

Leveraging an Innovative Teaching Strategy to Identify Use of Biostatistics by Advanced Practice Nurses

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Received: November 12, 2020

Accepted: January 11, 2021

Online Published: January 12, 2021

doi:10.5430/ijhe.v10n2p1

URL: <https://doi.org/10.5430/ijhe.v10n2p1>

Abstract

Advanced practice nurses (APNs) have a responsibility to translate research evidence into their clinical practice (i.e., evidence-based practice) for the promotion of patient and population health. A precursor to the adoption of evidence-based practice is APNs having sufficient knowledge and understanding of biostatistics. To promote APN students' motivation to learn biostatistics, nursing faculty teaching biostatistics need to know how biostatistics are used by APNs in their clinical practice. A teaching innovation was incorporated in a biostatistics course to describe the use of biostatistics by APNs. For this study, 118 students conducted interviews with APNs determining their use of biostatistics in clinical practice. Students posted interview summaries to Flipgrid, a video web-based blog. Blog posts were qualitatively analyzed; derived themes were Consuming the Literature, Translating the Evidence, and Conducting Biostatistical Analyses. The APN interview as implemented was an active learning strategy effective for generating the scientific premise to inform students of the need to learn biostatistics.

Keywords: statistics, advanced practice nursing, Flipgrid

1. Introduction

Advanced practice nurses (APNs) have a responsibility to translate research evidence into their clinical practice (i.e., evidence-based practice [EBP]) for the promotion of patient and population health (American Association of Colleges of Nursing [AACN], 2006; Kiekkas et al., 2015; Hayat et al., 2013). A precursor to the adoption of EBP is APNs having sufficient knowledge and understanding of biostatistics (Polancich et al., 2018); essential course content in graduate nursing education (Buchholz et al., 2013; Hayat et al., 2013). While the AACN's Essentials of Doctoral Education for Advanced Nursing Practice require APNs to learn and use this knowledge (AACN, 2006), phobia and anxiety to "math" challenge educators to effectively teach biostatistics (Hayat et al., 2013, 2015; Huang, 2018), and subsequently could reduce their use of biostatistical knowledge for EBP. Nurse educators have a responsibility to understand how biostatistics are used by APNs for EBP in order to teach content with relevance for APN students' future clinical practice (e.g., EBP). The primary purpose of this paper is to describe the use of biostatistics in clinical practice by APNs.

1.1 Background

APN students generally have a negative attitude towards and are intimidated by biostatistics (DiBartolo et al., 2012; Kim & Hayat, 2015; Shillam, Ho, & Commodore-Mensah, 2014; Wonder & Otte, 2015). Students' anxiety to "math" related courses further complicates this issue (Hayat et al., 2013, 2015). Even though Hogg (1991) very early on discussed that mathematical competence was not a requirement for taking a statistics course, math anxiety persists and affects student learning outcomes. Mathew and Aktan (2014) evaluated attitudes toward statistics comparing a sample of 175 undergraduate nursing students, graduate nursing students, and non-nursing students. The researchers found a significantly lower positive attitude toward statistics in the graduate nursing student group ($p = 0.001$). Kiekkas et al. (2015) studied attitudes with 156 nursing students. These researchers found significant correlations between final exam performance and affect, difficulty, interest, and effort in the statistics course. Essentially, the more positive students' attitude toward biostatistics, the better they performed on the final examination. Of particular note, students' perceptions of the value for biostatistics did not significantly improve over time (Kiekkas et al., 2015). This finding

could indicate students will not retain the course content and avoid situations where biostatistics content could be applied to clinical practice. Thus there was a need not only to increase student success but create learning opportunities increasing the desire to learn biostatistics.

Student barriers to learning biostatistics can be mitigated by having faculty teaching biostatistics' courses apply statistics as an investigative process coupled with data collection and analysis, focus on conceptual understanding, integrate real data, and use statistical technology to foster active learning (GAISE College Report ASA Revision Committee, 2016). Statistics' faculty have trialed different strategies to this end including having students create their own databases for analysis related to their scholarly project area, complete course work in small groups, use game-based learning, review video tutorials in YouTube, and participate in flipped classrooms (Eastridge & Benson, 2020; Huang, 2018; Polancich et al., 2018; Schwab-McCoy, 2019; Schwartz, Ajazi, & Monaco, 2018). Despite the incorporation of these strategies, students continue to report negative attitudes towards biostatistics (Schwab-McCoy, 2019).

