REVIEW ARTICLE

Twelve Steps of a Health Science Research Project for Novice Dental Researchers - An Overview

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ABSTRACT

Conducting a brief research project is essential for undergraduate medical, dental, and other health science students in their degree program. The aim of this review is to spotlight the required components of a research project. More than 40 research articles were sought out using keywords "research question, literature review, research methodology, research problem, data analysis, results" on Web of Science, Medline, PubMed, and Scopus. Twelve steps for a research proposal are established for health science students including medical, dental, and other applied health sciences which would ease their learning and engagement in research.

Key words: Data analysis, health science research, literature review, methodology, research question, research statement student project

INTRODUCTION

Research is a systemic investigation to develop or contribute to existing knowledge. The key to ensure future of medical research is to engage and grab the health-care students at an early stage of healthcare program because students perceived a number of key barriers while pursuing a research career.[1] A research project is a compulsory module, which varies from one semester to three semesters in different dental schools. It provides an opportunity for the students to familiarize the research process[2] using their creativity and help them to develop their skills in analysis and managing the project. The students find it difficult as they are a novice in research methods. The purpose of this review article is to illustrate the essential steps to handle the research proposal from beginning to end.

STEP 1. DETERMINING THE TOPIC

The very first step in conducting a research project is to identify a general topic or subject area to be investigated. In selecting the topic, the personal interests of the researchers also play a significant role. However, one of the key factors while beginning research is that the research topic should address a knowledge gap.[3] For example, diabetes mellitus is a topic which could be chosen by students. Similarly, oral health is an idea which could be taken for research.[4,5] Selecting the appropriate topic is an easy step because novice researchers are under supervision of academic staff (professors and senior researchers) who lead the students' group. Next step is to search for more information on the topic using search engines.

STEP 2. LITERATURE REVIEW

To pursue the research idea further, literature is searched to expand the information on the chosen topic to find the gaps in the literature. In addition, this step helps in developing the research question.[6-9] There are many search engines which provide information on the required research idea and make a baseline for the research question. Web of Science, PubMed/Medline plus, or CINAHL are some of major search engines which provide titles and citations on most health-related literature published in many international journals.[10,11]

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Abstracts and links of many full-text articles are available on these search engines.

Literature or systemic reviews are rigorous methods of collecting and synthesizing the results of many high-quality studies. It helps to narrow the broader aspects of a research problem and determines what research has been conducted on a particular topic or idea. It also helps to identify factors which may confound or complicate the study questions.[12] This step may involve more than one investigator while using two or more databases.[10]

STEP 3. RESEARCH PROBLEM

Making a logical problem with the help of a literature review is the next step. It prepares the researchers to have a mindset for that particular problem. Finding a research problem is a basic step which should be clearly written in a research project.[13,14] It is often presented in the beginning part of a research proposal.[15] Thus, each study starts with a research problem and ends with a report.[16]

Studies show that real-life problems are the resource of research problems when participants were inspired by examples of integration of modern technologies with education, testing theories, and recommendation raised by previous studies.[17-19]

The characteristics of a research problem include its solution within a certain amount of time and cost.[20,21] It is also important to distinguish between the research topic and research problem. Research topic may come from the personal choice of the researchers while research problem could be gained by different studies and it also shows the personal experiences of researchers.[20-23]

STEP 4. RESEARCH QUESTION

A research process more likely depends on a medical problem in the form of a research question which determines the research architecture, strategy, and methodology.[24,25] Getting the right question increases the likelihood of finding a solution to the problem.[26] In other words, it is the key to find an answer for successful research.[24] Therefore, it is requisite that energy or resources should be spent on getting a clearly defined research question because a virtuous question enhances the clarity of the research protocols including data analysis.[27] It is always considered best to focus on a single primary research question for projects which are supposed to be run by students or novice researchers. Research question helps in making research design and provides guidance to select suitable research methods.[28]

However, developing a researchable question is a challenging task. It is uncertainty about a problem that could be faced in day to day research activities. A well-formulated research question requires specificity and preciseness which leads towards study population and research tools to be determined.[11] Research questions could be classified as either "background or foreground" questions.[29] The questions which are related to what, when, how, and where about the disease, disorder, or treatment are considered as background questions while patient-oriented questions involving interpretation of therapy diagnosis and prognosis are included as foreground questions.[29]

Discussion of research questions with colleagues, coresearchers and especially biostatisticians would help to determine the study objectives, study designs and ultimately the completion of the project successfully. Other steps such as budget, study center, and timeline should also be considered while formulating them. Expert methodologists have proposed the use of a structured research question to guide this process.[30,31]

