

# Comparison of patients' ratings and examination of nurses' responses to pain intensity rating scales

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*Patients' ratings of pain intensity are an important component of a comprehensive assessment of pain. Although a 10-cm visual analog scale (VAS) is recommended for quantifying subjective pain intensity, a 0 to 5 point numerical rating scale (NRS) is commonly used. These two scales are often viewed as interchangeable or mathematically equivalent, with a 2 on a 0 to 5 point scale seen as equal to a 4 on a 10-cm VAS. The purposes of this study were to compare patients' pain ratings on each scale and to examine nurses' responses to mathematically equivalent pain ratings. Results indicated that patients do not rate their pain in a mathematically equivalent way. VAS ratings were lower than NRS ratings, and more than three quarters of patients provided ratings that were not mathematically equivalent. In addition, nurses provided with fictitious patient scenarios did not provide the same pain medication for equivalent ratings and chose smaller analgesic doses in comparison with experts.*

**Key Words:** Pain—Pain measurement—Neoplasms—Cancer—Self-report.

Although considerable attention has been given to improving pain management practices, the effective relief of pain for the adult cancer patient is a continuing problem (1-4). If cancer pain is to be managed effectively, a careful, systematic approach to the problem is required. A thorough and accurate assessment, appropriate choice of treatment, and evaluation of the effects of treatment are key components of a successful pain-management program (1,2). The assessment of pain provides a foundation for later treatment planning. Subjective pain intensity is an essential part of pain assessment (1,5) and is generally measured by a visual analogue scale (VAS) or numerical rating scale (NRS) (6).

Although a variety of scales are available for quantifying pain intensity, one of the preferred methods for assessing subjective pain intensity is the VAS. Experts in the field of pain management recommend using a 10-cm VAS with anchor words at each end (2). In practice, however, a 6-point numerical rating scale (NRS) with 0 meaning no pain and 5 meaning severe pain is commonly used.

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## PURPOSE

The purpose of the present study was to examine the use of a 0 to 5 point NRS and a 10-cm VAS in relation to (a) correlation of patients' responses to the scales, (b) influence of the different scales on nurses' decisions to medicate fictitious adult patients, and (c) comparison of nurses' and experts' medication choices. The following research questions were addressed: Do patients give numerically equivalent ratings on the two scales [rate 2 on the NRS (0 to 5) and 4 on the VAS (0 to 10)]? Do nurses' decisions regarding analgesic administration differ when a numerical equivalent is given on each of the two scales (different medication or dosage for a 2 on the NRS and a 4 on the VAS)? How do nurses' medication choices compare with experts' choices on each scale? Do nurses' medication choices approximate experts' choices more closely on either scale?

## LITERATURE REVIEW

Three studies have examined the similarities between scales used to measure pain intensity. Fifty subjects with chronic pain were asked to rate pain intensity on a 10-cm VAS, choose a number reflecting pain intensity on a 0 to 100 scale, and choose among five words describing pain. All three of the scales yielded similar results (7). However, no correlations were cited, and it is not clear how the word descriptors were quantified. Similarly, a high correlation ( $r = 0.92$ ,  $p < 0.001$ ) was reported between patients' ratings on a 10-cm VAS and a 6-point NRS (8). Subjects included 29 outpatients and 11 inpatients diagnosed with cancer.

Wilkie et al. (9) found strong correlations between pain ratings on a 10-cm VAS and a 10-point pain intensity numbered scale. Fifteen adults with cancer were asked to provide ratings on the scales at four different points in time. Correlations at times one through four were 0.89, 0.88, 0.77, and 0.82, respectively ( $p < 0.001$  for all correlations).

