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Prescription and Dosage of Analgesic Medication in Relation to Resident Behaviors in the Nursing Home

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Abstract

Objectives—To examine correlates of analgesic medication prescription and administration in communicative, cognitively impaired nursing home residents. Residents' behaviors were assessed using computer-assisted real-time observations as potential adjunctive indicators of pain.

Design—Cross-sectional study over a 4-week period.

Setting—Five nursing homes in the greater Birmingham, Alabama, area.

Participants—Ninety-two residents (mean age $\pm$ standard deviation = 83.86 ± 8.55) with a mean Mini-Mental State Examination (MMSE) score of 13.81 ± 6.34 .

Measurements—Data were obtained via chart review, resident assessments, questionnaire completion by certified nursing assistants familiar with residents' care, and direct observation of residents' daily behaviors.

Results—Receipt of analgesic medication was related to self-report of pain ($F_{2,89} = 9.89$, $P = .0001$), MMSE ($F_{2,88} = 3.98$, $P = .022$), and time spent inactive ($F_{2,89} = 3.04$, $P = .053$). Residents who received analgesic medication reported greater intensity of pain than other residents. Residents who received analgesics had higher MMSE scores than those who did not receive analgesics. Residents who received analgesics spent less time being inactive than those not prescribed analgesics. Receipt of higher dosage of opioid analgesic medication was associated with more time spent with others in verbal interaction ($r = .22$, $P = .03$).

Conclusion—This study refines the methodology of measuring analgesic medication dosage and its effect on resident behavior. Analgesic prescription and administration patterns are related to time residents spend being inactive. Results suggest that opioid analgesics may hold particular promise in alleviating pain, as indicated by resident behaviors.

Keywords

analgesics; nursing homes; dementia; resident behaviors

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Prescription and administration of analgesic medications in nursing homes occur at rates lower than reported need; one-quarter of nursing home residents reporting daily pain receive no analgesic medication.¹⁻³ Residents with low cognitive performance and aged 85 and older, minorities, and individuals already receiving other types of medication are particularly at risk for receiving no analgesic medication.^{1,3-5} The World Health Organization's guidelines for analgesic administration begin with the administration of nonopioid analgesics and move to administration of opioid analgesics. Although these guidelines have been shown to be effective,¹ there is a selective bias against the prescription and administration of opioid analgesics to older adults.^{6,7} In one study, fewer than 25% of postoperative older adults received their mean level of prescribed opioid analgesic medication.⁸

Efforts to quantify and understand analgesic drug use information include pill counts, categories of drugs, and percentage of maximum allowable dosages,⁹ but simple pill counts do not capture the variability inherent in dosage or differences between opioid and nonopioid drugs. Dividing analgesic drugs into particular categories (e.g., opioids, nonopioids) and assessing whether drugs of a particular category are administered does not address the dosage or the analgesic strength of the medication. Estimating the percentage of the maximum daily allowable dosage for particular analgesics taken does not account for differences in analgesic effects across drug categories. Thus, none of these methods adequately provide information on the complexity of quantifying analgesic drug use.

In an effort to provide quantifiable dosage information across analgesic categories, investigators have proposed various means of gauging the analgesic levels patients receive by comparing other opioids to morphine¹⁰ or converting all analgesic drugs to acetaminophen equivalents (Table 1; full table available on request).⁴ Converting all analgesic drugs into one standard unit of measurement for the purpose of measuring analgesic effect on the patient has the advantage of parsimony, but one potential disadvantage of this system is that nonopioid and opioid analgesics have different pharmacological effects and act on different parts of the nervous system. Thus, divergent associations between nonopioid and opioid analgesic dosage and resident functional status and behavior may be expected. In addition to using a standard acetaminophen-equivalent dosage for all analgesics,⁴ the authors of this study proposed considering nonopioid and opioid analgesics separately, using acetaminophen-equivalent dosages for nonopioid analgesics and morphine-equivalent dosages for the opioid component of opioid analgesics.

