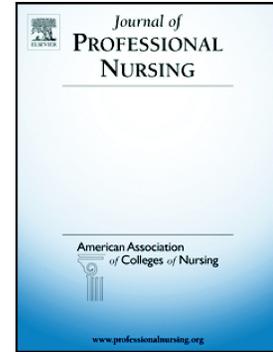


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A survey of current practices in data management education in nursing doctoral programs

Rebecca Raszewski, Abigail H. Goben, Martha Dewey Bergren, Krista Jones, Catherine Ryan, Alana Steffen, Susan C. Vonderheid



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## A Survey of Current Practices in Data Management Education in Nursing Doctoral Programs

### Corresponding Author

Rebecca Raszewski, MS, AHIP<sup>a</sup>

<sup>a</sup> Associate Professor & Information Services & Liaison Librarian

Library of the Health Sciences Chicago

University of Illinois at Chicago

1750 West Polk Street (MC 763)

Chicago, IL 60612

United States

[raszewr1@uic.edu](mailto:raszewr1@uic.edu)

Abigail H. Goben, MLS<sup>b</sup>

<sup>b</sup> Associate Professor

Data Management Coordinator

Liaison Librarian

Library of the Health Sciences Chicago

University of Illinois at Chicago

1750 W. Polk (MC 763)

Chicago, IL 60612

United States

[agoben@uic.edu](mailto:agoben@uic.edu)

Martha Dewey Bergren DNS, RN, NCSN, PHNA-BC, FNASN, FASHA, FAAN<sup>c</sup>

<sup>c</sup> Clinical Professor

Associate Department Head, Health Systems Science

Director, Advanced Population Health Nursing, Health Systems Leadership & Informatics

University of Illinois – Chicago College of Nursing

845 S Damen Ave MC 802, Room 938, 9<sup>th</sup> floor

Chicago IL 60612

United States

[bergren@uic.edu](mailto:bergren@uic.edu)

Krista Jones DNP, MSN, RN, PHNA-BC<sup>d</sup>

<sup>d</sup> Director, Urbana Regional Campus

Clinical Associate Professor

Department of Health Systems Sciences

University of Illinois – Chicago College of Nursing

625 S. Wright Street, Suite 201

Champaign, Illinois 61820

United States

kjones29@illinois.edu

Catherine Ryan, PhD, RN, APRN, CCRN, FAHA <sup>e</sup>  
<sup>e</sup> Clinical Associate Professor  
Department of Biobehavioral Health Science  
University of Illinois – Chicago College of Nursing  
845 S. Damen Ave., MC 802,  
Chicago, IL 60612  
United States  
cryan4@uic.edu

Alana Steffen, PhD <sup>f</sup>  
<sup>f</sup> Senior Biostatistician  
Research Assistant Professor  
Department of Health Systems Sciences  
University of Illinois – Chicago College of Nursing  
845 S. Damen Ave., MC 802,  
Chicago, IL 60612  
United States  
steffena@uic.edu

Susan C. Vonderheid, PhD, RN <sup>g</sup>  
<sup>g</sup> Clinical Assistant Professor  
Department of Women, Children, and Family Health Science,  
University of Illinois – Chicago College of Nursing  
Director of Nursing Research  
University of Illinois Hospital & Health Sciences System  
845 S. Damen Avenue  
Chicago, IL 60612  
United States  
vonde@uic.edu

# A Survey of Current Practices in Data Management Education in Nursing Doctoral Programs

## Abstract

Background: The inclusion of data management instruction within nursing doctoral curricula has not been systematically examined. Purpose: The purpose of this study is to determine the extent of data management education within nursing doctoral programs. Method: Separate surveys were created for DNP (332) and PhD (138) program directors. Survey questions were based on the stages of the UK Data Service Research Data Lifecycle. Results: One hundred and four nursing doctoral program directors responded, a 22% response rate. Sixty-seven (64%) were from DNP programs while 37 (35%) were from PhD programs. Although program directors reported that they were teaching stages of the research data lifecycle, data management is mostly being taught through individual mentoring or a single lecture within a required course, and that students' project data were not being preserved. Conclusions: Nursing doctoral programs need to develop consistent data management education, build an awareness of data policies, and clarify student project data sharing and ownership.