Foreground research question is framed from PICO strategy which involves the population, intervention, control, and outcomes of the research project.[32] These elements make a balance between the research questions and the feasibility to obtain the answer and prompt the investigators to think about the research designs.[30] A good research question may lead to produce a quantifiable, specific, valid, and reliable primary research outcome[33] and it leads toward the facts rather than opinion.[34] Another approach to develop research questions is FINER (Feasible, Interesting, Novel, Ethical, Relevant) criteria[35] because the feasibility of conducting a research project is based on the research question and new investigators need guidance from their mentors.[33]

It has been formulated that a structured research question guides to the study design.[9] One or two research questions are considered for beginners. Furthermore, researchers found that the PICO format was independently associated with better overall reporting quality.[36]

STEP. 5 STUDY OBJECTIVES

After making research questions, the next step is to set objectives of the study. They are driven by a critical evaluation of the literature concerned with the problem.[37] Researchers should identify the specific aspects to concentrate on and formulate the research objectives accordingly. The characteristics of research objectives include being realistic, logical sequence, and clearly phrased.[38] Thus, they should be SMART (Specific, Measureable, Achievable, Relevant and Timely).[39]

In fact, the research questions leading to study objectives and questions which are of prime interest are considered as primary aims, and they should be specific and hypothesis-driven. It is

common to have one or two primary questions that would likely to be answered and remaining one or two secondary questions would be taken as secondary aims.

STEP. 6 PREPARATION OF RESEARCH PROPOSAL

A research proposal is an outline of the proposed project. It defines the problem and questions related to this problem to obtain answers. The proposal as a collectively adds up existing literature or develops new knowledge. Research proposal may vary in length, but it should not be more than 2500 words or 5 pages in length.[39] Potential supervisors assess the quality and originality of ideas, critical thinking of the students.

The elements which are requisite in a research proposal include; title, summary, introduction, literature review, problem statement, research questions, hypothesis, aims of the study, research design, study samples, data tool, data analysis tests, and research timeline including budget and references.

The introduction part of the research proposal provides a brief summary of the chosen field. This section also relates the topic with other scholars who have done their work on the topic. The literature review indicates the context of existing knowledge and other studies in the chosen discipline/topic. It is written to build up a well-established theory on the existing knowledge and addresses the certain gaps in the knowledge. Five to eight studies could be addressed in this section of the proposal. This is a baseline to produce the knowledge gap in the selected topic. The cited studies should range from recent to past 10 years. The very old citations are not recommended unless until it is about a basic ideology where other researchers have not worked out. Literature review leads toward the research question.

STEP. 7 RESEARCH DESIGN

The research design is a strategy by which researchers map out approaches to solve the chosen medical/dental problem.[40] It is also considered a comprehensive choice which uses specific methods to obtain the anticipated outcomes.[41] However, the choice of research methodology is based on the type and features of the problem to be investigated.[42]

Quantitative research method is used to measure the problem by generating numerical data or data that can be transformed into usable statistics. At undergraduate level, quantitative research method is more common among health science students. It emphasizes objective measurements and the numerical analysis of data collected through surveys, questionnaire and polls. Any numerical data is quantitative data. Quantitative research documents social and psychological dynamics and provides insight into what people's experiences are and why they do what they do in order to change. Researchers investigate new field of study or ascertain theories relating prominent issues more often by qualitative methods because such methods provide in-depth and extensive understanding of pertaining issues.[14,43] Qualitative research provides data collection either by interviewing or observation.[44] In the observational research design, multiple study sites are involved, and its data are taken as auxiliary or confirmatory research. Interviewing the study participants is a format of data collection in qualitative research which provides the framework to record the in-depth feelings, thoughts of participants.[44] The interview guide is comprised of a core question and many associated questions related to the central question, which could be improved further through pilot testing.[43] Qualitative research method makes an important contribution to the understanding of health; the illness experience and effective health care.[45]

Research involving quantitative and qualitative research techniques, approaches or theories in a single study is taken as mixed method research.[46] Qualitative findings are supplemented with quantitative results to achieve diverse conclusions.[46] Therefore, the two methods are considered to be complementary to each other rather than incompatible with each other.[47]

STEP. 8 ETHICS

Ethical consideration is made before the actual research project is started. A formal Institutional Review Board (IRB) is established in every medical, dental, and other health science school research center where a formal request is sent along with all, required documents. Researchers need to take permission from IRB for any type of research, especially if human subjects or biological materials are needed to accomplish the study idea.[48,49]

It is important to mention for novice researchers 'The Human Medical Research Act'[50] recommends that research proposals may not be implemented until they have been approved by an authorized medical ethics review board. The members of review board could be physicians, senior researchers, psychologists, epidemiologists, lawyers and experts of medical ethics. The responsibility of the ethics board is to examine the worth of study, risks or disadvantages for the involved subjects consents of subjects because they should know what are the risks involved in the testing methods. The IRB gives a general judgment about the admissibility of the scientific study.[51]

Participation of subjects in the study is always voluntarily and based their own choice. They cannot be enforced to

participate in the study against their will. They can leave the study without any reason at any time. Participants have the right to get more information about the study aims/tests or advantages and disadvantages. It is also required by the researchers that they keep the confidentiality of the patients' data and process with codes.

