Randomness in nursing research – who needs it?

By Cathy Carter-Snell, RN, MN, ENC(C), SANE-A

This article is one of a series in which we explore aspects of research interpretation that are relevant to emergency nurses. Here, we review the concepts of random selection and random assignment and their importance to nursing research designs. We look at the definitions of both and explore the major types of research designs. Implications for participating in research and interpreting research are suggested.

You are reading a research report about something in your practice and the authors discuss random selection techniques. In another article, they state they randomly assigned patients by entering every fourth patient into a group. Each researcher makes conclusions about how the concepts being studied caused the outcome. Is this reasonable? The next night you see a patient who meets the criteria for the latest stroke study, but you are too busy to call the research assistant. Will this be an issue for the researchers? In order to answer these questions, we need to explore the concepts of random selection and assignment. We then need to look at various types of research designs and their focus to decide if randomness is important to the study or properly conducted.

Random selection and assignment

Random is defined as "without an identifiable pattern, plan, system or connection" (Encarta, n.d.). Random selection is performed when identifying patients to participate in a study. Each patient who meets the research criteria has an equal probability of being selected for the study, but not all patients are chosen. Some researchers mistakenly assume that if they choose every second or every third patient, or only patients on every third day who comes in, that they are randomly selecting. In fact, there is a pattern to this as well and it is possible that events such as time of day, the staff that is on a similar rotation or other cycles could impact on the characteristics of the group. In order to be truly randomly selected, use of random numbers tables is recommended. These tables are found in the back of most statistics textbooks and a sample is shown in Table One.

In looking at the table, consider you wish to study patients who arrive with asthma in the emergency. Suppose you wanted 20 patients in the study and saw 60 patients in a week with asthma. We look at the table and see all numbers in the table are much larger than two digits. Instead, look at the first two digits of the first number, since the number 60 is only two digits. The first number is 46, so the 46th patient who came in with asthma would be part of the study. Then follow the column downward to identify the next number between one and 60 without using duplicates. The next number is 69 so would be ignored. Below that is 14 so we would take the 14th patient as well. This process continues until you have 20 patients. You can see this may cause some problems in emergency. We don't know how many patients will be coming into emergency with a particular condition on a given evening or even during the study period. We then have to gather data about how many patients we would anticipate during the study period and then pre-select and pre-assign the numbers from the random numbers table. Then, we need someone in the department to track what number each asthma patient would be to know when to approach someone about the study. This is labour-intensive and clinically not realistic.

You will know if non-random selection was used when you hear terms such as "convenience sample", "quota sample", "purposive sample" and "stratified sample". Convenience sampling or selection involves using all of the available people in a group until the desired number of participants is obtained. In our asthma example, it would mean the first 20 asthma patients in our emergency. This sample is unlikely to represent all asthma patients and, in fact, may have unusual numbers of some particular characteristic or symptom if from the same geographic area or unit. A convenience sample is the weakest form of selection, yet is the most commonly used method in nursing research and has the greatest potential for the greatest bias, especially if the population has very diverse characteristics (Polit & Hungler, 1995a). Quota sampling is identifying the proportions of a population you wish to have, such as 40% female and 60% male, to represent the population, and then taking all available people until the quota for that segment is met. This technique, while potentially encountering bias, does a somewhat better job than convenience sampling in trying to represent the population. Purposive sampling or selection relies on the researcher's judgment to select specific participants who are thought to be typical of the population. While there is some bias inherent in this method, it is useful for pre-testing instruments for a population. A form of this purposive sampling, known as theoretical sampling, is used in qualitative inquiries. You want to ensure you will encounter the concept of study and be able to explore it.

Like random selection, random assignment relies on ensuring there is no pattern. Random number generation can be used for assignment as well as to choose which patient numbers will go into each group. Other easy methods for random assignment are using a coin toss if there are only two groups or pulling names or patient numbers out of a hat for more than two groups. Although some may criticize this as not scientific, it relies on probabilities

Table One.
Random numbers table sample

468523	346775	749106
692489	453050	613183
140133	597476	765033
563044	165206	116549
813044	686522	928525

and is perfectly acceptable (Polit & Hungler, 1995b). Non-random assignment methods include putting patients in who arrive on certain days or in any pattern such as every third day.