## Keywords

data management; data lifecycle; nursing doctoral education

## Introduction

The number of doctoral programs in nursing across the United States has increased in the past decade with the growth of Doctor of Nursing Practice (DNP) programs substantially exceeding that of PhD programs. In 2006, there were 20 DNP programs (American Association of Colleges of Nursing, 2018a). By 2018, there were 348 DNP programs in all 50 states and another 98 programs in the planning stages (American Association of Colleges of Nursing, 2019). During that same time period, nursing PhD programs increased from 103 to 136 programs. (Figure One)

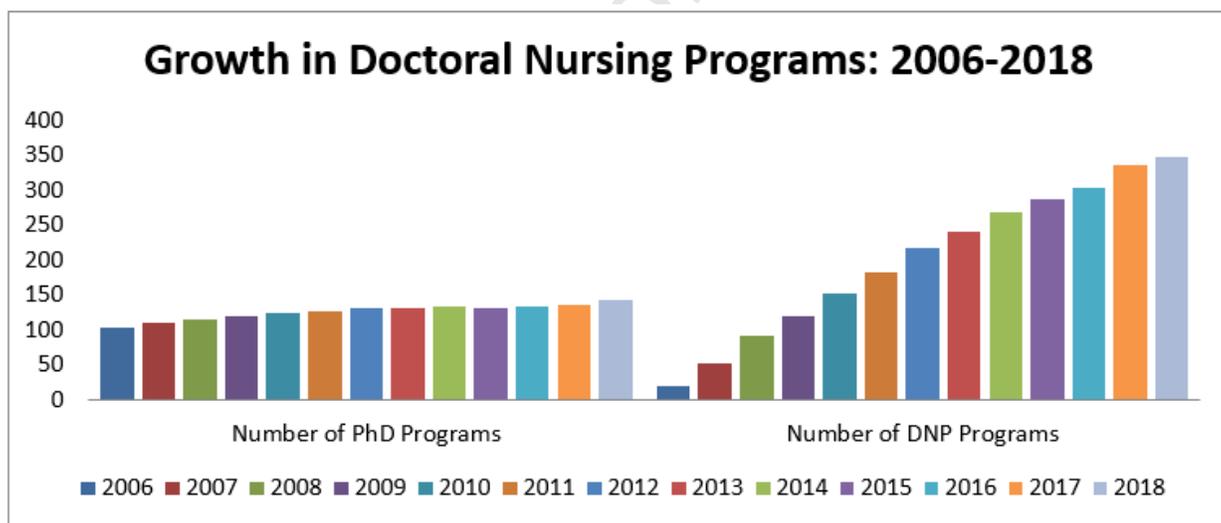


Figure One

American Association of Colleges of Nursing (2019). Reprinted with permission.

Scholarly inquiry and application are fundamental to both research- and practice-focused doctoral programs and data are integral to the process (American Association of Colleges of Nursing, 2015). Data are collected and analyzed by students, whether as parts of quality improvement projects, program evaluations, or complex research

studies (American Association of Colleges of Nursing, 2006). With the number of DNP programs far surpassing the number of PhD programs, many colleges or departments of nursing may not be prepared for the rapid increase in the number of students generating and managing data. With nearly 40,000 doctoral students, comprised of 4,698 PhD students (American Association of Colleges of Nursing, 2018b) and 32,678 DNP students (American Association of Colleges of Nursing, 2019), the sheer volume of scholarly projects and students who potentially collect and use data demands an investigation into the data management educational practices within nursing doctoral programs. Data management refers to “the process of validating, organizing, securing, maintaining, and processing scientific data, and of determining which scientific data to preserve” (Tabek, 2019).

## Review of the Literature

Data management has grown in importance with the rapid increase in the ability to capture and store data. This presents clinical nurses, nurse researchers, and nurse educators with new opportunities to explore and understand current practices and outcomes, as well as, to influence longitudinal change and population-scale change. New techniques have emerged such as the integration of big data, drawing on large stores of clinical healthcare data (Brennan & Bakken, 2015; Westra, Sylvia, Weinfurter, & Pruinelli, 2017), as well as the desire for improved reproducibility and data handling surrounding clinical trials (Houston, Probst, Yu, & Martin, 2018; Jansen, van den Berg, van Overveld, & Boiten, 2019), qualitative methods (Hackett & Strickland, 2019), and quality improvement projects (Needham et al., 2009). Recommendations and tools

providing guidance for data management across the data lifecycle have focused on clinical researchers (Borgh et al., 2018; Jansen et al., Privacy Technical Assistance Center, 2015).

There is also interest in increased data sharing through repositories. Antonio, et al. conducted a case study of a nursing qualitative data repository and found significant challenges with navigating the sharing and archiving of a variety of qualitative data types (2019). Additionally, funding agencies and partners are increasingly requiring data management plans that describe creating, sharing, preserving, and destroying data. Lastly, employers expect doctorally prepared nurses to possess data management skills (Beeber, Palmer, Waldrop, Lynn, & Jones, 2019).

