-term retention.

Physician participants also valued full-scope practice opportunities, which provided flexibility in work hours and scheduling. Many APP and nursing participants reported receiving mentorship from supervising physicians or department managers, which fostered reassurance and support. They also perceived their workplaces as offering opportunities for professional growth and development.

"I feel like our new nurse manager is very proactive with us and she listens to our concerns. I feel like our providers take care of their staff. They make us feel that we're doing a good job." – LPN1

One NP mentioned this support created a sense of autonomy in their work and contributed to a collaborative work environment.

"Our providers allow me to follow protocol and give me the freedom to practice within my means. And I also enjoy the fact that I can

collaborate with the providers at any point if I have any questions or concerns about anything." – NP2

Autonomy and collaboration often coexist within rural health settings. This balance creates a trust-based practice environment that empowers clinicians and staff to work independently while maintaining collegial support.

Supportive work environments, strong mentorship, and a sense of community connection are all important contributors to job satisfaction among rural health care professionals, directly promoting long-term retention.

Fulfillment through Social Connections and Environment. Participants found their social network and connections to their environment led them to stay in rural communities. For some, this meant living in a community where people were familiar with one another and creating a friendly environment. This sense of familiarity was mentioned by physicians, APPs, and nurses alike. One nurse stated:

"…I like that I know a lot of people […] it's friendly, people know each other […] But I like that I do know a lot of people, and it's home." – RN4

Participants noted involvement in local churches and non-profit organizations allowed them to be involved in their community, bringing a feeling of fulfillment. Involvement in local organizations also gave participants a way to socialize and form meaningful relationships. Social familiarity helps shape identity and meaning in work, while reinforcing a sense of purpose. The overlap of professional and social roles can create emotional investment in the community's well-being.

Other study participants enjoyed the physical landscape of their surroundings, leading them to stay in a rural community. They enjoyed the peace and quiet the rural landscape could offer.

"It's a beautiful part of Kansas. Truly wouldn't even know you're in Kansas…it's hilly, and it's green, and it's just lush and beautiful […] and honestly, all of those things do contribute to my decision to stay." – PA1

The physical landscape supported retention for some participants by enabling them to enjoy their personal hobbies. The physical landscape allowed one participant to create a farm, and they have been able to provide food for themselves.

"I always wanted cows and a farm, and so we've kind of created our own little trial by error farm, and we've got animals and butcher our own meat, grow a lot of our own fruits and vegetables." – MD3

The appreciation for the landscape demonstrates a relationship between place attachment and retention. For these providers, the environment offers an enjoyable outlet that may counteract the demands of rural practice.

Having strong social connections, community involvement, and a friendly environment were reasons for staying in a rural community. Many valued their community's natural landscape, which supported their hobbies and lifestyle. Each of these factors contributed to a sense of belonging.

Challenges in Rural Healthcare. Lack of adequate access to specialists was a common challenge encountered by rural health care professionals, mostly by physicians working in a primary care setting. One rural physician said:

"I think the availability of specialties is one of the biggest hurdles we face because patients have to travel to get specialty care for a lot of things. […] It's just a big hurdle that we have to jump with every patient." – DO1

Physicians felt the strain of coordinating care with limited specialists available, often causing them to feel isolated or overwhelmed in critical or very complex cases. Systemic gaps in specialty care intensifies clinical workload for rural providers. This highlights the structural inequities between rural and urban healthcare systems.

Other challenges mentioned among participants were burnout in the workplace and staffing shortages. Nursing participants felt this strain in their day-to-day work, with staffing shortages directly contributing to burnout in the workplace.

"[H]ere within the last few years, I have considered just changing or doing something different. […] you get burnt out a little bit. And then when coworkers aren't coming in as scheduled or calling in sick more, it kind of puts more work on those that are there." – RN3

Inadequate staffing not only affects daily workflow, but undermines retention and stability of the rural health care workforce.

Many participants also noted the strain associated with role overlap. This was described as a negative aspect of living in a community with a tight social network. Physicians reported frequently being asked medical-related questions while running daily errands. Other professionals described being approached by family members of patients and asked to share sensitive information about a patient's care or prognosis. This blurring of personal and professional boundaries reflects the deep integration of rural health care providers within their communities. While this integration can promote trust between patients and their care teams, it may also increase emotional strain.

Rural health care professionals face multiple challenges that contribute to burnout and decreased retention. Participants recognized that these challenges are often difficult to overcome and create additional barriers to strengthening the rural health care workforce.

DISCUSSION

To effectively address the shortage of rural health care workers, it is important to understand how community influences recruitment and retention. We aimed to further examine community characteristics that contribute to recruiting and retaining rural health care professionals. Five global themes emerged: however, the impact of each theme varied by profession.

Our findings align with previous research that show that early rural upbringing, and financial incentives are key drivers of

Table 2. Differences in organizing themes by profession.

