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Association of Inpatient Continuity of Care With Complications and Length of Stay Among Hospitalized Medicare Enrollees

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Abstract

IMPORTANCE—Continuity in primary care is associated with improved outcomes, but less information is available on the association of continuity of care in the hospital with hospital complications.

OBJECTIVE—To assess whether the number of hospitalists providing care is associated with subsequent hospital complications and length of stay.

DESIGN, SETTING, AND PARTICIPANTS—This retrospective cohort study used multilevel logistic regression models to analyze Medicare claims for medical admissions from 2016 to 2018 with a length of stay longer than 4 days. Admissions with multiple charges on the same day from a hospitalist or an intensive care unit (ICU) stay during hospital days 1 to 3 were excluded. The data were accessed and analyzed from November 1, 2020, to April 30, 2021.

EXPOSURES—The number of different hospitalists who submitted charges during hospital days 1 to 3.

MAIN OUTCOMES AND MEASURES—Overall length of stay and transfer to ICU or a new diagnosis of drug toxic effects on hospital day 4 or later.

RESULTS—Among the 617 680 admissions, 362 376 (58.7%) were women, with a mean (SD) age of 0.2 (8.4) years. In 306 037 admissions (49.6%), the same hospitalist provided care on days 1 to 3, while 2 hospitalists provided care in 274 658 admissions (44.5%), and 3 hospitalists

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Supplemental content

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provided care in 36 985 admissions (6.0%). There was no significant association between the number of different hospitalists on days 1 to 3 and either length of stay or subsequent ICU transfers. Admissions seeing 2 or 3 hospitalists had a slightly greater adjusted odds of subsequent new diagnoses of drug toxic effects (2 hospitalists: odds ratio [OR], 1.04; 95% CI, 1.02–1.07; 3 hospitalists: OR, 1.07; 95% CI, 1.03–1.12).

CONCLUSIONS AND RELEVANCE—There was little evidence that receiving care from multiple hospitalists was associated with worse outcomes for patients receiving all their general medical care from hospitalists.

Introduction

Continuity of care is a recognized aspect of good medical care. Much of the attention on continuity of care has focused on outpatients, exploring issues such as the impact of fragmentation of care on receipt of preventive medicine services, emergency department visits, and avoidable hospitalizations.[1–6] There have also been excellent studies of the consequences of discontinuities in care across transitions, such as from the community to a hospital or from a hospital back to the community or a skilled nursing facility (SNF).[5–11]

Another important area with discontinuity is medical care during hospitalization.[12] Most of the care for patients admitted to general medical services is provided by hospitalists.[7] Accompanying the growth of hospitalist care has been a decrease in the continuity of care, with increasing numbers of inpatients seeing 2 to 3 or more generalist physicians during their stay.[12,13]

The impact of discontinuity in inpatient care on patient outcomes, such as hospital complications or length of stay, has not been studied in any depth. Single-institution studies have reported associations of fewer hospitalists providing care with lower costs and fewer adverse events, but the possibility that the adverse events caused the discontinuity was not excluded.[14,15] Interpreting any relationship between the number of treating physicians and hospital complication rates can be challenging because the occurrence of a complication could contribute to discontinuity, such as if an on-call physician is called to see a patient with a sudden change in status. Two recent studies avoided that issue by using indirect measures to assess the likelihood that an admission was cared for by more than 1 hospitalist and found that inpatient discontinuity was associated with worse outcomes after discharge.[16,17] We use national Medicare data to explore the association between the number of different hospitalists providing care early in the admission with a subsequent transfer to the intensive care unit (ICU), new diagnosis of drug toxic effects, and overall length of stay.