Questions remain regarding possible differences in the clinical application of the 0 to 5 point NRS and the 10-cm VAS. Research has not addressed the question of whether the particular rating scale used influences patient outcomes in terms of pain relief. No information is available as to which type of rating scale leads to the most effective pain relief for patients. This lack of information leaves health-care professionals with little guidance regarding which rating scale to use. Although 59% of 53 oncology and

medical surgical nurses surveyed indicated that they routinely used a pain intensity rating scale to assess pain, they used a variety of methods. Forty-nine percent used a 1 to 10 point scale, 24% used a 0 to 5 point scale, 17% used a 0 to 10 point scale, and 10% used a 1 to 5 point scale (10).

Further research needs to be conducted to examine the patient's response to the most frequently used scales. The scale that best describes patients' pain intensities should be the scale of choice. To date, no systematic investigations of nurses' responses to different scales have been conducted. Because nurses play such an important role in the treatment of patients' pain, it is important to understand their responses to different pain rating scales. One scale may better facilitate pain relief depending on how nurses respond to that scale in terms of medication choice. This study examined patients' ratings and nurses' responses to two commonly used pain rating scales.

## METHODS

### Subjects

A 32-bed oncology unit in a community hospital located in the southeastern United States was chosen for the setting. Patients were included in the study if they were (a) >18 years of age and (b) experiencing cancer pain. Given that 70% of patients with cancer patients experience pain (2), this population was deemed appropriate for the study. A power analysis with  $\alpha = 0.05$  and power = 0.95 indicated that a sample size of 50 was adequate to find a significant correlation of 0.45 (11). Nurses were included in the study if they were (a) registered nurses and (b) employed by the oncology unit. The nurse sample was limited to registered nurses because they have primary responsibility for oral and intravenous analgesic administration in this setting.

### Instruments

#### 10-cm VAS

The 10-cm VAS is a popular and valid method for assessing the intensity of pain, including cancer pain (6). A horizontal line 10-cm in length is anchored by the words "no pain" (left end) and "worst possible pain" (right end). Patients were shown the VAS, and the phrases used as endpoints were read aloud by the investigator, who instructed them to "Show me how intense or bad your pain is now by drawing a line straight up and down along this horizontal line at the

point of your pain." Pain intensity was recorded as the length of a line to the nearest millimeter starting from the no pain end to the line drawn by the patient.

#### *6-Point NRS*

The 0 to 5 point NRS is a commonly used and valid method for assessing cancer pain (8). Patients were implored to "Rate how intense or how bad your pain is now from 0 to 5; 0 is no pain and 5 is the worst possible pain." Pain intensity was recorded as the number supplied by the patient.

#### *Fictitious Patient Scenarios*

Nurses were given an investigator-designed questionnaire that contained a total of six patient scenarios. Each scenario included the name, age, and pain intensity of a fictional cancer patient. The six scenarios were divided into a pair of patients with similar ages having mathematically equivalent mild pain (patient Little, 1.5 on the NRS; patient Brown, 3 on the VAS); a second pair of patients with similar ages and mathematically equivalent moderate pain (patient Woods, 2.5 on the NRS; patient Potter, 5 on the VAS); and a third pair of patients with similar ages and mathematically equivalent severe pain (patient Green, 4 on the NRS; patient Rice, 8 on the VAS). Below are the scenarios for the fictional patients with severe pain that illustrate that their only difference was in relation to the scale used to communicate pain intensity.

Patient Green is 74 years of age and has cancer. Green's pain intensity is 4 out of 5 points (scale of 0 = no pain, 5 = worst pain). Choose a treatment from 1 to 6.

Patient Rice is 70 years of age and has cancer. Rice's pain intensity is 8 out of 10 points (scale of 0 = no pain, 10 = worst pain). Choose a treatment from 1 to 6.

Background information, such as medication history, was excluded so that patients within a pair were comparable. Pairs of patients at each pain intensity were considered as equivalent by the investigators, differing only on the scale used to rate their pain. For example, treatment choices nurses made for patients Green and Rice could be compared because these fictional patients differed only on the scale used to communicate their pain.