	Predisposing Factors	Ability of Community to Meet Basic Needs	Satisfaction and Sense of Purpose in Workplace	Fulfillment through Social Connections and Environment	Challenges in Rural Healthcare
MD/DO	Rural upbringing. Early exposure to rural environments. Financial Incentives.	Local amenities. Proximity to larger communities. Low cost of living. High quality schools and education systems. Safety.	Full scope practice. Flexibility. Giving back to hometown. Keeping patient care local.	Accessibility to nature and hobbies. Ability to provide for self. Community support. Respect from patients.	Lack of access to resources and specialists. Role overlap. Staffing shortages.
PA/APRN/NP			Trust from physicians. Opportunities for growth. Autonomy. Caring for underserved populations.	Work near home. Peace and quiet. Family oriented environment. Community involvement.	
RN/LPN			Supportive work environment. Job viability. Familiarity of patients. Ability to impact others.	Open spaces. Peace and quiet. Proximity to family. Interconnected community.	

successful recruitment.[3,4,6] Physicians and APPs were more strongly influenced by financial incentives. Programs such as the KMSL Program played a significant role in physicians' decisions to practice in rural settings, reinforcing the importance of financial support programs. Financial incentives were less influential among nursing participants, which may reflect that many had spouses whose careers required living in rural areas. For these participants, proximity to family and familiarity with rural communities played a larger role in recruitment.

Findings of this study also provide insight into non-economic factors associated with retention. Participants described social connections, community ability to meet personal and family needs, and workplace satisfaction as contributors to long-term retention. Community needs included access to affordable housing, grocery stores, childcare, schools, and safe environments, particularly for participants with families. These findings support prior research demonstrating the importance of community infrastructure and support in retaining rural health care professionals.[7,19]

Workplace culture and job satisfaction were central to retention, although contributing factors varied by profession. Physicians highlighted patient diversity and practice flexibility. APPs and nursing staff valued familiarity with patients and support from supervising staff. APPs emphasized that supportive workplace environments helped reduce burnout. A positive work environment and the opportunity to care for underserved populations fostered a strong sense of purpose among rural health care professionals. These findings are consistent with prior literature.[5,19,20]

Participants also emphasized the importance of social and environmental connections in retention. Many valued close-knit communities, and participation in local organizations strengthened social connections and sense of fulfillment. Others described the rural environment as peaceful, with enjoyable landscapes and opportunities to pursue personal hobbies. These findings highlight the importance of community connection and quality of life outside the workplace in supporting retention.[3,4]

Despite these positive experiences, participants described persistent challenges in rural health care. Limited access to specialists and staffing shortages were frequently reported, particularly by physicians managing complex care coordination. Nursing staff frequently described burnout, often linked to staffing shortages. These findings highlight ongoing challenges in rural health care that must be addressed to improve retention.[3,21-24]

Addressing these challenges may require incorporating best practices from nursing literature on recruitment and retention. Rural health care professionals and their affiliated organizations may benefit from collaborating with hospital associations and advocacy groups to support policies such as apprenticeship programs and public funding for rural workforce training. Greater coordination across health systems also may improve access to specialty care and support delivery of the right care in the right setting. Future research should examine recruitment and retention outcomes and explore rural health care professionals' experiences with initiatives such as clinically integrated networks, the Rural Health Transformation Fund, publicly funded loan forgiveness programs, and other workforce support programs. Evaluating these programs using meaningful measures for rural health care professionals will be important.

Limitations. The sample size and characteristics limit generalizability. Participants were rural health care professionals currently practicing in Kansas; future studies should include individuals who have left rural practice to better understand factors that negatively influence retention. Participant diversity was limited, particularly in race and marital status. There also is potential for recall bias, as participants reflected on past recruitment experiences. Despite these limitations, this study provides valuable insight into how community characteristics influence the rural health care workforce.

Conclusions

This study provides insight into how rural health care professionals interpret the meaning of community characteristics. Recruitment and retention are influenced by a complex interplay of personal background, workplace satisfaction, and community integration. Although common themes exist across professions, the impact of these factors varies by profession. These findings highlight the importance of a multifactorial approach to strengthening and expanding the rural health care workforce.

ARTICLE INFORMATION

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Keywords: *rural population, health workforce, Kansas, rural health*

KANSAS JOURNAL of MEDICINE

Case Report

Unrecognized Durotomy Resulting in High Volume Cerebrospinal Fluid Diversion Through a Hemovac®

Thomas Woodard, D.O., Scott McLaren, M.D., William Krogman, M.S., Lueke Anderson, D.O.

INTRODUCTION

Incidental durotomy has an incidence rate of approximately 3.5-14%,[1,2] while unrecognized durotomy can occur in up to 26.7% of malignant spinal tumor surgeries.[3] When identified intraoperatively and repaired primarily with sutures or dural sealant, durotomies typically result in minimal postoperative sequelae.[4] However, if unrecognized or inadequately repaired, they can lead to complications such as intracranial hypotension, subdural hematoma (SDH), pseudomeningocele, cerebrospinal fluid (CSF) fistula, meningitis, and arachnoiditis.[2] We present a case illustrating the morbidity of an unrecognized incidental durotomy following spinal surgery, further complicated by Hemovac® placement that caused high-volume CSF diversion, resulting in severe intracranial hypotension and cerebral hemorrhages. Written informed consent was obtained from the patient for presentation and publication..