Despite the broad use of data across the data lifecycle in nursing informatics, quality improvement projects, and nursing research as well as increased funder and disciplinary interest and requirements, little is known about current data management educational practices in nursing doctoral programs. Data management concepts, if mentioned in the nursing educational literature, are often limited to types of software where data may be stored or manipulated (Lee, Carson, Clarke, Yang, & Nam, 2019; Raskind et al., 2019), descriptions of statistical analysis instruction (Hayat, Eckardt, Higgins, Kim, & Schmiede, 2013; Lauver & Phalen, 2012) or recommendations for improved data stewardship (Bergren, 2019). Current research on data management education is limited to case studies: one for a workshop at a medical center (Read, 2019); one for integration of data management concepts into an undergraduate nursing information literacy course (McGowan 2019); and two case studies outlining individual institutions' approach to teaching clinical data management for a DNP program

(Polancich, James, Miltner, Smith, & Moneyham, 2018; Sylvia & Terhaar, 2014). This is similar to the general research surrounding data management: a scoping review of data management literature in academic institutions found a focus on self-reporting or observations of researchers gathering or managing data, rather than a focus on educational and training aspects (Perrier, Blondal, Ayala, & Dearborn, 2017). While not focused on data management, a study examining mentoring reported that individual mentoring was the most widely used method for educating students on data management (Anderson et al., 2019).

Because of the increased need for data management expertise to meet the future demands of healthcare practice and research, it is important to understand the current techniques and methods through which doctoral nursing students are gaining experience with data management concepts. The purpose of this study is to identify existing data management education practices throughout the data lifecycle for DNP and PhD programs in the United States through surveys of nursing doctoral program directors. This study is the first in the nursing literature to report how and where data management has been integrated into the doctoral curricula.

## UK Data Service Research Data Lifecycle

The UK Data Service Research Data Lifecycle is a commonly used lifecycle in data management that illustrates the importance and usage of data throughout the research process (UK Data Service, 2012). There are six stages of the lifecycle: planning research; collecting data; processing and analyzing data; publishing and

sharing data; preserving data; and re-using data. The stages were used to guide the surveys' development for this study.

### Purpose

The purpose of this study is to determine the extent of data management education within nursing doctoral programs.

## Methods

### Design

The authors used a quantitative descriptive design to develop surveys that included questions about data management and data education in nursing doctoral programs.

### Sample

Doctoral nursing programs were identified from the American Association of Colleges of Nursing's list of *Institutions Offering Doctoral Programs in Nursing and Degrees Conferred* (2016). The list that was used originally had 346 institutions. Program information and contact information for DNP and PhD program directors was confirmed from institutional websites. As the nursing program websites were searched, eight nursing programs were eliminated for the following reasons: they were not currently offering a doctoral program, or were not accredited by the Commission on Collegiate Nursing Education. The categorization of the 338 remaining doctoral programs was as follows: 207 DNP programs only, 20 PhD programs only, and 111 with both DNP and PhD programs. The final number of nursing program directors included in the contact list was 470 (332 DNP;138 PhD).

## Instrument

Separate versions of the survey were created because the **DNP** focuses on practice, while the **PhD** focuses on research, thus the educational curriculum also differs. Each survey had 25 questions. Response sets allowed the participants to select multiple responses. Open-ended questions were included to capture a comprehensive description of data management education. The survey questions first asked about project and research requirements for nursing doctoral students and where and how data management was being taught within the curricula. The remainder of the questions explored specific areas of data management following the UK Data Service Research Data Lifecycle stages. If participants indicated that data management was taught as a full required or elective course, or as an individual lecture in a required or elective course, they were asked to enter the course title and description.

The surveys were developed based on an examination of the data management literature and reviewed by a panel of experts: our research team with expertise in nursing doctoral program content and survey development. The lead and second author designed the surveys. They performed internal content validity by consulting with nursing faculty as content experts due to their extensive experience in teaching and mentoring nursing doctoral students. Any differences in the content/topic or wording of questions were resolved by discussion until consensus was reached. Qualtrics was the survey platform used for designing and distributing the surveys (Qualtrics, 2019). The final surveys are included as Appendices A and B.

## Procedure

The surveys received an exemption from the [BLINDED FOR REVIEW] Institutional Review Board [2019-0118]. The surveys were distributed to 470 nursing program directors (332 DNP; 138 PhD) from 338 nursing doctoral programs via email over a 5-week period in Spring 2019. Those who had not completed the surveys within 2 weeks received two email reminder notifications during week 2 and week 5. Respondents who completed the surveys were invited to complete a separate, secondary set of questions asking for their contact information for a potential follow-up interview.