Nurses were asked to respond to each scenario by choosing between six treatment choices that could be used more than once. Treatments were based on

common medication choices and equianalgesic dosing. Each medication choice increased by 2 mg morphine sulfate, differing only in route, onset, and duration of action. Choices included (a) no analgesic, (b) one Percocet (Schein Pharmaceuticals) by mouth every 4 h as needed for pain, (c) two Percocets by mouth every 4 h as needed for pain, (d) morphine sulfate 6 mg i.v. every hour as needed for pain, (e) morphine sulfate 8 mg i.v. every hour as needed for pain, and (f) morphine sulfate 10 mg i.v. every hour as needed for pain. Nurses were asked to choose which order was appropriate for each of the six fictional cancer patients on the basis of pain intensity. Each nurse's medication choices were compared to determine if patients with mathematically equivalent pain intensity ratings were medicated similarly.

Content validity was established by a review panel of three expert, masters-prepared oncology nurses. Test-retest reliability on each item was conducted using 14 practicing oncology registered nurses. Correlation coefficients ranged from 0.40 to 0.74. One coefficient was 0 due to lack of variability in nurses' medication choices for the scenario, with pain intensity 2.5 out of 5. Treatment 4 (morphine sulfate 6 mg i.v. every hour as needed for pain) was chosen by 10 nurses on the pretest and 12 of the 14 nurses on the posttest. The lack of variability among these 14 nurses' choices resulted in a test-retest correlation of 0 for this one item.

#### **PROCEDURE**

Investigators asked each nurse (registered nurses and licensed practical nurses) on the oncology unit to provide room numbers of patients experiencing cancer pain. Few patients experiencing pain were identified. By approaching each patient on the unit sequentially, investigators determined that nurses were often not aware of patients' pain and could not be relied upon to identify potential subjects. Investigators continued sequentially inviting each patient on the unit to participate in the research regarding pain scales. Data on age, gender, diagnosis, and pain intensity were collected. Order of presentation of the pain scales was randomized. When obviously non-equivalent ratings were provided by a patient, the investigator assessed understanding of the rating scales and verified the patient's communicated pain intensity. Patients were not forced to choose a whole number on the 0 to 5 point NRS (i.e., 3 or 4) if they interpreted the scale as containing whole and half numbers (i.e., 3.5). Information on patients without

**TABLE 1.** Demographic characteristics of patients  
(*N* = 50)

Age range (yr)	28–81 (mean = 58)
Gender	
F	35 (70%)
M	15 (30%)
Cancer by primary site	
Lung	12 (24%)
Hematopoietic	6 (12%)
Lymphoma	6 (12%)
Breast	5 (10%)
Colon	5 (10%)
Pancreas	3 (6%)
Bone	2 (4%)
Ovary	2 (4%)
Stomach	2 (4%)
Cervix	1 (2%)
Liver	1 (2%)
Prostate	1 (2%)
Rectum	1 (2%)
Esophagus	1 (2%)
Unknown primary	2 (4%)

pain was not collected. Of those patients experiencing pain, one was <18 years of age and therefore excluded and five refused to participate, four due to fatigue.

Each registered nurse meeting the inclusion criteria was approached individually by the investigator and asked to complete the patient scenarios and a demographic data form after informed consent was obtained. Of the 25 registered nurses employed by the oncology unit, 24 agreed to participate. One registered nurse refused due to a heavy workload.

## RESULTS

Demographic characteristics of the patients are listed in Table 1. Patients represented a variety of ages and cancer diagnoses.

Demographic characteristics of the nurses are listed in Table 2. The number of A.D.N.-prepared nurses was equivalent to the number of B.S.N.-prepared nurses.

### Statistical Analysis

#### Patients

Patients' ratings of pain intensity on the 0 to 5 point NRS and the 10-cm VAS are described in Table 3.