CASE REPORT

A 76-year-old man with a past medical history of hypertension, coronary artery disease, and prior myocardial infarction status post-stenting and coronary artery bypass grafting presented to an outpatient surgery center for lumbar laminectomy, facetectomy, and transforaminal lumbar interbody fusion. The procedure was completed without any apparent complications, and a Hemovac® drain was placed, as is routine, to prevent infection and hematoma formation. The patient was successfully extubated and transferred to the post-anesthesia care unit (PACU). On arrival, he exhibited spontaneous movement in all extremities but remained somnolent. Over time, his neurological status declined, and he lost spontaneous extremity movement. Approximately 500 mL of predominantly clear fluid was noted in the Hemovac®. A head computed tomography (CT) scan revealed bilateral SDH secondary to intracranial hypotension caused by an unrecognized durotomy, leading to CSF diversion through the Hemovac®. The patient was transferred to a tertiary hospital for a higher level of care.

En route, he experienced a 40-second tonic-clonic seizure that resolved without intervention. Upon arrival, his Glasgow Coma Scale score was 6, and his pupils were equal but nonreactive; he was emergently intubated for airway protection. Repeat CT imaging demonstrated a 9 mm left-sided SDH extending the length of the hemisphere, a smaller posterior right-sided SDH, subarachnoid blood in the interhemispheric fissures and basilar cisterns, a small intraventricular hemorrhage, cerebral edema, effacement of the basilar cisterns, and a 4 mm left-to-right midline shift (Figure 1). The patient was loaded with 2 g of levetiracetam, then continued 500 mg twice daily. He was placed in the Trendelenburg position and monitored with electroencephalography, which showed no further seizure activity.

On postoperative day (POD) 2, he underwent lumbar wound exploration with dural repair. Postoperatively, he was maintained flat for 24 hours per neurosurgery recommendations. His neurological status gradually improved; he became responsive, opened his eyes, and followed commands. After a successful spontaneous breathing trial, he was extubated on POD 3. By POD 5, he had returned to his neurological baseline and was transferred to the general floor. On POD 10, he was discharged to inpatient rehabilitation, where he made a full recovery and was eventually sent home on antiepileptic therapy without residual neurological or physical deficits.

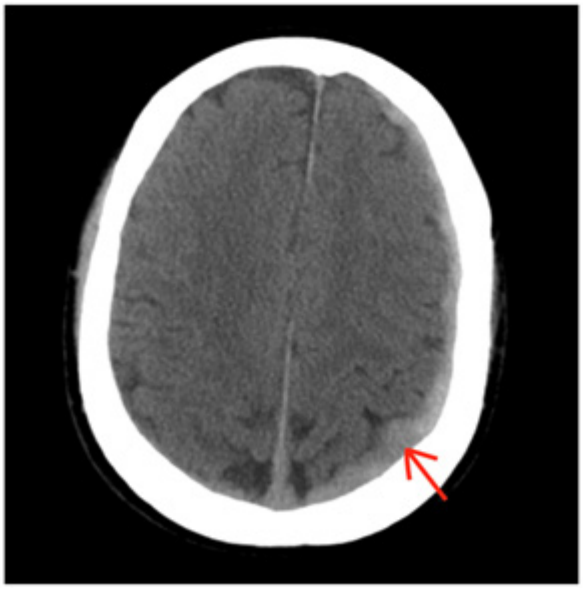

Figure 1. A head computed tomography (CT) showing a 9mm left-sided subdural hematoma extending the length of the hemisphere (red arrow) with a smaller posterior right-sided subdural hematoma (SDH).

DISCUSSION

Durotomy risk factors include revision surgery, advanced age, and obesity.[1-5] Associated complications include intracranial hypotension, pseudomeningocele, CSF fistula formation, meningitis, and arachnoiditis.[2] Prompt recognition and repair of a dural tear, using sutures or sealant, greatly reduce these risks. Even with repair, durotomy may prolong hospitalization and decrease patient satisfaction.[6]

This case was unusual because the dural tear went unrecognized, and Hemovac® placement resulted in high-volume CSF diversion. CSF is distributed between the subarachnoid spaces of the brain and spinal cord, with about 20% in the cerebral ventricles. The average adult has 150 mL of CSF (range: 90-200 mL) and produces roughly 20 mL per hour.[7] In our patient, approximately 500 mL of clear fluid drained into the Hemovac®, suggesting significant CSF loss despite the expected lower total volume. Imaging findings (Figure 1) were consistent with severe

intracranial hypotension secondary to this diversion.

Intracranial hypotension most commonly results from a dural leak, spinal nerve root diverticulum, or CSF-venous fistula.[8] Typical symptoms include orthostatic headache, nausea, neck stiffness, tinnitus, and dizziness, while severe cases may present with ataxia, parkinsonism, quadriplegia, or coma.[9-12] Imaging may reveal SDH, cerebellar hemorrhage, or effacement of the basilar cisterns due to traction on bridging veins caused by loss of CSF buoyancy.

Conservative management options for spontaneous intracranial hypotension include bed rest, caffeine, and epidural blood patch, but durotomy-related cases require primary closure.[4] Most dural tears effectively are managed with sutures, sealant, or both.[13] When promptly recognized and repaired, incidental durotomies rarely cause long-term sequelae. This case demonstrates the potential morbidity of an unrecognized durotomy, which can result in severe intracranial hypotension, cerebral hemorrhage, and seizures. Although our patient made a full recovery, the case underscores the need for vigilance in detecting and repairing durotomies to prevent serious complications.