Methods

This retrospective study was approved by the University of Texas Medical Branch institutional review board. The requirement for written informed consent was waived because all the data were stripped of identifiers prior to our access. This study follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

Overall Approach

We classified admissions by how many different hospitalists submitted evaluation and management charges for services during the first 3 days of hospitalization (or during days 2 to 4 in sensitivity analyses) and then measured the outcomes of length of stay, a new diagnosis of drug toxic effects, and ICU transfer starting on day 4 (day 5 in sensitivity analyses). We excluded admissions that had any ICU care or more than 1 evaluation and management charge for hospitalist care per day during the baseline period (ie, first 3 or 4 days) to exclude patients with evidence of complications during the baseline period. In assessing the complication of drug toxic effects during day 4 or later of hospitalization, we excluded admissions that had experienced that complication on days 1 to 3 of hospitalization or in the year before hospitalization to ensure that we were identifying new complications. We used a 20% random sample of national Medicare claims for January 1, 2016, through December 31, 2018, in the analyses, including the Medicare Denominator File, the Carrier File, the Outpatient Statistical Analysis File, and the Medicare Provider Analysis and Review (MEDPAR) File.

Study Population

The selection process for the main cohort is presented in the eFigure in the Supplement. We first identified all acute hospital admissions discharged with a longer than 3-day length of stay from January 1, 2016, to December 31, 2018. We then restricted the cohort to those aged 66 or older years and with Parts A and B Medicare and without health maintenance organization (HMO) enrollment in the 12 months prior to the hospitalization to capture diagnoses in the previous year. We also eliminated admissions with any ICU stay during the first 3 days of hospital stay by using evaluation and management charges for critical care. We selected only the patients with a medical diagnostic-related group (DRG) code. Next, we included only hospitalizations that received care from at least 1 generalist physician (ie, general medicine, internal medicine, family medicine, geriatric medicine, hospitalists) during hospital days 1 to 3. We eliminated admissions with more than 1 evaluation and management charge for care from any generalist physician in 1 day during hospital days 1 to 3 to eliminate patients who might have experienced complications during hospital days 1 to 3. To further reduce heterogeneity, we restricted the cohort to the top 30 Clinical Classification Software (CCS) categories on admission. CCS is a method used by the Center for Medicare & Medicaid Services (CMS) to group diagnoses.[18] CCS is a method introduced by CMS to identify groups of closely related *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (*ICD-10*) diagnoses. We excluded CCS 259, which is a residual code that includes all unclassified admissions. We further restricted the cohort to admissions who received all of their general medical care from hospitalists during hospital days 1 to 3. In sensitivity analyses, the cohort selection was similar to that in the eFigure in the Supplement except that the minimum length of stay was more than 4 days, and the restrictions for any ICU care or multiple evaluation and management charges on the same day were for days 1 to 4.

Patient and Physician Characteristics

The Medicare Denominator File was used to extract information on patient age, sex, and race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, other). Race and ethnicity are obtained by CMS from Social Security files, and are by self-report. Medicaid eligibility was measured in the Medicare Denominator File. The percentage of high school graduates in the patients' zip code area was obtained from the 2013 to 2017 American Community Survey (ACS).[19] Elixhauser comorbidities were assessed based on outpatient, inpatient, and carrier claims in the 12 months before the hospital admission.[20] MEDPAR claims were used to determine the length of stay, admission diagnosis classified by Medicare CCS,[18] residence prior to hospitalization (community vs nursing facility/institution), emergency hospitalization, weekend hospitalization, and the number of hospitalizations in the prior 12 months. The Carrier file was used to describe the number of hospitalist physicians submitting evaluation and charges during the hospitalization. Physician specialty was obtained from the Carrier file. We identified hospitalists as generalist physicians (ie, general internal medicine, family medicine, geriatrics, general practice) with 90% or more of evaluation and management charges generated on hospitalized patients.[21]

Outcomes

ICU transfer was identified by a critical care evaluation and management charge (ie, code 99291 and 99292) starting on day 4 or later (day 5 in sensitivity analyses). We identified the date of drug toxic effects as the first use of a CCS 2617 diagnosis in an evaluation and management claim in the carrier file. CCS2617 includes 490 *ICD-10* diagnoses that are all related to toxic effects from a specific drug and worded as the adverse effect of the drug. Admissions with a diagnosis of drug toxic effects during the first 3 days of hospitalization or during the prior year were excluded.