The specific hypotheses of this study were as follows: first, that nonopioid, opioid, and total analgesic prescriptions and dosage levels would vary as a function of resident cognitive status and self-reported pain; second, that residents' communication ability (normal conversation vs impaired) would be related to analgesic prescription and administration patterns of nonopioid and opioid drugs; and third, that, although greater self-reported pain would be associated with low levels of resident activity and social engagement,^{3,11} higher dosages of analgesic medication would be associated with low levels of activity (the medication was not adequately relieving pain or was resulting in sedation) or with high levels of activity (pain being relieved and residents not being sedated). Results concerning behavioral correlates of analgesic medication levels are of particular importance given the selective bias against prescribing^{6,7} and administering⁸ opioid analgesics to older people. If higher levels of analgesics, particularly opioids, are associated with inactivity, this selective bias might be warranted. If, instead, higher levels of analgesics are associated with more active engagement, there would be indirect evidence that proper use of analgesic medication leads to enhanced quality of life.

Methods

Participants

Participants were enrolled in an intervention study designed to improve communication between nursing home residents and staff via communication skills training and use of external memory aides.^{12,13} This report uses data from the initial 4-week study period. For entry into the study, residents completed a 5-minute semistructured conversation assessing their capacity for spontaneous speech¹⁴ and had to demonstrate use of multiword phrases during the conversation.

Measures

Medication Tracking Form—All medications prescribed for the residents were catalogued on a detailed tracking form used by the research group from the nursing medication administration record. Each individual's medications were assigned a therapeutic classification code.¹⁵ Only nonopioid and opioid analgesics were considered in this study. Residents whose analgesic regimen consisted of only one regular or baby aspirin per day were classified as not receiving analgesics because aspirin may be prescribed for anticoagulation effects.

Analgesic medication dosages were coded in three ways. To measure total analgesic dosage, the two-step standardization procedure used by Horgas et al.⁴ was followed; medications were converted to an equianalgesic oral dosage of acetaminophen or morphine, and approximate equivalence between acetaminophen and morphine was calculated using codeine as a conversion mechanism. Thus, all nonopioid and opioid analgesic medications administered to a resident within the 4-week study period were converted into one total acetaminophen-equivalent dose. Nonopioid analgesic medication dosage was measured separately for all nonopioid analgesics and the nonopioid component of analgesics with nonopioid and opioid parts. This produced a number for each resident representing the total acetaminophen-equivalent dosage administered during the 4-week study period. For all opioid analgesics or the opioid component of mixed analgesics, the total morphine equivalent was calculated.^{1,4,6,7,16,17} This produced data for each resident representing the total opioid analgesic dosage administered and enabled comparison of the effect of nonopioid analgesics to opioid analgesic drugs.

Philadelphia Geriatric Center Pain Measure—The Philadelphia Geriatric Center Pain Measure¹¹ is an adaptation of the McGill Pain Questionnaire¹⁸ and consists of six questions regarding the resident's subjective experience of pain. Each response is scaled from 1 = not at all to 5 = extremely. This provides a composite measure of the experience of pain and has been shown to have high internal consistency in prior research ($\alpha = 0.91$)¹¹ and in this sample ($\alpha = 0.87$).

Mini-Mental State Examination—The Mini-Mental State Examination (MMSE)¹⁹ has been shown to differentiate reliably between individuals with and without global cognitive impairment.²⁰

Charlson Comorbidity Index—The Charlson Comorbidity index²¹ was designed for use in obtaining medical diagnostic information from medical records; scale scores correlate with outcomes such as mortality, postoperative complications, length of hospital stay, and discharge to nursing homes.²²

Functional Independence Measure—Resources for Enhancing Alzheimer's Caregiver Health Version—The Functional Independence Measure—Resources for Enhancing Alzheimer's Caregiver Health Version²³ was developed for the Resources for

Enhancing Alzheimer's Caregiver Health funded by the National Institute of Health (total score range 13–91);²⁴ certified nursing assistants familiar with the daily care of the resident provided information. Reliability data indicate an intraclass correlation coefficient of 0.96 for the motor domain, with unweighted kappas ranging from 0.53 to 0.66.^{23,25}