ARTICLE INFORMATION

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***Keywords**: intracranial hypotension, subdural hematoma, cerebrospinal fluid*

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Case Report

The Reappearing Pancreas: A Case of Acute Pancreatitis on a Background of Diffuse Fatty Infiltration

Blake D. Sarrazin, M.D., Kirk Miller, D.O.

INTRODUCTION

Acute pancreatitis is a common cause of hospitalization in the United States, while fatty infiltration of the pancreas (FIP) is among the most frequent benign pancreatic conditions, affecting nearly one-third of the population.[1] The extent of FIP varies, with diffuse involvement of the entire gland occurring in only a minority of cases.[2] Total fatty replacement of the pancreas can be associated with exocrine insufficiency.[3-5]

This report presents a case of diffuse FIP with exocrine insufficiency complicated by acute pancreatitis, highlighting key imaging findings and their potential pitfalls. A broader discussion of the underlying pathophysiology of pancreatitis also is included, informed by the unique combination of clinical factors in this patient.

CASE REPORT

A 55-year-old woman presented to the emergency department with generalized body aches, fever, and acute worsening of abdominal pain accompanied by intractable nausea and vomiting. She also reported a recent history of intermittent abdominal pain, nausea, and loose stools. She had experienced multiple prior episodes of pancreatitis, most recently three weeks earlier during a hospitalization at an outside facility. Her past medical history was notable for obesity, celiac disease, adrenal insufficiency, and rheumatoid arthritis, and her surgical history included a cholecystectomy. She denied alcohol use.

On physical examination, she had abdominal tenderness. Her body mass index (BMI) was 31 kg/m^2. Initial laboratory studies revealed mild normocytic anemia (hemoglobin 11.0 g/dL), a low serum lipase level (5 U/L), hypoalbuminemia (2.9 g/dL), and hyponatremia (129 mmol/L). White blood cell count and levels of total bilirubin, calcium, and triglycerides were normal. During the hospitalization, her International Normalized Ratio (INR) and prothrombin time (PT) were found to be markedly elevated, 9.0 (reference 0.9-1.2) and 95 seconds (reference 9.9-14.2), respectively, suggesting vitamin K deficiency. A fecal pancreatic elastase-1 level was extremely low (<10 µg/g), indicating severe exocrine insufficiency.

Contrast-enhanced computed tomography (CT) of the abdomen and pelvis showed extensive edema and fat stranding throughout the pancreas and adjacent retroperitoneal fat (Figure 1), consistent with interstitial edematous pancreatitis. When compared with a CT scan from two months earlier (Figure 2), the pancreatic parenchyma had markedly changed. The earlier CT demonstrated extensive fatty infiltration of the entire pancreas with minimal residual normal parenchyma; the average density at the pancreatic body was -83 Hounsfield units (HU). More remote abdominal magnetic resonance imaging (MRI) from three years prior (Figure 3) also showed near-complete fatty infiltration, evidenced by pancreatic isointensity relative to retroperitoneal fat and loss of signal on fat-saturated sequences. Notably, a small region of fatty sparing within the anterior pancreatic body had been present at that time, appearing as an island of normal parenchyma. By the time of the current presentation, this area had become fully infiltrated by fat.

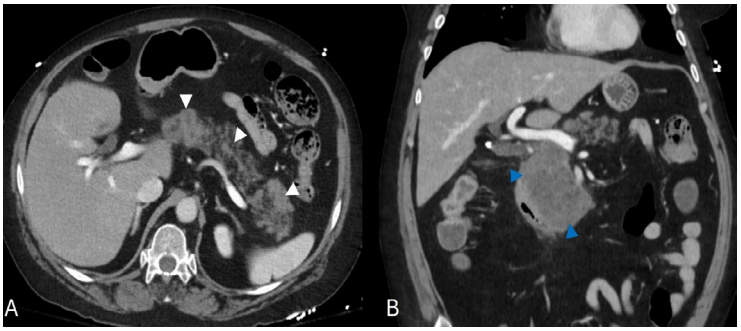

Figure 1. Computed tomography (CT) of the abdomen and pelvis with contrast. (A) Axial image demonstrates diffuse stranding and edema throughout the pancreatic body and tail (white arrowheads). (B) Coronal reformatted image shows stranding with mass-like thickening of the pancreatic head (blue arrowheads). Attenuation of the inflamed tissue appears similar to that of normal pancreatic parenchyma.