STEP. 9 DATA COLLECTION AND ANALYSIS

Data, based on the study design, should be collected carefully and accurately without any subject bias. Double-blind is taken as where clinicians and patients are not informed what they are given the products. Triple blind means even statisticians are not also informed about groups. This is important that deliberate fabrication in the data is ethically unforgivable. Novice or even senior researchers should not change the data to obtain the desired results.

The data are collected in different ways such as interviews, videotapes, survey, field notes, log books, diaries, and file reviews. These methods have diversity and flexibility. Therefore, researchers must describe with sufficient detail what steps were taken in collecting and recording the data to provide understanding to the readers.[52]

Data are analyzed by various methods. The commonly used tools are the Statistical Package for the Social Sciences (SPSS), Excel (spreadsheet), and Microsoft Access (database mntg) and Statistical Analysis System (SAS).[53,54] In SPSS, it is recommended that all alphabetic and numeric variables are correctly specified, and they can be viewed as data view and variable view.[55] A large set of data can be described by descriptive statistics[56,57] and summarized in table forms to provide a clear and quick view for readers. The data give relationships of variables either obtained as qualitative or quantitative. There is a possibility that variables are differentiated or compared. Therefore, outcomes are forecasted based on data analysis.[53] Qualitative data is suggested to be analyzed manually because the desired results entail analysis of attitude, values and feelings. However, software tools like NVivo, ATLAS.ti, MAXQDA are available for qualitative data analysis. Data analysis is the process where mass of collected data is brought in order, and structured in meaningful results to the readers.[58,59]

STEP. 10 RESULTS

This section is fairly factual and described in the text as well in table or graph forms. Salient analytical analysis is demonstrated in sentences while some of the non-essential facts are tabulated. It correlates the research question and hypothesis to provide specific information and solves the problem. Significant facts are highlighted in this section.[60]

STEP. 11 DISCUSSION

After results, this is requirements to compare the results with other researchers available on the websites of various relevant journals. This section gives freedom to the writers in the sense that writers/researchers should use as many as others research findings which are in the line of their findings or they may contradict also. The IMRaD structure (Introduction, Methods, Results, and Discussion) is used by researchers for medical scientific papers.[58] Reviewers also follow the same pattern. Keeping in view the readers choices, journals also recommend abstract to be framed the IMRaD structure which is termed as structured abstract.[59,60]

It has been described how authors use rhetoric in the discussion of papers.[61] Extensive texts without subheadings, introducing new findings or emphasizing the strength or weakness of the study are all used in the discussion part of the research paper.[62] A structured discussion includes a restatement of the principal finding which may not be more than two sentences followed by a comprehensive examination of the strength as well as the weakness of the research project. If weakness of the study is not mentioned, it may shake the trust of the editors and readers.[63]

Research proposals are of various types, so journals have introduced specific structures for particular types of papers such as the CONSORT structure for reporting randomized trials.[64,65] There is a possibility that uniform structuring is difficult and even restrictive.[66] Richard and Michael[67] suggested a reduced overall length, unjustified extrapolation, and selective repetition, and improving the overall quality of reporting. Hiding the relative weakness of the study comparing other studies is not recommended. Important is reaching on a different conclusion based on circumstances relating to other studies. Having a right or wrong results are not the issue. The findings should be discussed which may be related to clinicians or policymakers.

STEP. 12 WRITING AND REVISING RESEARCH ARTICLE

Writing a research manuscript is also a part of research project. This is required by novice as well as senior researchers because this is the opportunity to share the certain findings of the chosen research topic with colleagues and peers across the global. A research paper is a highly codified rhetorical form.[68,69]

Writing a paper requires the structure of the paper to be placed properly and accordingly. An important and basic recommendation is to follow the instruction to the authors of the selected journal because each journal has its specific requirements and such information is given on the website of

the journal. It is recommended to the novice writers that they should have several drafts before it is submitted to the chosen journal. The words count suggested for original research article could be an introduction (500 words), methods (up to 1000), findings (500–1000), and discussion (1000–1500). The suggested words count for the qualitative report is 3500 words.[70,71]

CONCLUSION

Making a research proposal for its publication is a twelve step process. Getting an idea makes the "title" of the research proposal. "Literature search" helps in finding gaps of the knowledge which creates "research question." Loops are the "research problem." Research questions build "aims and methods." "Data analysis" provides the "results" or answer to the questions and correlating the results with other studies is the "discussion and conclusion."

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