An underlying key strategy to reducing the barriers for students' willingness to learn biostatistics and, ultimately achieving course student learning outcomes lies in increasing students' perceived relevance of course content. Kim and Hayat (2015) surveyed 72 graduate nursing student alumni finding that 33% of respondents "believed that the statistics course content was relevant for the workplace" (p. 146). This finding lends itself to an ideal teaching-learning intervention grounded in Knowle's self-directed adult learning theory. In this theory, six principles to learning can be leveraged to increase the relevance of a biostatistics course: the need to know, learners' self-concept, role of the learners' experiences, readiness to learn, orientation to learning, and motivation (Wang & Dennett, 2014). The first principle, the need to know, is defined as adults needing to be informed of the purpose or value for learning something new before they will commit to learning (Wang & Dennett, 2014). The present study capitalized on this principle by having students interview APNs to generate their own evidence to explain why they need to learn biostatistics to be an effective APN rather than rely on faculty explanations as was historically done.

1.2 Curriculum Development

Previous strategies used to promote student learning in this course were similar to those previously stated: students created databases, used real research data, used discussion boards for online sections, and received flow charts to guide determination of statistical tests to use. Course readings were tailored for read/write learners; voiceover PowerPoint presentations for aural learners; graphs, figures, and tables for visual learners; and practice problems with instructions for kinesthetic learners (VARK Learn Limited, 2016). Course content also was aligned with statistical procedures reported as frequently used in the nursing literature. Unfortunately, these efforts did not allay students' resistance associated with this course. Therefore, determining how APNs use biostatistics in their clinical practice was paramount for helping faculty obtain the scientific premise to motivate students to learn biostatistics. To achieve this purpose, an active learning strategy was used whereby students collected the data for this scientific premise while simultaneously gathering their own evidence for the need to learn biostatistics.

2. Method

A qualitative descriptive design was used in this study. This study took place in a Midwest U.S. college of nursing with 125 students enrolled in one of two subsequent sections of Biostatistics for EBP. The university Institutional Review Board deemed this study as "not human subjects research".

2.1 Active Learning Intervention

During the first half of the semester, students were provided written instructions for conducting 15 minute, one-on-one interviews with APNs. For this assignment, APNs needed to have one of four professional licensure credentials consistent with the Consensus Model for Advanced Practice Registered Nurse (APRN) Regulation (APRN Consensus Work Group and the National Council of State Boards of Nursing APRN Advisory Committee, 2008): certified nurse practitioner, certified nurse midwife, certified registered nurse anesthetist, or clinical nurse specialist. Interviews could be conducted in person or by telephone. Several examples of the interview process were modeled and recorded using a Flip video camera and placed on YouTube for students' review. During the interviews, students asked APNs four questions:

1. What is your area of advanced practice nursing?
2. Tell me about your roles and responsibilities as an APN?
3. How do you use biostatistics to influence your professional practice and patient outcomes?

4. What else is important for graduate nursing students to know about biostatistics as they become APNs?

Students posted a summary of the interviews to a Flipgrid webpage. Flipgrid is a web-based video blog developed by researchers from the University of Minnesota (2016). To generate a new post, students clicked on a hyperlink provided by the faculty taking them directly to the Flipgrid video blog. No login or passwords were required, only first and last names were entered prior to the video recording. Flipgrid posts could be done using laptop, iOS, or Android devices having built-in or plug-and-play web camera capability. After starting a new video post, an onscreen timer counted down from 90 seconds. All Flipgrid posts were limited to 90 seconds allowing students practice synthesizing large amounts of information into the most notable content needing to be communicated. This 90 second summary is a skill needed by APNs, because they often need to use brevity reporting a patient's condition and plan of care to other healthcare providers (e.g., physicians, registered nurses).

Once students reviewed and saved their videos to the Flipgrid page, they could watch all previously recorded and subsequent posts allowing them to compare their responses to other students. On the Flipgrid page, only student first names appeared under each video post. Administrators (i.e., course faculty) for the Flipgrid account could access additional details for each post such as student last names and date/time of posts.

2.2 Qualitative Data Analysis and Trustworthiness

Flipgrid posts were transcribed verbatim. Student names were deleted and transcripts were screened for relevance to the study purpose. Four cases were deleted due to no sound and the transcript listed "No audio". Three cases were excluded, because students conducted interviews with persons who were not APNs. This left 118 cases/transcripts for qualitative analysis.