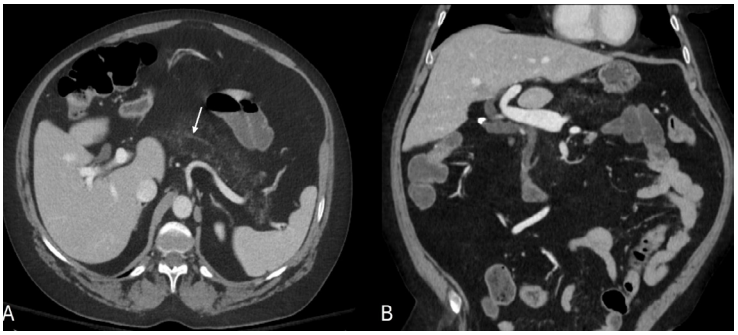

Figure 2. Computed tomography (CT) of the abdomen and pelvis with contrast obtained two months before Figure 1. (A) Axial and (B) coronal reformatted images demonstrate near-complete fatty replacement of the pancreas. The normal, non-dilated main duct is seen in the pancreatic body (white arrow).

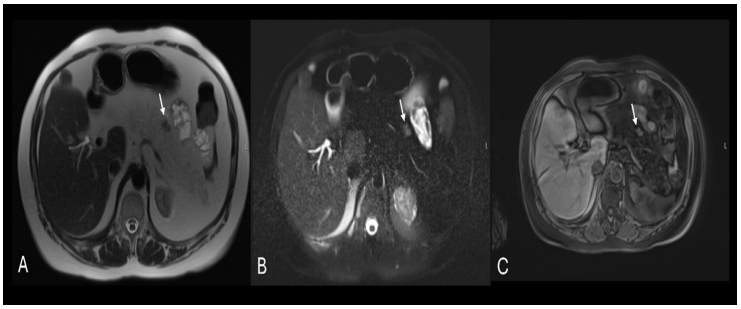

Figure 3. Magnetic resonance imaging (MRI) of the abdomen obtained three years before Figure 1. Axial (A) T2-weighted, (B) T2-weighted fat saturated, and (C) T1-weighted fat saturated pre-contrast images. (A) Macroscopic fat signal throughout the pancreas. (B, C) Diffusely hypointense pancreatic signal on fat saturated sequences. Small focus of tissue within the anterior pancreatic body (white arrow) with signal characteristics of normal parenchyma indicating an area of fatty sparing.

DISCUSSION

FIP is one of several terms used in the literature to describe the same process. Other synonyms include *fatty replacement, fatty pancreas, pancreatic lipomatosis, pancreatic steatosis, intrapancreatic fat deposition, and non-alcoholic fatty pancreas disease*.[3,6] The pathogenesis of FIP is not fully understood but is considered multifactorial. Age, obesity, diabetes, diet, and alcohol consumption are known associations, and FIP generally is viewed as a manifestation of metabolic syndrome. Rare hereditary pediatric disorders, such as cystic fibrosis, Shwachman-Diamond syndrome, and Johanson-Blizzard syndrome, also can cause FIP and are invariably accompanied by pancreatic exocrine insufficiency.[6,7]

Histologically, FIP is characterized by adipocyte infiltration between pancreatic lobules as well as intracellular fat deposition within acinar and islet cells.[7] FIP typically is heterogeneous, with uneven fat deposition more common than the diffuse pattern seen in this case. Matsumoto et al.[2] developed a classification system for uneven fatty infiltration and found that the anterior pancreatic head is most frequently affected, while the posterior head and uncinate process often are spared.[2] Most patients are asymptomatic, with FIP discovered incidentally on imaging. However, marked fatty infiltration can lead to exocrine insufficiency, resulting in malabsorption of dietary fat and fat-soluble vitamins, with symptoms including chronic diarrhea, steatorrhea, and abdominal pain. Diabetes and low serum lipase levels also may be present.[3-6]

Only a few reports describe diffuse fatty replacement complicated by acute pancreatitis. In Coulier's pictorial review, two such cases were included.[6] In this patient, the diffusely edematous fatty pancreas demonstrated CT attenuation similar to normal parenchyma, giving the impression that the pancreas had "reappeared" (Figure 1). This highlights the importance of comparison imaging. Without prior studies showing extensive fatty replacement, the degree of inflammation could easily have been underestimated. Clinically, there were few specific indicators of pancreatitis, the lipase level was low, and the abdominal pain could have been attributed to her comorbidities. Thus, the temporal change in pancreatic appearance combined with peripancreatic inflammatory stranding was important for accurate diagnosis.

Two recent studies by Sbeit et al.[8,9] found that FIP is associated with both increased occurrence and greater severity of acute pancreatitis. Proposed mechanisms include persistent tissue stress and low-grade inflammation within the fatty pancreas, punctuated by episodic inflammatory surges that precipitate acute pancreatitis.[3,8]

In general, acute pancreatitis results from autodigestion of the pancreas following inappropriate activation of digestive enzymes. Under normal conditions, enzymes are stored as inactive proenzymes in acinar cells, with activation occurring only in the duodenum. These safeguards prevent autodigestion. When they fail, a cascade of intrapancreatic enzyme activation leads to acinar injury, ischemia, fat necrosis, proteolysis, and inflammatory edema.[10]

This patient's extremely low fecal elastase-1 level is specific for exocrine pancreatic insufficiency,[11] and the low serum lipase level further supports this diagnosis. Additional laboratory abnormalities, including anemia, hypoalbuminemia, and vitamin K deficiency (elevated PT/INR), indicated generalized malabsorption. Her malabsorption likely is due to both celiac disease and exocrine insufficiency, though their relative contributions cannot be distinguished.

