Sources of Measurement Error in Evidence Based Research

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Purpose

The purpose of this study is to describe the potential sources of error in the accuracy and completeness of data collected from participants in a descriptive clinical study. The results of this study will assist the research team in evaluating the role intrinsic and extrinsic sources of error play in study implementation, and identify those that can be eliminated or mitigated to assure the integrity of study findings.

The specific aims were to:

1. Examine extrinsic factors that might interfere with data collection
2. Examine intrinsic factors that might interfere with data collection
3. Explore ways to minimize measurement error such as improving patient-interviewer rapport, building confidence, and using more efficient data collecting instruments to collect data in order to minimize errors.

Background

There are numerous sources of error in the observation and measurement of data in evidence-based research. Due to the increasing demands of patient-based research, often research participants and researchers commit errors that account for various inconsistencies in data. When these inconsistencies occur, the data then becomes faulty and the research itself is not producing genuine results. This can lead to incorrect findings and thus skew the research entirely.

Measurement error is common in evidence-based research when using patient self-report questionnaires as a data-collecting instrument in hospital units. When the patient population is elder, additional factors may influence the validity and reliability of data.

This study is part of a larger research project that examines differences in patient satisfaction with the care they receive while hospitalized for a cardiac condition and their practice of health promoting behaviors after discharge. The study is being conducted at a university hospital, in Philadelphia, Pennsylvania.

Methods

Design. This descriptive observational study examines sources of measurement error and barriers to accurate data collection that may arise in the context of implementing a larger comparison study. The parent study examines differences in care outcomes as a function of provider training (nurse practitioner versus traditional house staff) and relies entirely on patient self-report and therefore depends on the accuracy, truth, and completeness of data on patient satisfaction, health promoting behaviors, and patient knowledge of their condition

Sample and Location. The method of sampling for this particular study was convenience (accidental) sampling. The study was conducted on three units at Hahnemann University Hospital, 17 North Tower, 20 North Tower, and 21 North Tower. These are all cardiac care floors. In addition, patients may be placed on telemetry and/or require critical and trauma-related care.

Patient census varies by unit and time of day. On 17 NT there are 55 beds and on average around 30% of these are occupied. On 20 NT there are 50 beds and on average 56% are occupied. On 21 NT there are 50 beds at any given time around 60% are occupied.

A typical patient on one of these floors is between the ages of 50-85. For most, their cardiac condition is coupled with another disease and/or underlying medical issue.

Data Collection. Potential sources of measurement error were divided into two types: "extrinsic factors" and "intrinsic factors" as they related to the patient. *Intrinsic factors* included: a) average age of patients, b) physical limitations, c) arthritic conditions, and d) vision problems. *Extrinsic factors* included: a) number of physicians on the unit, b) level of noise, c) average amount of time physician spent in room, d) treatments scheduled, and e) numbers of visitors.

Instruments/Measures. Data were collected in repeated measures over time and imported into Excel spreadsheets that designated: type of factor, time of day, and number of floor, etc. These spreadsheets were updated twice a day, each day, for two weeks.

Procedures. Intrinsic factors were tabulated via chart review of the patients on the floor to see if they possessed any of the characteristics on the list. Charts were checked daily to ensure that not only were new patients included but to also ensure that prior charts were re-reviewed in case new findings were discovered. Extrinsic factors were observed and calculated without chart review as most of the variables could be visually observed. The date of collection began July 23rd and ended on August 7th.

Table 1

	17NT	20NT	21NT
July 23rd	2	1	3
July 24th	2	1	1
July 25th	2	2	1
July 26th	2	2	1
July 29th	1	2	2
July 30th	1	1	1
July 31st	2	2	2
August 1st	1	1	1
August 2nd	1	2	1
August 3rd	2	2	1
August 4th	1	1	2
August 5th	3	3	1
August 6th	2	1	1
August 7th	2	2	3