Data were analyzed using conventional content analysis including independent, line-by-line coding and clustering significant statements into themes (Hsieh & Shannon, 2005). Discussions about significant statements continued until both researchers agreed upon the coding schema. After independent coding of the data to the coding schema, the researchers met to determine consistency of coding. Each discrepancy was discussed until agreement was achieved. The coded data were organized using NVivo-8 (Cambridge, MA). The collapsed data for each theme were read independently by the researchers to verify accurate allocation of data to themes and judge the consistency of data within each theme.

Trustworthiness of the data analysis process was promoted by recommendations described by Lincoln and Guba (1985). First, each investigator independently analyzed the data and coded the data to the coding schema. Second, the coding schema itself was developed after in-depth discussions between the two investigators. Third, an audit trail was generated to explain and promote consistency in the coding decisions.

2.3 Quantitative Data Analysis

Student characteristics were extracted from the course learning management system. APN characteristics were obtained from the transcription data. Student and APN characteristics were reported using descriptive statistics.

3. Results

Most students were female (n=112, 94.9%) and matriculating in the family nurse practitioner program (n=53, 44.9%). Of the APNs interviewed by the APN students, the majority (n=67, 65.7%) practiced within 10 miles of the college campus and were credentialed as a certified nurse practitioner (n=108, 92.3%). In addition, most of the APNs interviewed worked in a hospital setting (n=67, 57.3%) with about a third (n=38, 32.3%) working in a pediatric setting whether inpatient or outpatient. See Table 1 for additional demographic findings. Three overarching themes were derived from Flipgrid data: *Consuming the Literature*, *Translating the Evidence*, and *Conducting Biostatistical Analyses*.

3.1 Consuming the Literature

In *Consuming the Literature*, 95 (80.5%) students discussed the need for APNs to gather, read, and critique peer-reviewed literature. In order to consume this literature competently and confidently, a strong foundation in biostatistics was required. One student reported, "[The APN] doesn't use biostatistics on a daily basis, but if she gets an article with that in it, she will be able to decipher the information. And if it's statistically or clinically significant." Another student described a greater importance to consuming the literature versus performing biostatistical computations: "It wasn't as necessary for her to know to perform the statistics. It's more about understanding them, because that's where she gets a lot of her information when she's looking up those best practices and new treatments for her patients."

3.2 *Translating the Evidence*

In *Translating the Evidence*, 99 (83.9%) students explained how APNs need to interpret and place value on biostatistical findings found in the literature. These findings after being deemed valid will be used for the design of clinical programs, EBP, and clinical practice guidelines (CPGs). For example, “He said that his advice to us is health care policy is emphasizing more and more on quality and safety of care and you can’t base things just out of comfort and tradition or even opinion. He says you need to be able to back these claims up. So he said, ‘Don’t stick with the same method out of habit or comfort and to incorporate EBP in your practice.’” In relation to translation to practice, another student said: “She uses statistics a lot in finding protocols in sepsis and resuscitation and stuff.”

3.3 *Conducting Biostatistical Analyses*

In *Conducting Biostatistical Analyses*, 41 (34.7%) students reported the APNs they interviewed were conducting biostatistical analyses in order to disseminate their research or quality improvement project findings or generating evidence for other practitioners to develop CPGs. One student reported the APN “helps monitor specific things like catheter acquired urinary tract infection and they follow how those rates change when new clinical practice is implemented.” The students also reported that some APNs benchmark their local findings to a local, regional, or national standard. For example: “They look at z-scores in the echocardiograms and I have never noticed or knew that echocardiograms actually take into account the z-score... She says she looks at this daily for kids that she’s evaluating for anesthesia.”