Some evidence suggests that FIP may be partially reversible through lifestyle modification and pharmacotherapy.[3,7,12] However, given this patient's degree of exocrine insufficiency, she likely has passed the threshold of reversibility, with substantial loss of acinar cells responsible for proenzyme production. In such cases, pancreatitis may be driven predominantly by non-autodigestion mechanisms. Local immune factors may provoke a leukocyte infiltrate that drives inflammation. Alternatively, as suggested by Caldart et al.,[12] intracellular fat within residual acinar cells may impair trafficking and exocytosis of proenzymes, leading to inappropriate intrapancreatic activation. The abundant interlobular adipocytes may then fuel a lipase-mediated cascade of rapid, diffuse fat necrosis, essentially allowing fat to amplify the pancreatitis.

Conclusions

This case illustrates how a common but often overlooked condition, fatty infiltration of the pancreas, can lead to serious clinical consequences. While FIP frequently is asymptomatic and incidentally detected, some patients, such as the one described here, may develop acute pancreatitis and profound exocrine insufficiency with resulting malabsorption. This report highlights the pathophysiologic links between FIP, pancreatitis, and exocrine dysfunction, and emphasizes the important role of comparative imaging in evaluating these dynamic processes. As clinical recognition and scientific understanding of FIP continue to expand, this case offers a clear example of its relevance to patient care.

ARTICLE INFORMATION

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Conflict of Interest Disclosure: None.

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Does Mortality Risk Increase with Active Treatment of Patent Ductus Arteriosus in Preterm Infants? A Critical Appraisal Skills Programme (CASP) Assessment of a Meta-Analysis

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Type of Investigation: A meta-analysis of randomized controlled trials (RCT).

Question: Do clinical outcomes differ when active treatment is compared to expectant management of hemodynamically significant Patent Ductus Arteriosus (hsPDA) in preterm infants enrolled in randomized controlled trials?

METHODS

Design. Systematic review with meta-analysis of RCTs.

Setting. Ten internationally located neonatal intensive care units.

Participants. RCTs that compared active treatment group (ATG) to expectant management group (EMG) for hsPDA in preterm infants.

Inclusion Criteria. RCTs that enrolled preterm infants born before 33 weeks' gestation, diagnosed with hsPDA by clinical or echocardiographic criteria, which compared ATG vs. EMG.

Exclusion Criteria. Studies that administered treatment for prophylaxis against hsPDA.

Randomization. Method of randomization varied by study.

Intervention. Infants in ATG received either indomethacin, ibuprofen, acetaminophen, or a combination of medications.

Controls. Premature infants in EMG did not receive treatment or received placebo.

Consent. Details of ethical review and informed consent were reported in the eligible RCTs.

Primary Outcomes. Composite outcome of death at 36 weeks postmenstrual age (PMA) or at discharge, or moderate to severe bronchopulmonary dysplasia (BPD); Composite outcome of death at 36 weeks PMA or moderate to severe BPD; Death at 36 weeks PMA; Death at 36 weeks PMA or at discharge; Moderate to severe BPD.

Secondary Outcomes. Death before hospital discharge; death at 28 days; cause of death; intraventricular hemorrhage; periventricular leukomalacia (PVL); retinopathy of prematurity (ROP; stage 3 or treated ROP); pulmonary hemorrhage; cardiovascular support (hypotension, inotropic support, or both); pulmonary hypertension; necrotizing enterocolitis (NEC; Bell stage >2); gastrointestinal perforation; gastrointestinal bleeding; time to full enteral feeding; use of diuretics; sepsis; kidney failure; use of postnatal steroids; ligation of hsPDA; duration of respiratory support (supplemental oxygen, non-invasive ventilation, or invasive ventilation); length of hospital stay; hsPDA status at discharge; weight gain; and discharge home with respiratory support or supplemental oxygen.

Analysis and Sample Size. Analyses included relative risk (RR), risk difference (RD), and random-effects models. Heterogeneity among studies was assessed using the Cochran Q test and I^2 statistic. Publication bias was evaluated using Egger and Begg tests (results not reported). Subgroup analyses included studies of infants born before 29 weeks' gestation. Statistical significance was set at $p < 0.05$ (two-tailed). All analyses were conducted using Stata version 18 (StataCorp LLC). The meta-analysis included 10 randomized controlled trials with a total of 2,035 infants (ATG: 1,018; EMG: 1,017).

RESULTS

The mean gestational age, birth weight, and proportion of male infants were similar between groups. Treatment of hsPDA was initiated within the first 72 hours of life in seven trials and after 72 hours but within the first two weeks of life in three trials. Six trials used ibuprofen, one used indomethacin, and three used a combination of ibuprofen, indomethacin, or acetaminophen. Open-label medication use was higher in the EMG than in the ATG (29.2% vs 16.1%).