Statistical Analysis

We describe the association between the number of different hospitalists (1, 2, or 3) submitting evaluation and management charges for a patient during the first 3 days of hospitalization and other patient characteristics using χ^2 tests, with $P < .05$ considered statistically significant. Unadjusted lengths of stay by number of hospitalists were compared with the Kruskal-Wallis test because length of stay was not normally distributed.[22] A multilevel linear regression model (admission and hospital) examined the association of number of hospitalists, adjusted for admission, and hospital characteristics, with length of stay followed by a γ distribution with log link. Unadjusted rates of drug toxic effects and ICU transfer by number of treating hospitalists were compared by χ^2 tests. Multilevel logistic regression models with admissions clustered within hospitals were constructed with admission and hospital characteristics, with either drug toxic effects or ICU transfer as the dependent variable.

In the sensitivity analyses, we restricted the sample to admissions with a length of stay of at least 5 days and counted the number of different hospitalists providing care during days 2 to 4. We excluded the initial charge because it might be more likely to represent services from an on-call physician such as a nocturnist, and, therefore, the number of different internists would reflect both discontinuity and a greater likelihood of an off-hour admission.

All analyses were performed with SAS Enterprise version 7.1 (SAS Institute) at the CMS Virtual Research Data Center.[23] The data were accessed and analyzed from November 1, 2020, to April 30, 2021.

Results

Among the 617 680 admissions, 362 376 (58.7%) were women, with a mean (SD) age of 80.2 (8.4) years. The main cohort included 617 680 medical admissions to 4489 US hospitals who received all their general medical care from hospitalists during days 1 to 3 and with a length of stay of at least 4 days, admitted and discharged between January 16, 2016, to December 31, 2018. Table 1 presents characteristics for all admissions and stratified by the number of different hospitalists providing care during days 1 to 3.

A total of 562 986 admissions (91.1%) were admitted from the community, and 54 694 admissions (8.9%) were admitted from nursing and other facilities; 510 758 admissions (82.7%) were emergency admissions, and 178 748 admissions (28.9%) were admitted on weekends. The same hospitalist provided care during hospital days 1, 2, and 3 in 306 037 (49.6%) admissions, while 2 hospitalists provided care in 274 658 (44.5%) admissions, and 3 hospitalists provided care in 36 985 (6.0%) admissions. Most of the differences in admission characteristics by the number of hospitalists providing care were small but statistically significant because of the large numbers of admissions analyzed (Table 1).

Table 2 presents the association of the number of different hospitalists providing care for an admission during days 1 to 3 with the hospital length of stay and rates of ICU transfer or of a new diagnosis of drug toxic effects on day 4 or later. Unadjusted results and results adjusted for admission and hospital characteristics are presented (Table 2). In the unadjusted analyses, there were significant associations between a higher number of hospitalists providing care and slightly longer lengths of stay and higher rates of ICU transfer and drug toxic effects, but most of these associations were not found in the analyses adjusting for admission and hospital characteristics. For example, unadjusted mean (SD) length of stay in admissions with 1 hospitalist was 5.25 (3.58) days while admissions with 3 hospitalists was 5.40 (4.43) days ($P < .001$ by Kruskal-Wallis test). Meanwhile, there were no changes in adjusted length of stay in admissions that received care from either 2 hospitalists (4.96 days; 95% CI, 4.93–4.98 days) or 3 hospitalists (4.95 days; 95% CI, 4.92–4.99 days) during days 1 to 3 compared with 1 hospitalist (4.94 days; 95% CI, 4.92–4.97 days). There were small but statistically significant increased odds of drug toxic effects in the multilevel model controlling for admission and hospital characteristics; the OR was 1.04 (95% CI, 1.02–1.07) for admissions with 2 hospitalists and 1.07 (95% CI, 1.03–1.12) with 3 hospitalists. There were no significant differences in adjusted analyses between the numbers of hospitalists during the initial 3 days and subsequent ICU transfer. The full models including admission diagnoses and comorbidities and hospital characteristics are shown in eTables 1, 2, and 3 in the Supplement. We tested for interactions between number of hospitalists providing care and specific admission and hospital characteristics and found no interactions.