In order to examine mathematical equivalence, descriptive statistics for the 0 to 5 point NRS were doubled and compared with those of the 10-cm VAS. The doubled mean, median, and mode of the NRS were not equivalent to the mean, median, and mode

**TABLE 2.** Demographic characteristics of nurses  
(*N* = 24)

Age (yr)	
20–30	<i>n</i> = 8 (33%)
31–40	<i>n</i> = 13 (54%)
41–50	<i>n</i> = 3 (13%)
Education	
Diploma	<i>n</i> = 1 (4%)
A.D.N.	<i>n</i> = 11 (46%)
B.S.N.	<i>n</i> = 11 (46%)
M.S.N.	<i>n</i> = 1 (4%)
Employment status	
Full-time	<i>n</i> = 19 (79%)
Part-time	<i>n</i> = 2 (8%)
Pool (prn)	<i>n</i> = 3 (13%)
Oncology-certified nurses	<i>n</i> = 6 (25%)
Experience (yr)	
Nursing	mean 6 ± 4.75, range 1–17
Oncology nursing	mean 4.4 ± 3.8, range 0–12

of the VAS. Scores on the 10-cm VAS were an average of 1.5 points lower and ranged from 8 points lower to 2 points higher than doubled scores on the NRS.

A significant difference was found between patients' responses to the two scales ( $t = -6.32$ ,  $p < 0.001$ ). As shown in Table 4, wide discrepancies existed between patients' ratings of pain on the two scales. Only 12 of the 50 pairs (24%) of ratings were mathematically equivalent. Scores were considered mathematically equivalent if doubled 0 to 5 point NRS ratings corresponded to 10-cm VAS ratings. For example, a patient's rating of 2 on the NRS was doubled to four and compared with his or her rating on the VAS. If the 10-cm VAS score was between 3.5 and 4.4, the NRS and VAS ratings were considered mathematically equivalent. Although major differences are apparent in patients' ratings of pain (Table 4), a correlation of 0.78 ( $p < 0.001$ ) was calculated on the two sets of ratings.

#### Nurses

Correlation coefficients between medication selections made by nurses for fictional patients with

**TABLE 3.** Patients' pain intensity ratings

	NRS <sup>a</sup>	VAS <sup>b</sup>
Mean	2.9	4.28
Median	3	3.85
Mode	3	1.8
Standard Deviation	1.26	2.63
Range	0.5–5	0.6–10

<sup>a</sup> NRS: 0 = none, 5 = worst possible pain, scale administered verbally.

<sup>b</sup> 10-cm VAS: no pain (left end) to worst possible pain (right end).

**TABLE 4.** NRS (0-5) and VAS (10 cm) pain intensity ratings for each patient

NRS	VAS
0.5	<b>0.8</b>
1	0.6
1	0.7
1	1
1	<b>1.5</b>
1	<b>1.9</b>
1	<b>2.3</b>
1.5	1.7
1.5	3.9
2	0.7
2	1.5
2	1.7
2	1.8
2	2.3
2	2.5
2	2.7
2	<b>3.8</b>
2.5	1.8
2.5	3.8
3	0.8
3	0.8
3	3.3
3	3.4
3	3.6
3	3.7
3	3.9
3	4.5
3	4.8
3	4.9
3	5.3
3	<b>5.6</b>
3	<b>5.8</b>
3	7
3	8
3.5	5
3.5	5.2
3.5	<b>7.3</b>
3.5	<b>7.3</b>
4	5.7
4	6.2
4	6.3
4	<b>8</b>
4.5	<b>9.2</b>
5	2
5	5.9
5	6.6
5	8.3
5	8.3
5	9.1
5	<b>10</b>

Boldfaced scores are mathematically equivalent, meaning NRS ratings multiplied by 2 = VAS ratings rounded to the nearest whole integer.

mathematically equivalent ratings were calculated. Two correlations were weak: nurses' treatment choices for (a) pain 3 of 10 points and 1.5 of 5 points ( $r = 0.14$ ,  $p = 0.51$ ) and (b) pain 5 of 10 points and 2.5

of 5 points ( $r = 0.18$ ,  $p = 0.41$ ). The third correlation was moderate: pain 8 of 10 points and 4 of 5 points ( $r = 0.58$ ,  $p = 0.003$ ). Correlations indicate that nurses' treatment choices were more consistent between scales when pain intensity was severe.