Now that we know what random selection and random assignment are, we need to look at what they do. We also need to understand when they should (and shouldn't) be used.

Why do we do it?

There are a number of different types of research designs. The design chosen is based on what type of knowledge we need to obtain, as well as the constraints of the setting. One categorization of research designs is to describe them in three levels (Brink & Wood, 1998): level 1 – descriptive or exploratory research, intended to determine factors in a concept or disorder and relations between factors; level 2 – survey designs, including correlational and comparative designs, which look at relations between situations or concepts; and level 3 – experimental designs, either "true" experimental or "quasi" experimental, intended to understand how to produce or predict the concept (causation).

Randomness is one of the key characteristics of a true "experimental" design (Campbell & Stanley, 1963b). Randomness is required in order to examine causality or what causes the phenomenon we are exploring. It is therefore necessary to put in techniques that help to reduce the sources of other explanations for the results. We do this in a number of ways such as creating control groups and treatment groups, using larger sample sizes, and other techniques to help recognize and control for other events which may explain the results. Random selection and random assignment are important to this by helping to increase the probabilities that strange events or characteristics are evenly distributed between study groups. This is called controlling for threats to internal validity. A few examples of threats include factors such as history or events which occur during the study to influence results, testing in which results improve only because participants know the test or selection in which we systematically choose participants with a particular characteristic (Campbell & Stanley, 1963a).

Randomization is not foolproof. Most researchers can tell you of the study in which all the patients who had a complication ended up in one study group. One example from my own practice was in looking at the incidence of nosocomial pneumonias with the use of an inline endotracheal suction catheter which remained attached to the ventilator and endotracheal tube for 24 hours compared to standard disposable catheters and techniques. As it turned out, all of the patients who vomited during intubation ended up in the experimental group (the inline catheter group) (Carter-Snell, 1988). Obviously the vomiting was not related to the catheter subsequently used, but it almost certainly affected who got pneumonia. Researchers should be looking for this differential distribution of characteristics by comparing the "biographics" of each group as part of their analysis and interpretation. We see this as tables which compare characteristics such as length of stay, age of patients, number of chronic diseases or other factors which may be alternate explanations for the results. Look for these in the research report. Other factors, such as patients dropping out of the study can affect the distribution of groups. This should also be described in the report.

Now, the key point in the above discussion is that randomness is a crucial aspect if and when you are trying to establish causation. While the "ideal" experiment would have both, random assignment to groups is the minimum requirement of experiments (Buckwalter, Maas, & Wakefield, 1998). Although we would like to claim causation in our studies, without randomness we cannot make these claims. The majority of nursing studies are "quasi-experimental", correlational or interpretive in design, therefore randomness becomes less critical.

You don't always want or need randomness. In fact, randomness may actually create other problems. In some instances, group members will act differently because of their resulting group placement, or there may be ethical concerns with not giving everyone the same treatment if it is thought to be better. Certain situations lend themselves to randomization. These include situations when there are limited resources available for treatment and when it is possible to temporarily isolate study settings. If there are limited resources, randomization actually facilitates ethics by giving everyone an equal chance of receiving the resource (Cook & Campbell, 1979). In a perfect world, non-random or non-probability selection methods would only be used in pilot studies or for exploratory research (qualitative studies). Sometimes there may be limitations preventing this, particularly in clinical research where it is not possible or reasonable to expect random selection. Examples include situations when results are required quickly, when there are limited funds or when an event has already occurred and is not able to be reproduced such as a disaster or a change implemented in treatment in the department. A research design which is randomized is usually larger and, therefore, more time-consuming and costly (Cook & Campbell, 1979). It is also not possible to randomize to groups if this places people at harm or suffering or to characteristics such as those who develop the disease and those who don't. Consider the research on cardiopulmonary resuscitation (CPR). We wonder why techniques keep changing. We cannot randomly select nor randomly assign who gets CPR. This means that we cannot also claim causation or effectiveness of techniques.