Computer-Assisted Behavioral Observation System: Hardware and Software—

Real-time Computer-Assisted Behavioral Observation System (CABOS) data were generated using the software programs previously used by the research group^{26,27} and adapted for this intervention study.¹³ Resident behaviors were sampled during half hour periods two times per week between noon and 2 p.m. and 5 p.m. and 7 p.m. for an average total of 4 hours (range 1.52–4.55) over the 4-week study period. These observation periods were chosen because prior research indicated that residents spend more time in verbal interaction during these periods.²⁶ One set of keys coded the resident's location. Another set coded whether the resident was engaged in activity. Two sets of keys coded the residents' social behavior: resident speech in the presence of others and verbal interaction from others directed to the resident. All targeted behaviors were coded with the observed resident as the point of reference. Interobserver agreement was assessed independently among four observers during 12.51% of the total observation time (359.42 hours) and calculated through a second-by-second comparison of the observational files using Cohen's kappa.²⁸ Average kappa reliability across all categories was 0.78 (range 0.58–0.98).

Statistical Analysis

Medication dosages were log-transformed because of the skewed nature of these distributions. Prescription patterns were examined in relation to resident characteristics using chi-square analysis and analysis of variance (ANOVA). Three resident groups were examined: those prescribed no analgesic drugs, those prescribed nonopioid analgesics, and those prescribed analgesics with an opioid component. Nonopioid, opioid, and total analgesic dosage levels were calculated, and administration patterns were examined using chi-square analysis and ANOVA among three resident groups: those not prescribed and therefore not receiving analgesic drugs, those prescribed analgesic drugs as needed who were not administered analgesics, and those prescribed and were administered analgesics. The relationship between residents' communication ability and prescription and dosage/administration categories were examined using chi-square analysis. Correlational analyses with other resident behaviors were conducted using Pearson *r*.

Results

Sample Characteristics

The average age $\pm$ standard deviation of residents ($n = 92$) was 83.86 ± 8.55 (range 61–105); 83% were white and 17% African American. Their average MMSE score was 13.81 ± 6.34 (range 1–29), and their average Functional Independence Measure score was 45.61 ± 22.83 (range 13–89), where higher numbers indicate greater independence. Fifty-nine percent demonstrated normal conversational patterns, whereas 41% demonstrated some conversational impairment.

Chart review indicated that residents' average score on the Charlson Comorbidity index was 2.19 ± 1.68 (range 0–8), indicating a moderate degree of comorbid illness. Twenty-seven residents (29%) had a primary diagnosis of an illness frequently associated with pain.⁴ Only 14% of the sample did not have one of these painful conditions listed in their medical chart at least as a secondary or tertiary diagnosis.

Analgesic Prescription Patterns and Resident Characteristics

Seventy percent of the residents ($n = 64$) were prescribed analgesic medication: 47% ($n = 43$) nonopioid analgesics, 23% ($n = 21$) a drug with an opioid component. On average, the 64 residents who were prescribed any analgesic medication were prescribed 1.67 ± 0.76 nonopioid and opioid drugs during the period of observation (range 1–4). Twenty-one percent of nonopioid analgesics were prescribed on a regular dosing schedule (not as needed), but only 3% of opioid analgesics were prescribed on a regular dosing schedule. This difference trended toward statistical significance ($\chi^2 (1, N = 107) = 2.68, P = .10$).

There was no association between residents' conversational ability in the prescription of analgesic drugs ($\chi^2 (2, N = 92) = 0.86, P = .651$). ANOVA demonstrated no difference between residents not prescribed analgesics, those prescribed nonopioid analgesics only, and those prescribed analgesics with an opioid component in self-reported pain, medical comorbidity, MMSE, functional status, time spent in common areas of the nursing home, resident speech, or speech by others to the resident, but the between-subjects ANOVA with Bonferroni post hoc comparisons revealed that residents who were prescribed opioid analgesics spent less time inactive than residents not prescribed analgesics ($F_{2,89} = 4.25, P = .017$) (52.31 ± 19.02 and 67.86 ± 19.04 , respectively).