## Data Analysis

Reports were analyzed utilizing Qualtrics to capture both quantitative and qualitative data. Data were summarized with frequencies and percentages. For questions that allowed multiple responses, the frequencies and percentages were calculated for each response option. We used the Carnegie Classification's Basic category (The Carnegie Classification of Institutions of Higher Education, n.d.) to compare data management educational offerings between research and non-research intensive institutions to identify any inconsistencies between nursing doctoral programs. Qualtrics defaulted links the respondents' contact information to their responses. The authors will deidentify the responses post hoc to protect the respondents' anonymity.

## Findings

Of the 470 nursing doctoral program directors who were invited to participate in the surveys, 104 responded, a 22% response rate. Sixty-seven (64%) were from DNP programs while 37 (35%) were from PhD programs. Forty-two (9%) of email addresses

failed in delivery. Of those that initiated the surveys, 86 (83%) completed it with similar proportions representing DNP and PhD programs, 82% and 84%, respectively. Most non-completers left the surveys before answering the specific questions surrounding the areas of the data lifecycle. When examining the questions individually, the surveys had some missing responses, up to 52% of respondents, depending on the question.

### Projects Required for Graduation

Respondents were asked to choose all of the types of projects which might be required by their DNP program. The most frequent responses were individual quality improvement projects (90%), individual evidence-based projects (87%), program implementations or evaluations (72%), clinical practice guidelines (48%), change leaderships (38%), literature reviews (15%), and projects split between multiple students/cohorts (10%). In the "Other" category, the most frequent response was for a policy-related project (28%). PhD student research required for graduation included: original quantitative research (94%) or qualitative research (90%), literature reviews (e.g. scoping, systematic, etc.) (55%), or secondary data analysis (65%).

### Data Management Education Content and Instructors

Figure Two illustrates respondents' answers to questions on the data management content being taught to students within their respective programs. The most frequent responses for both programs were collecting (DNP 98%; PhD 97%) and analyzing data (DNP 84%; PhD 97%).

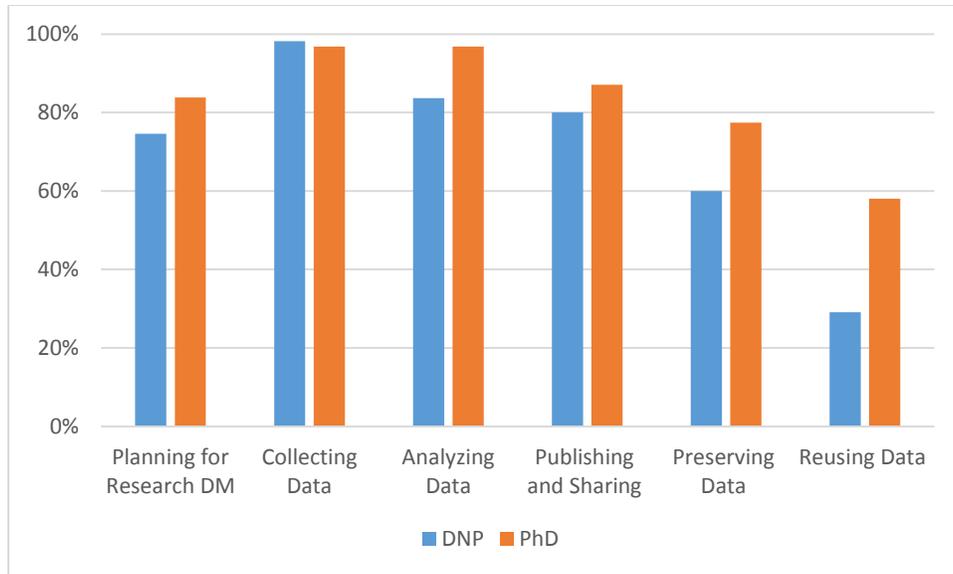


Figure Two

### Data Management being Taught within DNP and PhD Programs

Figure Three illustrates respondents' answers to questions on how data management is being taught. Individual mentoring was the most frequently selected category within both surveys (DNP 54%; PhD 73%). This was followed by individual lectures in required or elective courses. In the "Other" category for DNP programs, one respondent mentioned data management was "threaded through curriculum" while another wrote data management "is taught over more than one lecture." For PhD programs, one respondent wrote that [data management] is a "specific program competency" while another wrote that there was "written policy and procedures."