Primary Outcomes:

1. The composite outcome of death at 36 weeks PMA or at discharge, or moderate to severe bronchopulmonary dysplasia (BPD), was significantly higher in the ATG compared with the EMG (56.2% vs 50.8%; RR 1.10, 95% CI 1.01-1.19; p = 0.02).
2. The composite outcome of death at 36 weeks PMA or moderate to severe BPD did not differ significantly between groups (55.6% vs 50.1%; RR 1.10, 95% CI 1.00-1.21; p = 0.06).
3. Death at 36 weeks PMA was significantly higher in the ATG (14.3% vs 11.2%; RR 1.27, 95% CI 1.01-1.61; p = 0.04).
4. Death at 36 weeks PMA or at discharge (whichever occurred later) also was significantly higher in the ATG (15.5% vs 12.4%; RR 1.25, 95% CI 1.01-1.56; p = 0.04). 0.02).
5. The risk of moderate to severe BPD did not differ significantly between groups (RR 1.08, 95% CI 0.95-1.23; p = 0.25).

Secondary Outcomes. The risk difference for PVL was significantly higher in the ATG (RD 1.8%, 95% CI 0.4-3.2%; p = 0.01); however, the relative risk was not statistically significant (RR 1.5, 95% CI 0.98-2.30; p = 0.06). No other secondary outcomes differed significantly between the two groups.

Study Conclusions. ATG, compared with EMG, was associated with a higher incidence of the composite outcome of death or moderate to severe BPD and an increased risk of mortality in preterm infants with hsPDA diagnosed within the first two weeks of life.

Scientific Commentary. The ductus arteriosus (DA) is a fetal vessel that shunts blood from the pulmonary artery to the aorta, bypassing the lungs.[2] In term infants, it closes shortly after birth; however, in preterm infants, ductal immaturity may prevent closure. Persistent patency beyond the transitional period results in a left-to-right shunt, termed patent ductus arteriosus (PDA), which can reduce gastrointestinal, renal, and cerebral perfusion.[3] In preterm infants, hsPDA is associated with increased risks of pulmonary hemorrhage, intraventricular hemorrhage, BPD, and mortality.[4-7]

Historically, 60-70% of infants born at <28 weeks' gestation with persistent PDA received pharmacologic treatment.[8] Recent evidence supports a shift toward expectant management,[9] coinciding with a marked increase in transcatheter PDA closure.[10] Annual transcatheter procedures increased from 17% to 84% in Lai et al. (see Table 1)[11] and from 0.1% to 2.9% in Shah et al. (see Table II).[12]

Medical Treatment for PDA. Indomethacin, ibuprofen, and acetaminophen commonly are used for PDA closure. Indomethacin reduces treatment failure compared with placebo without affecting mortality.[13] An umbrella review showed all three agents effectively close PDA compared with placebo.[14] However, another meta-analysis of 19 RCTs found no mortality benefit with early or very early treatment compared with expectant management, though early ibuprofen use was associated with increased mortality on sensitivity analysis.[15]

In Buvaneswarran et al.,[1] ATG was associated with increased mortality at 36 weeks postmenstrual age (PMA) but not at hospital discharge. Among infants who died, sepsis and gastrointestinal disease frequent were more in the active treatment group (eTable 8, Supplement[1]), although culture-positive sepsis did not differ significantly between groups (eFigure 2, Supplement[1]). These findings suggest that extreme prematurity, rather than pharmacologic treatment alone, may contribute to excess mortality in the ATG group.

Statistics Commentary. In a methodological assessment of meta-analyses, Ioannidis[16] reported that only 3% are clinically useful. The remainder were classified as redundant or unnecessary (27%), flawed beyond repair (20%), unpublished (20%), decent but not useful (17%), or misleading (13%). Given this context, a critical statistical appraisal of the meta-analysis by Buvaneswarran et al.[1] is warranted. We evaluated the statistical evidence using the Critical Appraisal Skills Programme (CASP) checklist for systematic reviews and meta-analyses of randomized controlled trials.[17] This 10-item tool assesses validity, methodology, trustworthiness, relevance, and applicability.

Table 1 summarizes the CASP results, identifying two strengths (Section A) and multiple weaknesses across Sections B-E (Items 3-10). The full CASP assessment is provided in Supplemental (available online at journals.ku.edu/kjm). Key limitations included a potentially incomplete literature search (CASP Item 3), absence of a certainty-of-evidence assessment (CASP Item 4), unadjusted statistical analyses, and underpowered subgroup analyses (CASP Items 5-6).

To assess the completeness of the literature search, we compared Buvaneswarran et al.[1] with two contemporary systematic reviews (see Table 2). Mitra et al.[15] included 14 studies, seven of which were not captured by Buvaneswarran et al.[1] Matsushita et al.[18] included 14 studies (nine distinct from Mitra et al.[15]), 11 of which also were absent from Buvaneswarran et al.[1] Of the 25 unique studies identified across these reviews, only 10 were included in the Buvaneswarran et al.[1] meta-analysis. Thus, the evidence appears to be insufficient, and may have introduced a bias in the results and conclusion made by Buvaneswarran et al.[1]

Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines recommend assessing certainty of evidence using frameworks such as GRADE, which evaluate study design, risk of bias, inconsistency, imprecision, and publication bias.[19] These assessments are essential for determining the reliability of effect estimates (CASP Items 4, 7-10).

Buvaneswarran et al.[1] did not report certainty-of-evidence assessments or statistical adjustments for zero-event outcomes (e.g., Sidik-Jonkman or Knapp-Hartung methods[20]), nor did they account for small sample sizes in subgroup analyses, some of which included as few as two studies. These limitations raise concerns about the robustness of the reported findings.