Nurses' treatment choices were examined for diversity and compared with experts' treatment choices in Table 5. Experts included three masters-prepared oncology nurses, all of whom reached consensus on optimal treatment choices for each patient scenario.

Nurses' treatment choices were consistently lower on an equianalgesic basis than experts' treatment choices. Depending on fictional pain level, 70.8% to 91.7% of nurses chose a smaller equianalgesic dose than did experts.

## DISCUSSION

Both the 0 to 5 point NRS and the 10-cm VAS are thought to be valid measures of clinical pain (12). In this study, patients rating their pain sequentially on each scale did not provide the nurse with similar kinds of information. Patients who rated their pain a 2 out of 5 points were unlikely to rate their pain a 4 out of 10 points. Although ratings overall on the 10-cm VAS tended to be lower than ratings on the 0 to 5 point scale, in some cases there was little apparent relationship between ratings. For example, in one case a patient rated pain as 5 on the 0 to 5 point NRS, indicating severe pain, but as 2 on the 10-cm

**TABLE 5.** Frequency of nurses' medication choices for scenario pain intensity ratings in comparison with experts' choices

Pain intensity	Medication choices <sup>a</sup>					
	1	2	3	4	5	6
1.5 of 5 <sup>b</sup>	2	19	3 <sup>c</sup>			
3 of 10 <sup>d</sup>		17	7 <sup>c</sup>			
2.5 of 5 <sup>b</sup>		1	20	3 <sup>c</sup>		
5 of 10 <sup>d</sup>		2	18	4 <sup>c</sup>		
4 of 5 <sup>b</sup>			1	12	6	5 <sup>c</sup>
8 of 10 <sup>d</sup>			1	12	9	2 <sup>c</sup>

<sup>a</sup> 1, no medication; 2, one Percocet by mouth every 4 h as needed for pain; 3, two Percocet by mouth every 4 h as needed for pain; 4, morphine sulfate 6 mg i.v. every 1 h as needed for pain; 5, morphine sulfate 8 mg i.v. every 1 h as needed for pain; 6, morphine sulfate 10 mg i.v. every 1 h as needed for pain.

<sup>b</sup> NRS: 0, no pain; 5, worst possible pain.

<sup>c</sup> Experts' choice of treatment.

<sup>d</sup> 10 cm VAS: no pain (left end), 0 cm; worst possible pain (right end), 10 cm.

VAS, indicating mild pain. The clinical importance of this finding is apparent when one considers that a nurse would medicate this patient differently depending on which scale was used to elicit the pain intensity rating. Some of the extreme differences found between the ratings may be due to the different processes used, i.e., visual versus aural or a patient's difficulty in switching from one method of assessment to another. Even though patients responded to the scales sequentially, they did not tend to double or halve their ratings depending on the order of presentation. Two patients responded verbally that the scales were "not at all the same."

Although further research in this area is recommended, the results of this study suggest that the 0 to 5 point NRS and the 10-cm VAS should not be used interchangeably in the same setting. It appears that patients give different kinds of information relative to the severity of their pain depending on the scale used.

Nurses in this study did not medicate the fictional patients in a mathematically equivalent manner. A wide variation in the nurses' choices of medications was evident when the patient's pain was mild or moderate. A patient with a rating of 2 on the 0 to 5 point NRS was medicated differently from the same patient who rated pain as a four on the 10-cm VAS. Two nurses chose to give no medication for mild pain (1.5 out of 5) on the 0 to 5 point scale but gave either one or two Percocets for mild pain (3 out of 10) on the 10-cm scale.