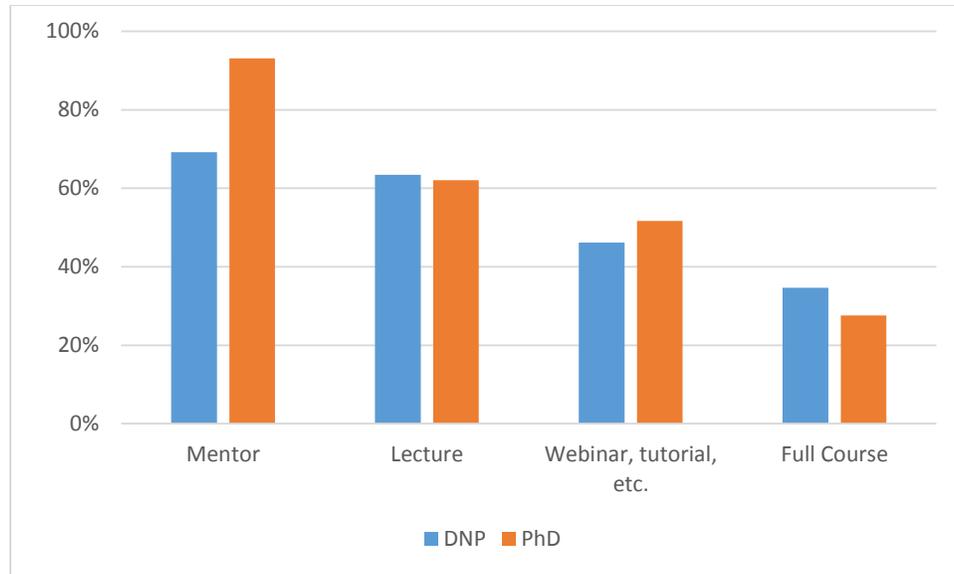


Figure Three

#### How Data Management is being Taught within DNP and PhD Programs

When asked who was teaching data management within DNP and PhD programs, the order of responses was the same in both surveys. Nursing faculty were predominantly teaching data management (DNP 98%; PhD 97%) followed by statisticians (DNP 37%; PhD 62%), non-nursing faculty from other units (DNP 14%; PhD 24%), and librarians (DNP 18%; PhD 14%).

#### Data Management Lifecycle Stages Coverage in Nursing Doctoral Programs

The next six sections of the paper will report the responses of the questions based on the research data management lifecycle. Most of the questions were developed to indicate multiple responses.

#### Planning Research

A data management plan is a structured document now required by many federal granting agencies that may describe types of data, software and hardware used in a project, and policies and procedures for data storage and sharing. Respondents reported that data management plans were required by half of the programs within the DNP Project Proposal (50%), and in almost half of the program's PhD research proposals (48%).

### Collecting Data

Collecting data refers to the data that forms the basis of the students' projects, whether data are gathered for their projects or reused from other sources. When asked what types of data students collected and used for their projects, DNP program directors selected data captured by students specifically for the DNP project (96%), followed by retrieving data from physician/clinic/medical records (94%), publicly available data such as from the U.S. Census Bureau or Centers for Medicare and Medicaid (56%), hospital data containing no health information (e.g. employee data) (54%), and data previously collected for research purposes (38%). In the PhD survey, most responses were received for using data collected by the student specifically for PhD student research (100%), followed by data previously collected for research purposes (71%), publicly available data (68%), physician/clinic/hospital medical records (61%) and hospital data containing no health information (39%). In the "Other" category for the DNP survey, one respondent commented that "All students are required to ONLY use deidentified aggregate data that can be provided by the [DNP project] setting" and that [DNP students] "are not to collect their own data".

When asked if the institutions' institutional review boards reviewed and/or approved student protocols, 73% of DNP survey respondents indicated that a quality improvement determination application/request was submitted for review. Sixty-five percent of respondents also reported that an expedited or full review of human subjects' application was submitted for review. Additional comments included a college-internal review, university compliance officer approval, and a comment on non-human-subject nature of public data reuse. For the PhD survey, the categories with the most responses were that an expedited or full review of human subjects' application was submitted for review (81%); followed by an exempt determination application/request was submitted for review (71%).

#### Processing and Analyzing Data

Processing data may involve cleaning or organizing data. The analysis of data for research usually involves statistical analysis. When asked which software was recommended for students to process or analyze their data, quantitative data analysis tools such as R, SAS, or SPSS received the most responses in both surveys (DNP 86%; PhD 97%). Microsoft Access and Excel received the second most frequent responses in the DNP survey (75%) while data collection using Qualtrics or RedCap had the second most frequent responses in the PhD survey (84%). Qualitative data analysis software such as Atlas.ti, DeDoose, and NVivo, got more responses in the PhD survey with 77% compared to 16% of the DNP survey responses. Data visualization tools such as Tableau were the least recommended software in both surveys. Data standardization tools, such as OpenRefine, was the only option not selected in both

surveys.

### Publishing and Sharing Data

The next few questions from each survey focused on data policies for students and resources available to them for preparing data to be shared. Figure 4 shows responses based on college/department level versus university or institution-level data policy that apply to students. Responses indicated department level data policies for students were more likely the DNP programs (30%) compared to the PhD programs (23%) while university or institution-level data policy were more likely for the PhD programs (57%) compared to DNP programs (42%).