Analgesic Dosage/Administration Patterns and Resident Characteristics

Thirty percent of residents ($n = 28$) were not prescribed analgesic drugs, 32% ($n = 29$) were prescribed as-needed analgesic drugs that were not administered during the 4-week study period, and 38% ($n = 35$) were prescribed and administered analgesic drugs. Thirty-two percent of nonopioid as-needed analgesics were administered to residents, and 26% of opioid as-needed analgesics were administered; this difference did not approach statistical significance.

There was no association between residents' conversational ability and the administration of analgesic drugs ($\chi^2 (2, N = 92) = 2.29, P = .318$). ANOVA also demonstrated no difference between analgesic dosage status and medical comorbidity, functional status, time spent in common areas, resident speech, or speech by others to the resident. Nevertheless, several variables did differ by analgesic dosage status, including self-report of pain ($F_{2,89} = 9.89, P = .0001$), MMSE ($F_{2,88} = 3.98, P = .022$), and time spent inactive ($F_{2,89} = 3.04, P = .053$). Residents who received analgesic medication reported greater intensity of pain (2.53 ± 1.08) than those who were not prescribed analgesic medication (1.62 ± 0.95) or those who were prescribed as-needed analgesics that were never administered within the study period (1.58 ± 0.86). Residents who received analgesic medication had higher MMSE scores (15.83 ± 6.29) than those who were prescribed as-needed analgesics that were never administered (11.48 ± 5.82). Residents who received analgesic medication spent less time inactive (56.20 ± 19.55) than those who were not prescribed analgesic medication (67.86 ± 19.04). Those not prescribed analgesic medication did not differ in cognitive status from those administered analgesics.

Associations with Total, Nonopioid, and Opioid Analgesic Dosage

The total amount of analgesic medication in acetaminophen equivalents received by residents during the 4-week study period was significantly associated with greater self-reported pain, higher MMSE, and less time spent in common areas (Table 2). Total analgesic dosage was not related to medical comorbidity, functional impairment, or demographic variables (e.g., age, sex, race), whereas self-reported pain was related to African-American ethnicity, higher MMSE, more medical comorbidity, and less time spent in common areas. Although nonopioid and opioid analgesic dosages were significantly associated with self-reported pain, nonopioid dosage was associated with higher MMSE scores, and opioid analgesic dosage was associated with more speech by others to the resident.

Discussion

These data replicate and extend prior research regarding the relationship between analgesic prescription and dosage patterns in nursing homes and the methodology of measuring analgesic effect on resident behavior. The results of this study suggest that, in nursing home residents selected for the ability to use multiword phrases, analgesic medication prescription and dosage patterns are related to resident activity levels but unrelated to residents' medical comorbidity or functional status. Unlike prior studies,⁴ an analgesic standardization procedure was refined to examine nonopioid and opioid analgesic dosage patterns in addition to total analgesic dosage measured in acetaminophen equivalents. Notably, 86% of this sample had been diagnosed with a painful condition,⁴ but the overall prescription of analgesic medications was only 70%, similar to that found in previous research.^{1,29} The goals of this study were to examine the associations between analgesic prescription (nonopioid, opioid, none) and dosage (administered, as needed not administered, none) and (1) cognitive status and self-reported pain, (2) conversational ability (normal vs impaired), and (3) observed resident activity levels, including time spent in common areas, time spent in no discernible activity, and time spent verbally interacting with others.

Hypothesis 1 was partially supported. No associations between prescription patterns and cognitive status or self-reported pain were found, but residents who were administered analgesic medication reported more pain than those who were not administered or prescribed analgesics.²⁹ As in prior research,^{1,3–5} cognitive impairment was associated with not receiving prescribed analgesic medication.

Hypothesis 2 was not supported. Contrary to expectation, no significant associations were found between conversational ability and analgesic prescription or dosage. It could be that this association was not found because the sample was restricted to those residents with the ability to communicate using multiword phrases. More-refined measurement of conversational ability³⁰ might reveal such patterns of association in these residents.