Additional statistical concerns include potential confounding and treatment heterogeneity. Treatment initiation timing varied, as did medication type (ibuprofen, indomethacin, or multiple agents), without reported evaluation of regimen differences. Moreover, open-label medication use was higher in the EMG than in the ATG (29.2% vs 16.1%).[1] Given treatment contamination and lack of stratification, it remains unclear which interventions, if any, primarily drove the observed outcomes, limiting interpretability and causal inference (CASP Items 8-10).

Conclusions

Our critical appraisal of Buvaneswarran et al.[1] identified strengths in CASP items 1-2 but also multiple weaknesses across items 3-10, including potential confounding, treatment contamination, and unreported treatment differences. Given these substantial limitations, we conclude that there is insufficient evidence to determine that active management within the first two weeks of life is associated with increased mortality.

If complete evidence was collected from the published trials (as listed in Table 2), and treatment contamination along with statistical issues listed in CASP were addressed, Buvaneswarran et al.[1] conclusion to "question the conventional wisdom in the management of PDA in preterm infants" may have been different.

Table 1. CASP General SR Checklist: Collation of critical appraisal responses.

Checklist question	Yes	No	Can't tell
A. Is the basic study design valid for a systematic review?			
1. Did the systematic review address a clearly formulated research question?	X		
2. Did the researchers search for appropriate study designs to answer the research question?	X		
B. Is the systematic review methodologically sound?			
3. Were all relevant primary research studies likely to have been included in the systematic review?		X	
4. Did the researchers assess the validity or methodological rigour of the primary research studies included in the systematic review?		X	
5. Did the researchers extract, and present information on the individual primary research studies appropriately and transparently?		X	
C. Are the results of the systematic review trustworthy?			
6. Did the researchers analyse the pooled results of the individual primary research studies appropriately?		X	
7. Did the researchers report any limitations of the systematic review and, if so, do the limitations discussed cover all the issues in your critical appraisal?		X	
8. Would the benefits of intervention outweigh any potential disadvantages, harms and/or additional demand for resources associated with acting on the results?		X	
D. Are the results of the systematic review relevant locally?			
9. Can the results of the systematic review be applied to your local population/in your local setting or context?			X
10. If actioned, would the findings from the systematic review represent greater or additional value for the individuals or populations for whom you are responsible?		X	

Table 2. Comparison of articles included in three meta-analyses of the same topic and period.

Trial	Intervention	Comparison	Included in the systematic review
Clyman 2019	more than one	expectant	Buvaneswarran[1]
Sung 2020	ibuprofen	expectant	Buvaneswarran1
de Waal 2021	more than one	expectant	Buvaneswarran1 / Mitra[15]
Gupta 2024	ibuprofen	expectant	Buvaneswarran1 / Mitra[15]
Kluckow 2014	indomethacin	expectant	Buvaneswarran1 / Mitra[15]
Potsiurko 2024	more than one	expectant	Buvaneswarran1 / Mitra[15]
Hundscheid 2023	ibuprofen	expectant	Buvaneswarran1 / Matsushita18 / Mitra[15]
Rozé 2021	ibuprofen	expectant	Buvaneswarran1 / Matsushita18 / Mitra[15]
Sosenko 2012	ibuprofen	expectant	Buvaneswarran1 / Matsushita18 / Mitra[15]
Babaei 2018	acetaminophen	expectant	Matsushita[18]
Bagheri 2018	paracetamol	placebo	Matsushita[18]
Ding YJ 2014	ibuprofen	placebo	Matsushita[18]
Harkin P 2016	paracetamol	placebo	Matsushita[18]
Kanmaz G 2013	ibuprofen	expectant	Matsushita[18]
Kluckow M 2013	indomethacin	placebo	Matsushita[18]
Kluckow M 2019	paracetamol	placebo	Matsushita[18]
Noori NM 2023	expectant	acetaminophen	Matsushita[18]
Sung SI 2020	ibuprofen	expectant	Matsushita[18]
El-Khuffash 2021	ibuprofen	placebo	Matsushita18 / Mitra[15]
Schindler T 2021	paracetamol	placebo	Matsushita18 / Mitra[15]
Bagnoli 2013	ibuprofen	placebo	Mitra[15]
CTRI 2009	indomethacin	no treatment	Mitra[15]
Ghanem 2010	ibuprofen	placebo	Mitra[15]
Knight 2011	indomethacin	placebo	Mitra[15]
Lin 2012	ibuprofen	placebo	Mitra[15]

Note: Expectant, placebo, and no treatment all indicate expectant management of patent ductus arteriosus.

Given the concern of potential harm from active treatment, it would be prudent to selectively treat premature infants with Patent Ductus Arteriosus that is >1.5 mm in diameter with unrestricted left to right flow, left atrium to aortic root ratio of >1.5 and moderate to large shunt volumes. Active treatment is best avoided when the PDA diameter is <1.5 mm, and in those with heart dysfunction, pulmonary hypertension, and low shunt volume.[21-23]

ARTICLE INFORMATION

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