Nurses responded to severe pain in a more consistent fashion. As patients' ratings moved closer to the top of each scale, nurses' choices of medications were more similar. Findings relative to the lack of consistency of nurses' medication choice are surprising in that the paper and pencil questionnaire used could have suggested the notion of mathematical equivalence between rating scales. Even so, nurses chose to medicate patients differently based on the scale used.

In relation to the nurse's decision-making regarding the effective management of pain, the findings of this study support prior research (3,4,13). Nurses were not aware of many patients on the unit who were experiencing pain and undermedicated fictional patients in comparison with experts. Medication choices for patients reporting severe pain on both scales ranged from two Percocets (equivalent to 4 mg of morphine sulfate) to 10 mg of morphine sulfate. One nurse never gave more than two Percocets; her

medication choices for both moderate and severe pain did not vary.

In summary, these findings suggest that consistency in the use of a scale to measure pain intensity is an important factor in the management of pain. Neither nurses nor patients interpreted the 0 to 5 point NRS and the 10-cm VAS in a similar manner. Patients' reports of pain and nurses' selection of medications varied considerably depending on the scale used.

Findings also suggest that efforts to educate nurses to the importance of adequately medicating patients in pain should continue. Some of the unanswered questions are as follows: Does an aural versus a verbal presentation of a rating scale make a difference in the patient's report of pain intensity? Is there more agreement among nurses as to how severe pain should be medicated versus mild or moderate pain? Do numbers themselves, i.e., a 2 out of 5 versus a 4 out of 10 connote a different meaning to a nurse? Which method of eliciting a patient's report of pain intensity results in the most effective pain management? Research in these areas may help clarify some of the difficult issues inherent in the assessment of pain. In addition, caution is suggested when interpreting the correlations found between pain intensity ratings using different scales. In this study, an examination of the patient ratings on the two scales showed serious clinical differences, although a strong correlation was found. □

## REFERENCES

1. Cleeland C. Research in cancer pain: What we know and what we need to know. *Cancer* 1991;67:823-7.
2. Grossman SA, Sheidler VR, Swedeen K, Mucenski J, Piantadosi S. Correlation of patient and caregiver ratings of cancer pain. *J Pain Symptom Management* 1991;6:53-7.
3. Myers JS. Cancer pain: assessment of nurses' knowledge and attitudes. *Oncol Nurs Forum* 1985;12:62-6.
4. Vortherms R, Ryan P, Ward S. Knowledge of, attitudes toward, and barriers to pharmacologic management of cancer pain in a statewide random sample of nurses. *Res Nurs Health* 1992;15:459-66.
5. Harrison A. Assessing patients' pain: identifying reasons for error. *J Adv Nurs* 1991;16:1018-25.
6. Chapman CR, Casey KL, Dubner R, Foley KM, Gracely RH, Reading AE. Pain measurement: an overview. *Pain* 1985;22:1-31.
7. Kremer E, Atkinson JH, Ignelzi RJ. Measurement of pain: patient preference does not confound pain measurement. *Pain* 1981;10:241-8.
8. Ahles TA, Ruckdeschel JC, Blanchard EB. Cancer related pain II. Assessment with visual analog scales. *J Psychosom Res* 1984;28:121-4.

9. Wilkie D, Lovejoy N, Dodd N, Tesler M. Cancer pain intensity measurement: concurrent validity of three tools—finger dynamometer, pain intensity number scale, visual analog scale. *Hosp J* 1990;6:1-13.
10. Ferrell BR, Eberts MT, McCaffery M, Grant M. Clinical decision making and pain. *Cancer Nurs* 1991;14:289-97.
11. Cohen J. *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum, 1988.
12. Price DD, Bush FM, Long S, Harkins W. A comparison of pain measurement characteristics of mechanical visual analogue and simple numerical rating scales. *Pain* 1994;56:217-26.
13. Paice JA, Mahon SM, Faut-Callahan M. Factors associated with adequate pain control in hospitalized postsurgical patients diagnosed with cancer. *Cancer Nurs* 1991;14:298-305.