We performed sensitivity analyses where we eliminated evaluation and management charges from the first day of hospitalization in assessing the number of different hospitalists providing care. We determined the number of different hospitalists providing care during hospital days 2 to 4 and assessed outcomes on day 5 and later. This resulted in a cohort of 396 980 admissions (Table 3). There were no associations between number of hospitalists and either length of stay or ICU transfer. The association between number of hospitalists with subsequent diagnoses of drug toxic effects was similar in magnitude to the analyses in Table 2, although the association of admissions seeing 3 hospitalists with subsequent diagnoses of drug toxic effects was no longer significant (OR, 1.07; 95% CI, 0.97–1.17).

Discussion

In this retrospective study, the underlying hypothesis was that discontinuity in medical care early during hospitalization would lead to higher subsequent complication rates and longer lengths of stay. However, after adjusting for admission and hospital characteristics, we found only a very small association between rates of subsequent drug toxic effects with the number of different hospitalists providing care. We found no significant association between the number of hospitalists providing care and transfers to the ICU or length of stay. Overall, we found little evidence that discontinuities with multiple hospitalists were associated with worse hospital complications.

In an earlier study,[17] we found that admissions receiving care from hospitalists with discontinuous schedules, such as working every third day, experienced higher mortality and readmissions after hospital discharge than admissions cared for by hospitalists with schedules promoting continuity of care, such as working 5 or 7 days in a row. Farid et al[16] reported that patients with high risk admitted toward the end of a hospitalist’s 7-day shift were at higher risk of discontinuity and had a slightly higher postdischarge mortality. While the methods, populations, and outcomes differed greatly between those 2 studies and the current study, it is still surprising that the 3 sets of results lead to conflicting conclusions.

There is an extensive literature on the prevalence, etiology, and consequences of hospital complications.[24–30] Estimates of hospital complications vary depending on definitions, methods of assessment, and types of patients (eg, surgical vs medical patients). Most of the work on the physician’s role in complications has involved studies of postgraduate trainees. Many complications are considered nurse sensitive, with an unclear or unknown contribution by physicians.[27,28,30] We chose transfer to the ICU on day 4 or later as a global indicator of clinical deterioration. We chose the complication of drug toxic effects because drug prescribing is under physician control. However, understanding the relationship between the number of physicians providing care and drug toxic effects is complex. For example, the association of multiple hospitalists with higher risk of diagnoses of drug toxic effects does not necessarily reflect higher real rates of drug toxic effects. Multiple physicians might increase the chances of a drug toxic effects being recognized.

Also, the inclusion of a diagnostic code for a specific drug toxic effects reflects several steps —the occurrence of a drug toxic effects; the correct recognition of the drug toxic effects; and the recording of such an event by adding the diagnosis to the medical record. The frequency and accuracy of each of these steps may vary among physicians.

There are several factors that might contribute to discontinuities in care during hospitalization, including the work schedules of the hospitalists, whether the patient is transferred to a different unit, acute events requiring attention from an on-call physician, and use of part time physicians in areas with shortages of hospitalists. Also, hospitals and hospitalist groups vary in using systems to promote informational and relationship continuity across multiple hospitalists. For example, involvement of house staff, nurse practitioners, or physician assistants with schedules different from the hospitalist's schedules, could ameliorate any adverse impact of having multiple hospitalists during an admission. We could not assess the involvement of such individuals in the Medicare data. However, we indirectly assessed the impact of house officers by testing for interactions between the number of hospitalists providing care and the hospital's teaching status on outcomes. There were no significant interactions, suggesting that the presence of house officers did not influence any relationship between the number of hospitalists and outcomes.

Limitations

This study had limitations. First, we used fee-for-service Medicare data excluding HMO enrollees. Patients in Medicare HMOs, particularly those in staff or group model HMOs, such as Group Health and Kaiser Permanente, would be more likely to have systems in place to increase communication among treating physicians, and thus may have lower rates of complications.[25] Second, as indicated above for drug toxic effects, choosing complications relevant to physician behavior is complex. To assess adverse outcomes, we relied on coded rates of drug toxic effects, which may not be uniform across providers or health systems. Similarly, ICU transfer rates may reflect a more aggressive approach by a physician less familiar with the patient, not severity of a complication. Third, we limited this analysis to older adult medical patients. Surgical patients have a different spectrum of complications that may have different causes.[26,29] Fourth, our sample had a length of stay of at least 4 days in order to get a measure of discontinuity. The Medicare mean length of stay for many diseases is less than 4 days, suggesting that our analysis is skewed toward more complex illness. Also, only full admissions were studied, not observation stays. Fifth, we could not assess the role that nurse practitioners, physician assistants, or house officers might have had in patient care.