Results

Data were analyzed using descriptive statistics including measures of central tendency (means and standard deviation) and measures of variability (percentages, frequencies, and standard deviations)
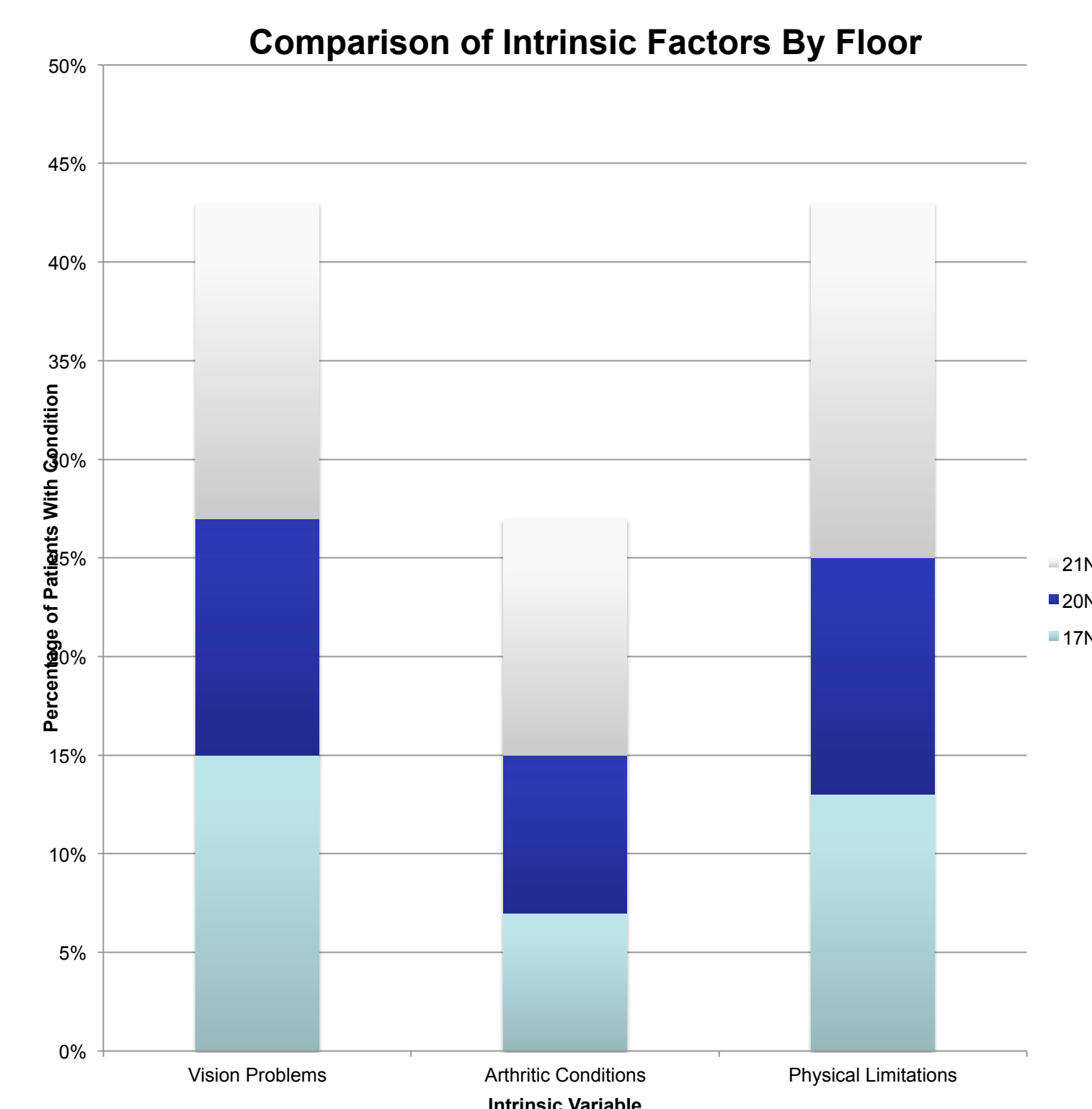
Extrinsic Factors

On 17NT, the mean level of noise was 1.714 and the standard deviation was 0.589 when averaging both the morning and afternoon levels of noises. On 20NT, the mean level of noise was 1.679 and the standard deviation was 0.758 when averaging both the morning and afternoon levels of noise. On 21NT, the mean level of noise was 1.393 and the standard deviation was 0.557 when averaging both the morning and afternoon levels of noise. Table 1 compares the average levels of noise on each floor throughout the fourteen day data collection period in a table. The level of noises were quantified with a Likert Scale in which 1 translates to soft levels of noise, 2 translates to moderate levels of noise, and 3 translates loud levels of noise.

Intrinsic Factors

On 17NT, the average number of patients with vision problems was 8, the average number of patients with arthritic conditions was 4, and the average number of physical limitations was 7. On 20NT, the average number of patients with vision problems was 6, the average number of arthritic conditions was 4, and the average number of physical limitations was 7. On 21NT, the average number of vision problems was 8, the average number of arthritic conditions was 6, and the average number of patients with physical limitations was 9. Figure 1 compares the various intrinsic factors by prevalence and floor.

Figure 1

Comparison of Intrinsic Factors By Floor

Discussion

It has become increasingly clear that various extrinsic and intrinsic factors exist that may pose barriers to the collection of accurate and complete data from study subjects. These factors have clear sources of measurement error. In general, one might expect that elderly patients will have a high frequency of vision and arthritic problems which may contribute to their difficulty in both reading self-measurement data collection tools and in responding to them (should the questionnaire or data collecting instrument require writing or filling in boxes/checking off squares). In addition, extrinsic factors such as the number of treatments on a floor or the level of noise can also distract a participant and deter them from answering a question genuinely or properly.

Commonly found in the elderly population is a strict adherence to levels of hierarchy, especially when it comes to their medical care. An elderly patient might be hesitant to provide negative comments on surveys that solicit opinions of medical/nursing care. Due to this, truthfulness in self-measurement surveys is often skewed.

Response set biases may be mitigated when the interviewer builds rapport and trust with the individual participating in the study. Interviewees are less likely to acquiesce to the answers an interviewer desires if they feel a certain level of comfort or trust exists between themselves and the interviewer.

Conclusion

Research is still being conducted into how to lessen measurement error in nursing research, though it remains a pressing problem due to the difficult nature of the issue itself. Measurement error is a prevalent, but poorly understood problem because it is often difficult to measure and even more difficult to correct. Though sources of measurement error will always exist when collecting data for evidence-based research, it is the desire of many to ensure that the statistics for such continue to trend downward as more precautions are taken.

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