An added problem is the depth of knowledge we have in an area. It is unethical to begin experimental or quasi-experimental studies in an area if we don't really know what the concepts include. If we begin to conduct an experiment and exclude what later ends up being key variables or issues in the concept, then the data are useless and the experiment may even be harmful. We would need to do further exploratory or correlational types of research to better understand the concept first and would not need or want randomization.

Correlational and survey research do not rely on manipulating or controlling an intervention and are non-random. For these reasons, they are not capable of determining what causes the correlation, only which factors relate to each other (Rumrill, 2004). The cause of two highly correlated items may be something entirely different that has not been identified or measured. Consider the often-quoted mosquito research. Malaria was strongly correlated with rainfall, therefore it was concluded

by some that the organisms were carried in the raindrops. We realize now that mosquito populations increase with rainfall. It is therefore less important to have randomness. The selection in these situations is sometimes done by quotas to ensure that specific subgroups are represented. It becomes the reader's job to determine if the sample is representative of the group in which you are interested (Wood & Brink, 1998). For instance, if reading a study on substance abuse in inner city children, does the sample adequately represent the subgroups in your city or region?

There are many issues and concepts in nursing which we don't understand enough to study, or for which the purpose of the research is only to understand. For instance, knowing what the experience of being a trauma patient means and what themes they recall or stand out for them (O'Brien & Fothergill-Bourbonnais, 2004) can influence your approach to the next patient you see. Many nursing studies are conducted in order to understand the phenomenon and perhaps understand societal, clinical or social influences on the phenomenon rather than what caused it. These studies use qualitative methods for data collection and randomness is not relevant. It is more important to ensure that the results are meaningful to the participants and reflect what the participants feel or believe. The use of qualitative methods is also scientific. The emphasis is not on what causes the phenomenon or sources of error, however. The focus is on whether the results are consistent across participants, applicable, bias neutral and true (Guba & Lincoln, 1981). This is known as scientific rigour. If the study is one in which qualitative methods are used, the issue of randomness is not relevant. It is more important to purposely select patients who represent the concept being studied and to look for themes and common concepts which emerge. Even sample size is not usually an issue.

Researchers often wish to generalize the results of their study to other populations. This would be considered high external validity. While it seems backwards, as you get better at controlling for internal threats or alternate explanations for your results, such as through random selection and assignment, the level of external validity decreases (Buckwalter, Maas, & Wakefield, 1998). This means you are less likely to be able to generalize the results of the experimental study to other similar populations, even though you may understand what caused it in this population. You need to look at the study population and the distribution once more to determine if this population resembles yours before attempting to generalize the study results to your emergency. Similarly in exploratory research, generalizability is often equated to "applicability" or "fittingness" of the conclusions to other populations (Guba & Lincoln, 1981). You determine if the results "fit" with your population of interest. Randomness is therefore not an issue.

Summary

When reviewing research or participating in data collection, it is important to understand the importance of randomization to the type of research. Experimental studies are conducted when the need to know causation is important. In an experimental study, both random selection and assignment are required. In quasi-experimental studies, at least random assignment to groups is required. When randomness is required, you then have to ask what methods they used for randomness. Then look at the description of the various group characteristics and see if they remained evenly distributed at the end of the study. Attempting randomization and achieving it are not always the same. If you are assisting a researcher in enrolling patients into an experimental or quasi-experimental study, it is hoped that you recognize how important it is to include all relevant patients in the selection or assignment pool, even when busy. Not doing so can affect their interpretation of the data.

We deal with humans in a clinical setting, usually with organizational and financial constraints, especially in our busy emergency departments. It may not be possible, or sometimes even ethical, to conduct randomized experiments in this setting. In addition, there are many unexplored areas of emergency nursing for which we have insufficient data about the concept. We cannot build rigorous studies to look at what causes the disorder or increases its risk if we don't understand what the concept is, the factors involved and its meaning to patients. When reading or participating in research, it is recommended you examine the researchers' use of randomness and whether it is important to the goal and type of research.

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