Conclusions

Our findings suggest that any association of hospital complications with the number of physicians providing care is minimal at most. This is in contrast with previous studies finding worse posthospital outcomes if multiple physicians provided inpatient care. Electronic health record systems that promote communication among treating physicians may work better in inpatient settings and among full-time hospital clinicians than systems promoting communication across transitions from hospital to posthospital care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key Points

Question

Is decreased continuity of care associated with increased complications in hospitalized patients?

Findings

In this cohort study of 617 680 hospital admissions of Medicare enrollees from 2016 to 2018, individuals who received care from 2 or 3 hospitalist physicians on hospital day 1 to 3 experienced a small increase in risk of drug toxic effects, with no differences in intensive care unit transfers or length of stay.

Meaning

In this study, discontinuity of care early in the hospital stay appeared to be only minimally associated with subsequent hospital complications.

Table 1.

Admission Characteristics Associated With the Number of Different Hospitalist Physicians Providing Care During the First 3 Days of Hospitalization

	Admissions, No. (%)				
		Hospitalists seen during the first 3 d			
Characteristic	**Total**	**1**	**2**	**3**	***P* value**
All	617 680 (100)	306 037 (49.6)	274 658 (44.5)	36 985 (6.0)	
Age quartile, per year					
1 (≥66 to ≤73)	160 586 (26.0)	78 585 (48.9)	72 031 (44.9)	9970 (6.2)	<.001
2 (≥74 to ≤80)	158 226 (25.6)	77 966 (49.3)	70 876 (44.8)	9384 (5.9)	
3 (≥81 to ≤87)	160 506 (26.0)	80 218 (50.0)	70 754 (44.1)	9534 (5.9)	
4 (>87)	138 362 (22.4)	69 268 (50.1)	60 997 (44.1)	8097 (5.9)	
Education quartile, per %[a]					
1 (≤83.0)	155 592 (25.2)	82 311 (52.9)	64 690 (41.6)	8591 (5.5)	<.001
2 (≥83.1 to ≤89.0)	157 402 (25.5)	79 913 (50.8)	68 438 (43.4)	9051 (5.8)	
3 (≥89.1 to ≤93.1)	151 328 (24.5)	72 786 (48.1)	69 106 (45.7)	9436 (6.2)	
4 (≥93.2)	153 358 (24.8)	71 027 (46.3)	72 424 (47.2)	9907 (6.5)	
Year					
2016	195 558 (31.7)	98 394 (50.3)	85 804 (43.9)	11 360 (5.8)	<.001
2017	310 232 (34.0)	104 551 (49.7)	93 018 (44.3)	12 663 (6.0)	
2018	211 890 (34.3)	103 092 (48.7)	95 836 (45.2)	12 962 (6.1)	
Sex					
Male	255 304 (41.3)	125 753 (49.3)	114 080 (44.7)	15 471 (6.1)	<.001
Female	362 376 (58.7)	180 284 (49.8)	160 578 (44.3)	21 514 (5.9)	
Medicaid eligible					
No	484 979 (78.5)	237 752 (49.0)	218 028 (45.0)	29 199 (6.0)	<.001
Yes	132 701 (21.5)	68 285 (51.5)	56 630 (42.7)	7786 (5.9)	
Race					
White	516 940 (83.7)	253 734 (49.1)	232 221 (44.9)	30 985 (6.0)	<.001
Black	54 234 (8.8)	28 036 (51.7)	22 955 (42.3)	3243 (6.0)	
Hispanic	26 701 (4.3)	14 504 (54.3)	10 722 (40.2)	1475 (5.5)	
Other[b]	19 805 (3.2)	9763 (49.3)	8760 (44.2)	1282 (6.5)	
Residence before hospitalization					
Community	562 986 (91.1)	280 540 (49.8)	249 049 (44.2)	33 397 (5.9)	<.001
Nursing facility or other institution	54 694 (8.9)	25 497 (46.6)	25 609 (46.8)	3588 (6.6)	
Emergency hospitalization					
No	106 922 (17.3)	57 130 (53.4)	44 421 (41.6)	5371 (5.0)	<.001
Yes	510 758 (82.7)	248 907 (48.7)	230 237 (45.1)	31 614 (6.2)	
Weekend hospitalization					