Table 1. Demographic characteristics for the student interviewers and advanced practice nurse interviewees (N=118)

Characteristics and Categories	N	%
Student (Interviewer) Characteristics		
Gender		
Female	112	94.9
Male	6	5.1
Nursing program		
Primary care pediatric nurse practitioner	5	4.2
Acute care pediatric nurse practitioner	15	12.7
Family nurse practitioner	53	44.9
Adult/geriatric primary care nurse practitioner	7	5.9
Adult/geriatric acute care nurse practitioner	30	25.4
Occupational health nursing	6	4.2
Doctor of philosophy	3	2.5
Advanced Practice Nurse (Interviewee) Characteristics		
Proximity to the project site (college of nursing) ^a		
0-10 miles	67	65.7
11-50 miles	9	8.8
51 or greater miles	26	25.5
Specialty practice ^b		
Certified nurse midwife	6	5.1
Certified registered nurse anesthetist	3	2.6
Certified nurse practitioner		
Primary care pediatric nurse practitioner	19	16.2
Acute care pediatric nurse practitioner	5	4.3
Family nurse practitioner	13	11.1
Adult/geriatric primary care nurse practitioner	5	4.3
Adult/geriatric acute care nurse practitioner	26	22.2
Women's health nurse practitioner	2	1.7
Psychiatric/mental health nurse practitioner	1	0.9
Not specified	37	31.6
Practice setting ^c		
Hospital	67	57.3
Emergency department	8	6.8
Surgery/operation room	8	6.8
Labor and delivery	1	0.9
Clinic/outpatient care	11	9.4
Private practice	17	14.5
Home care	1	0.9
Staff education/administration	4	3.4
Pediatric population	38	32.2

^a Missing data for 16 cases; ^b Missing data for 1 case; ^c Missing data for 1 case

4. Discussion

The underlying goal of this study was to leverage an active learning strategy to collect data to build the scientific premise for why biostatistics needs to be learned by APN students for their future practice as APNs with the assumption that collecting these data would positively affect their attitude and willingness to learn biostatistics. Consistent with Hayat et al. (2013, 2015), findings in this study indicated the need for APNs to be able to read and translate the literature for the purposes of EBP. Following implementation, students persistently asked the faculty to provide additional examples and practice problems to help them learn, because “I need to know this to work safely as a nurse practitioner.” This anecdote relays the importance of adopting a teaching strategy that can help build the case to learn biostatistics. Without the ability to read, interpret, and judge the statistical procedures and findings in peer-reviewed articles, these future APNs will not be able to consume or translate the research evidence into their clinical practice.

While most students in this study reported that the APNs they interviewed consumed or translated evidence requiring knowledge of biostatistics (80.5% and 83.9%, respectively), only about a third (34.7%) of the APNs conducted biostatistical analyses. These findings were consistent with Kim and Hayat (2015) in their study with nursing alumni: 49% (n=20) of the alumni needed to understand the biostatistics being reported in the literature, which was akin to the theme *Consuming the Literature*. Only 24% (n=10) of their respondents carried out statistical analyses and only 20% (n=8) needed to disseminate biostatistical findings. The infrequent need to conduct one’s own analyses also was reported by Hayat et al. (2013). Given the precursor to effective patient/population management is the ability to perform EBP (theme: *Translating the Evidence*) and biostatistical knowledge is a precursor to EBP, APNs need to understand biostatistics in order to reliably judge the merits of the peer-reviewed literature (Polancich et al., 2018). In some instances, they need the ability to conduct their own analyses to evaluate effectiveness of their EPB efforts (theme: *Conducting Biostatistical Analyses*). This knowledge and skill then will permit APNs to develop EBP guidelines as well as provide safe, effective care.

There were two key limitations in this study. First, interview summaries were limited to 90 seconds. Longer summaries may have been more revealing as to the use of biostatistics in practice by APNs. This time limitation was important; however, because APN students will ultimately need to condense patient case histories into similarly short time periods when discussing clinical cases with other clinicians or engaging with politicians on matters of health policy (e.g., “elevator speech”). As a result, the 90 second limitation was more important for their ultimate career success than generating longer narratives for this study. Second, the sample was drawn from two sections of a biostatistics course from one college of nursing. This limitation was somewhat moderated by over a fourth of the APNs interviewed by the students worked in practice settings at least 50 miles away from the study site.

5. Conclusion

The APN interview for use of biostatistics in clinical practice as an active learning strategy used in this project was effective for generating evidence for the value of how biostatistics are used by APNs. The APN interview could be incorporated in GAISE recommendations as a teaching activity for their proposed “Activities, Projects, and Datasets” to generate similar evidence for other disciplines. As indicated in the study findings, biostatistics are regularly used by APNs to consume and translate the literature and commonly used to conduct biostatistical analyses. Future research is needed to determine if course changes (i.e., relaying these study findings to APN students in the biostatistics course) based on the research findings will decrease resistance to learning biostatistics and increase subsequent use of biostatistics in clinical practice after graduation.

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