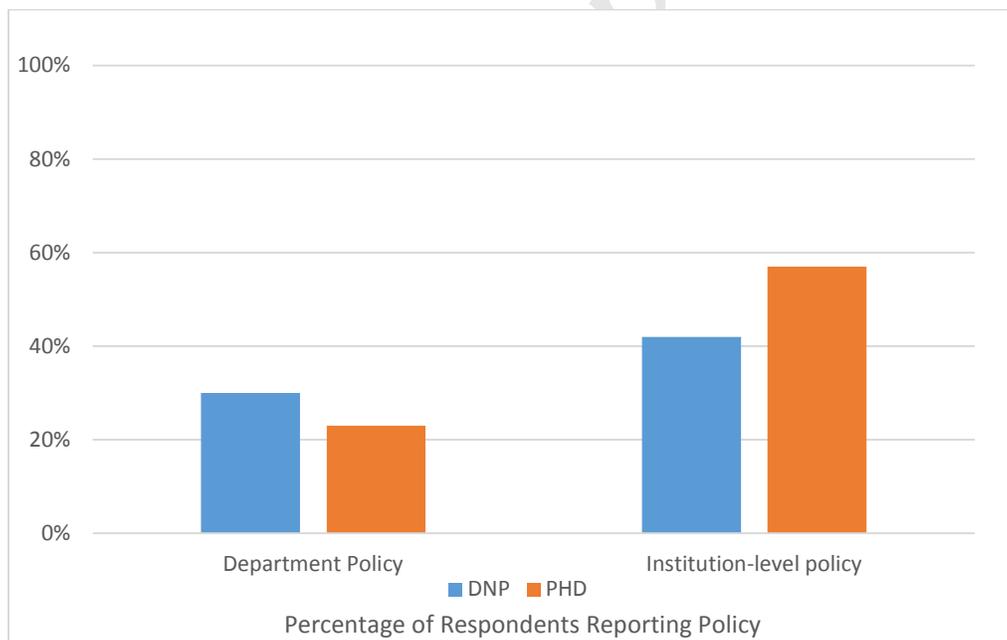


Figure 4

### Reported Department Level and Institution Level Data Policies that Apply to Students

When asked if there were resources at the institutions to assist students with de-identification of data in preparation to sharing the data, many DNP program respondents indicated no (44%), with an additional 30% reporting that they did not

know. Similarly, in the PhD survey, the predominant response was (45%) said yes although 39% of respondents said they did not know. When asked to describe the resources available for de-identification, three similar responses to the DNP survey described a combination of the faculty and institutional review board, though respondents selecting “Other” mentioned honest brokers, IT [Information Technology], and a research design and analysis center. Four respondents in the PhD survey mentioned a statistician or a statistical consultant, with one including faculty in the response.

When asked with whom doctoral nursing students shared their project data, the faculty mentor/advisor received the highest responses in both surveys (DNP 96%; PhD 90%). Additional responses in the DNP survey were the DNP committee (73%), agencies (63%; e.g. hospital, school, or health department), statistician (61%), college or department of nursing (41%), and university (20%). Additional responses in the PhD survey were statistician (77%), PhD committee (68%), agencies (10%), and college or department of nursing (6%). In the DNP survey, the general access/publicly available response was 3 (6%) but was not selected in the PhD survey.

### Preserving Data

Preserving data refers to backing up and storing data to assure it can be accessed in the future. When asked which tools are being used for storing data while the students were working on their projects, most respondents, (57%) in the DNP survey said there was not an institutional/college level data storage solution. The rest of the responses for the DNP survey were campus shared storage (28%), Google Drive or Microsoft OneDrive not campus supported, and college shared drive/server or Dropbox

with 6% each. In the “Other” category, four respondents wrote that the students stored their data on password-protected or personal USB drives or similar devices, and password-protected computers through their university or their personal laptops. Alternately, most PhD survey respondents (48%) indicated a campus shared storage system. The rest of the responses were college shared drive/server (32%), no institutional/college level data storage solution provided (29%), 6% for Google Drive or Microsoft OneDrive not campus supported, and Dropbox (3%). Github and Bitbucket, which are code management services, were not selected in either survey.

When asked which tools were being used for preservation or archival storage of the data after the students’ project or research was completed, most respondents in both surveys indicated no institutional/college level solution is provided (DNP 60%; PhD 66%) followed by campus shared storage (DNP 20%; PhD 24%), and college shared drive/server (DNP 7%; PhD 17%).