The observational data (CABOS) revealed interesting findings with regard to the relationships between resident behavior and analgesic prescription and dosage (Hypothesis 3). It was found that residents who were prescribed opioid analgesics spent less time being inactive than those not prescribed analgesic medication, but these groups of residents did not differ in cognitive status, comorbid illness, or functional status. It is possible that opioid analgesics are prescribed to residents who are more active so that these individuals can maintain their levels of activity. It is also possible that these residents are able to maintain more-active engagement with their environments because their pain is relieved.

Individuals who received analgesic medication during the 4-week study period spent less time being inactive than those not prescribed analgesics, but these groups did not differ in cognitive status. Total analgesic dosage and nonopioid and opioid dosage measured separately were significantly associated with self-report of pain. Although residents receiving analgesic medication spent less time being inactive, greater total analgesic dosage was related to less time spent in common areas. Additionally, greater opioid analgesic dosage was related to more time spent with others speaking to the resident. This finding is particularly important when considering the bias against prescribing and administering opioid analgesics in older people.^{6,7} It is possible that these residents required more verbal interaction from others to elicit a response because of the potentially sedating effects of these drugs, but the finding that these residents were less inactive suggests that they were not overly sedated. It is also possible that control of pain via administration of opioid analgesics allowed residents to focus on their social environment with greater active engagement. These intriguing results require further study.

This study has several limitations. The CABOS data were collected as part of a larger intervention study designed to improve effective communication between staff and residents in nursing homes^{12,13} and were not intended to directly measure residents' behavioral expression of pain. Recent and ongoing research suggests that external behavioral cues associated with pain can be measured reliably;⁸ these measures need to be employed to further examine the associations between analgesic administration and resident behavior observed in this study. Nevertheless, a benefit of this secondary data analysis is that observers were not aware of potential associations between analgesic prescription or dosage and resident behavior. Thus, observers were "functionally blind" to the hypotheses of this study.

Another limitation is that the timing of observations centered on periods of high verbal interaction, not necessarily on when residents would likely be engaged in activities. A third limitation is the absence of proxy pain reports such as the Minimum Data Set or the recently developed Proxy Pain Questionnaire.²⁹ Multimodal assessment of pain will likely be the most valid indicator of the relationship between experienced pain, analgesic medications, and resident behavior. Finally, these cross-sectional data require longitudinal replication to adequately explore the intriguing relation between analgesic dosage and resident behavior, focusing on observational assessment of experienced pain, changes in analgesic medication dosage, and resident behavior during periods when residents are most likely to be actively engaged and verbally interactive.

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Table 1
Nonopioid Analgesic Medication/Acetaminophen Equivalent Conversion Chart Examples

Drug	Dose Preparation	Acetaminophen Equivalent
	mg	
Acetaminophen	325	325
Aspirin	325	325
Celecoxib	100	1,300
	200	1,300
Diflunisal	250	650
	500	1,300
Etodolac	200	867
	300	1,300
	400	1,733
	500	2,167
Ibuprofen	100	81
Nabumetone	500	650
	750	975
Naproxen	250	650
	375	975
	500	1,300
Naproxen sodium	275	650
Oxaprozin	600	2,600
	1,800	3,900
Piroxicam	10	325
	20	650
Rofecoxib	13	650
	25	650
Sulindac	150	1,800

Table 2
Pearson Correlation Coefficients for the Log Transformation of Total, Nonopioid, and Opioid Analgesic Dosages

Variable	Total [*]	Nonopioid [*]	Opioid [†]
Age	.04	.04	.01
White	.04	.06	-.01
Female	.05	.04	.05
Pain report	.51 [§]	.36 [§]	.27 [§]
Charlson Comorbidity index	-.03	-.08	.05
Mini-Mental State Examination	.27 [§]	.21 [‡]	.15
Functional Independence Measure	.16	.14	.05
Observed resident speech	.11	.08	.09
Speech to the resident	.11	.00	.22 [‡]
Common area	-.26 [‡]	-.19	-.19
No activity	-.19	-.14	-.19

^{*} Measured in mg of acetaminophen equivalents.

[†] Measured in mg of morphine equivalents.

[‡] $P < .05$;

[§] $P < .01$.