	Admissions, No. (%)				
		Hospitalists seen during the first 3 d			
Characteristic	**Total**	**1**	**2**	**3**	***P* value**
No	438 932 (71.1)	214 219 (48.8)	197 408 (45.0)	27 305 (6.2)	<.001
Yes	178 748 (28.9)	91 818 (51.4)	77 250 (43.2)	9680 (5.4)	

[a] Percent of persons older than 25 in zip code area with a high school education.

[b] Other includes Asian, Pacific Islander, American Native, and all other races and ethnicities.

Table 2.

Association of Number of Hospitalist Physicians Providing Care During Hospital Days 1 to 3 With Unadjusted and Adjusted LOS or Subsequent ICU Transfer and Drug Toxic Effects

	Hospitalists per admission, No.		
Outcomes[a]	**1**	**2**	**3**
Admissions, No. (%)	306 037 (49.55)	274 658 (44.47)	36 985 (5.99)
LOS, d			
Unadjusted, mean (SD)	5.25 (3.58)	5.35 (3.71)[b]	5.40 (4.43)[b]
Adjusted, mean (95% CI)	4.94 (4.92–4.97)	4.96 (4.93–4.98)	4.95 (4.92–4.99)
ICU transfer			
No. (rate)	5688 (1.86)	5324 (1.94)	740 (2.00)[c]
Adjusted OR (95% CI)	1 [Reference]	1.03 (0.99–1.07)	1.05 (0.97–1.14)
Drug toxic effects			
No. (rate)	21 316 (6.97)	20 944 (7.63)[c]	2914 (7.88)
Adjusted OR (95% CI)	1 [Reference]	1.04 (1.02–1.07)	1.07 (1.03–1.12)

Abbreviations: ICU, intensive care unit; LOS, length of stay; OR, odds ratio.

[a]All admission and hospital characteristics in eTable 1 in the Supplement were included in the adjusted analyses.

[b]Different from unadjusted LOS with 1 hospitalist from Kruskal-Wallis test,[23] with $P < .001$.

[c]Different from unadjusted rate with 1 generalist by χ^2, with $P < .001$.

Table 3.

Association of Number of Hospitalists Providing Care During Day 2 to Day 4 of Hospitalization With LOS, and With ICU Transfer and New Drug Toxic Effects on Day 5 or Later

	Hospitalists Per Admission, No.		
Outcomes[a]	**1**	**2**	**3**
Admissions, No. (%)	273 780 (68.97)	116 884 (29.44)	6316 (1.59)
LOS, d			
Unadjusted, mean (SD)	6.47 (3.97)	6.38 (3.83)[b]	6.61 (7.57)
Adjusted, mean (95% CI)	7.25 (7.10–7.40)	7.18 (7.03–7.33)	7.34 (7.18–7.51)
ICU transfer			
No. (rate)	5492 (2.01)	2272 (1.94)	135 (2.14)
Adjusted OR (95% CI)	1 [Reference]	0.98 (0.94–1.03)	1.08 (0.91–1.29)
Drug toxic effects			
No. (rate)	21 030 (7.68)	9373 (8.02)[c]	531 (8.41)[c]
Adjusted OR (95% CI)	1 [Reference]	1.04 (1.01–1.07)	1.07 (0.97–1.17)

Abbreviations: ICU, intensive care unit; LOS, length of stay; OR, odds ratio.

[a]The first day evaluation and management charge from each admission was excluded in the determination of which generalist provided care during the admission. This was done because the first evaluation and management charge might be from an on-call generalist or nocturnist if the patient was admitted during the off-hours. All admissions and hospital characteristics in eTable 1 in the Supplement were included in the analyses.

[b]Different from unadjusted LOS with 1 hospitalist from Kruskal-Wallis test,[23] with $P < .001$.

[c]Different from unadjusted rate with 1 generalist from χ^2, with $P < .001$.