In order to identify if data, coding, or other relevant documentation were preserved with the students’ final projects, program directors were asked about the preservation of any supplemental files. Figure Five indicates which supplemental files are recommended or required when preserving students’ project data after completion. Most respondents to both surveys indicated that no supplemental files were required to be preserved (DNP 69%; PhD 67%). Further, both surveys indicated that there was no institutional/college level data storage solution for supplemental files (DNP 42%; PhD 66%).

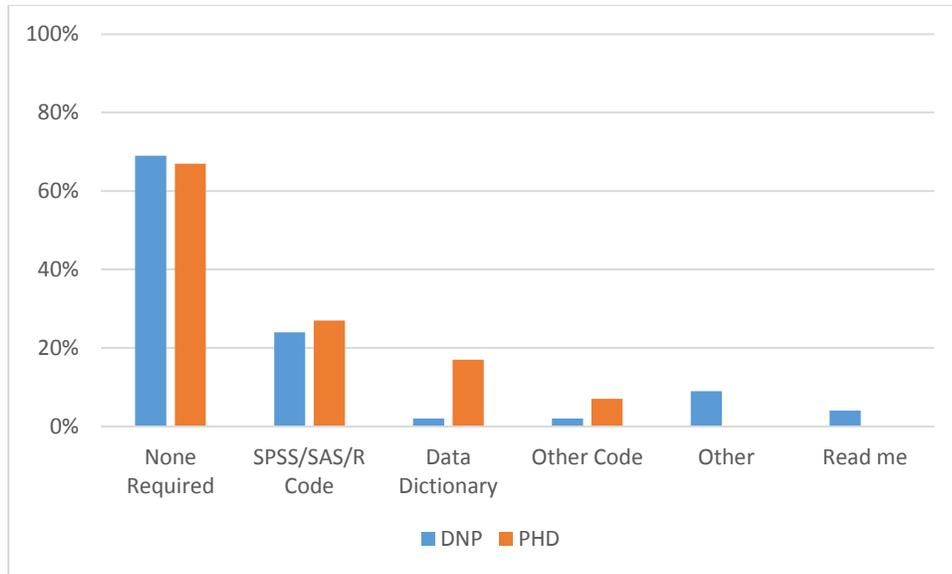


Figure Five

Which Supplemental Files are recommended or required when Preserving a Student's Project Data after the Project is completed?

When asked who is responsible for the students' project data, the student received the most responses in both surveys (DNP 83%; PhD 80%) followed by faculty mentor (DNP 28%; PhD 30%) then college or department of nursing (DNP 17%; PhD 13%).

#### Reusing Data

The reuse of data involves conducting secondary data analysis on existing data sets. When asked who had the authority to grant permission to reuse or validate students' project data, the doctoral student received the most responses (DNP 64%; PhD 69%) in each survey with faculty mentor/advisor (DNP 39%; PhD 34%) second. College or department of nursing administration (e.g. Dean, Association Dean of

Research) received the third most responses (DNP 18%; PhD 21%) followed by campus partner (e.g. Graduate College, Office of Research) (DNP 16%; PhD 7%).

Respondents were asked if DNP student projects or PhD research might reuse data from various data sources. The DNP respondents indicated equally reusing data from the institutionally affiliated health care sites and students' own place of employment with 52% each. The next highest responses in the DNP survey were government or professional association level surveys (39%) responses, data sets from regionally affiliated health care sites (28%). Thirty-three percent of DNP students did not reuse data from other sources compared to 17% in the PhD survey. For the PhD survey, data sets from government or professional association level surveys (70%) received the most responses followed by datasets from college or department of nursing faculty (53%).

For both surveys, students were financially responsible if they needed to purchase data sets for secondary analysis (DNP 59%; PhD 88%). College or department of nursing program received the second most responses (DNP 13%; PhD 13%).

### Campus Partnerships on Data Management

The final section of the surveys sought to identify which campus partners colleges or departments of nursing collaborated with for data management resources and support. The Library received the most responses as a partner in the DNP survey with (42%) while Campus IT [Information Technology] was selected the most in the PhD survey (60%). In the DNP survey, further responses were Campus IT (38%), the Office of Research (27%) and the Graduate School (24%). For the PhD survey, additional

responses included the Office of Research (37%) and the Library (23%). Respondents indicated relationships with none of the potential listed partners for 31% of the DNP responses and 30% for the PhD survey.

## Discussion

The most salient finding of this study is the lack of a systematic and pragmatic instructional approach programs in most colleges or departments of nursing for managing what is now a considerable amount of data collected by doctoral students with a modicum of faculty and college oversight through ad hoc individual mentorship. Inclusion of data management content within the curriculum is a rarity and when it is included, it is often limited to single lectures.

What has been traditionally handled by faculty mentorship of a small number of PhD candidates, has burgeoned into a tsunami of data collected and likely mismanaged by underprepared students and overwhelmed faculty members (Anderson et al., 2019). With the rapid rise in the number of DNP projects that a single faculty member is overseeing each year, the expectation that data management practices can be mentored on an ad hoc basis is unrealistic.

This study identified several specific gaps in programmatic preparedness to educate doctoral students about data management. Doctor of Nursing Practice programs were significantly more likely to report that they lacked data management resources compared to PhD programs. Deidentification of data and lack of college or department level data storage solutions are important examples of this. Nursing doctoral program directors are unaware of policies or support regarding data preservation and storage. There appear to be few standards for requiring development of a data

management plan, using institutionally-supported storage for active data capture or preservation, and institutional review board review seems to not be uniform across programs.

Our comparative analysis of college and universities using the Carnegie Classification's Basic category (The Carnegie Classification of Institutions of Higher Education, n.d.) identified differences in data management instruction between research and non-research-intensive institutions in our review. Our findings revealed 83% of PhD and 46% of DNP programs were in research designated institutions. Thirty-five percent of these institutions offered full course data training compared to 26% of masters level institutions. Mentoring was a significant strategy employed by 88% of programs at these research institutions compared to 61% at master's level institutions. Research institutions were utilizing lectures in a required course to disseminate content in 63% of programs compared to 61% in masters level institutions. Additional strategies were used 53% of doctoral programs and 42% of masters level institutions.

## Recommendations

Best practices guidelines are needed to guide both students and faculty and would address identified gaps. Accountability for data management needs to be established with the appointment of a Data Steward who will oversee the entire lifecycle of a college or department of nursing's data management practices (Bergren, 2019; Jansen, van den Berg, van Overveld, & Boiten, 2019; Privacy Technical Assistance Center, 2015). Colleges or departments of nursing may need to develop partnerships with other units on campus to facilitate training or develop infrastructure.

A standard curriculum of data management practices would accelerate student and faculty knowledge and skills. Systematic and ongoing data management training for students, faculty, administrators, and college or department of nursing information technology managers is necessary. The curriculum should include content from each of the data lifecycle stages. Of particular importance for doctoral nursing students is data protection content, which should include limiting access to data, safeguarding the system managing the data, and ensuring data integrity. Tutorials similar to HIPAA training and Human Subjects training could standardize the content and would measure if adequate mastery of data practices is met. Demonstrating knowledge is the first step towards becoming competent in data management practices.

Nursing doctoral students were indicated as ultimately being responsible for their data. The colleges or departments of nursing need to create a hard stop during DNP Project or dissertation proposal development that mandates data management plans and directs student to the requisite data management infrastructure and support. Data ownership agreements should take graduation and subsequent publications into account.

The expectation of employers is that the DNP prepared nurse has training in data mining and data analysis (Beeber, Palmer, Waldrop, Lynn, & Jones, 2019) One advantage of hiring a DNP-prepared graduate over other advanced practice registered nurses is that they have received instruction in data competencies. That expectation would logically extend to knowledge of data management best practices and the ability to operationalize current data management guidelines as a part of their role. By

incorporating the recommendations, data management practices will extend to facilities who employ DNP and PhD graduates.

### Limitations

Although steps were taken to establish content validity, external validity and reliability estimates were not conducted. There are no validated instruments related to data management at this time. Further development of a validated and reliable instrument is encouraged.

Respondents to these surveys were self-selected, likely representing programs that have developed data management educational practices and infrastructure. The response rate is relatively good for an external survey, but participation bias may be present. The surveys did not include questions related to the publication of students' projects or research. Further research is recommended to identify how doctoral nursing students navigate data sharing requirements related to scholarly publication.

### Conclusions

The current ad-hoc state of data management in nursing education requires an overhaul and the adoption of a culture of data. Nursing faculty must be given professional development opportunities or support to grow their data management skill sets for mentoring students and creating new data-focused course content.

Infrastructure must be built to support students and faculty throughout the data lifecycle, from the development of data management plans through the archiving and destruction of data. Colleges or departments of nursing must adopt data management plans for student projects or research, enable data storage solutions for students, and create or incorporate data themed policies into student best practices. DNP and PhD nursing

doctoral programs must integrate data management content into their curricula. By creating more robust data management infrastructure, policies, practices and curricula, nursing doctoral programs will graduate doctoral prepared nurse leaders who are prepared to meet the data competency expectations of health care systems, primary care clinics, in the community, and in academia.

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### Highlights

- Doctoral nursing program directors need education on institutional data policies.
- Mentoring is the most common teaching method for data management to doctoral nursing students.
- Survey results show little systematic data management education for doctoral nursing students.

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