

Exploring the Biostatistics Learning Needs of Healthcare Experts and Medical Doctors for Improved Evidence-Based Clinical Decision-Making and Research Understanding: A Qualitative Study

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ABSTRACT

Purpose: Biostatistics is a fundamental tool that enables healthcare professionals to support evidence-based decision-making, analyze clinical data, and improve the quality of patient care. Therefore, this study aimed to explore the biostatistics learning needs of doctors and healthcare professionals. The research also examined the role of biostatistics in research understanding and evidence-based clinical decision-making. **Design/ method/ approach:** The research adopted an interpretive qualitative research approach with a multi-exploratory research design. The study employed a purposive sampling technique. Data were collected from different healthcare professionals, including resident doctors, consultant physicians, public health experts, and clinical researchers. The collected data were analyzed using reflective thematic analysis based on Braun and Clarke's framework. **Findings:** The study findings showed that healthcare professionals recognized biostatistics as the foundation of evidence-based medical practice. The results further revealed that healthcare professionals mostly perceive biostatistics as an examination- and theory-oriented subject, resulting in low research self-efficacy and statistical anxiety. Participants also reported difficulties in applying and understanding statistical knowledge in evidence-based clinical decision-making. **Originality:** The research provides insight into the practical and educational challenges of biostatistics learning and their role in evidence-based healthcare decision-making.

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1. Introduction

In modern healthcare, biostatistics is one of the key components that plays an important role in healthcare policy development, public health decision-making, clinical research, and evidence-based medicine (Sultana et al., 2024). The healthcare system mainly relies on data-driven approaches to improve population health and patient outcomes. The demand for healthcare experts with biostatistical competencies has increased rapidly (Chao et al., 2023). However, educational programs in biostatistics are mostly structured using a generalized approach. They are developed on the assumption that healthcare professionals share similar statistical learning requirements, research responsibilities, and professional goals. This generalized teaching approach often fails to address the diverse practical needs, research tasks, and learning requirements of healthcare professionals, thereby reducing the effectiveness of biostatistics training (Chaoubah, 2021).

Healthcare experts represent a broad spectrum of learners, ranging from public health practitioners to clinicians who require statistical literacy for interpreting biomedical literature, to researchers conducting collaborative and independent scientific investigations, and to trainees completing important research milestones (Sullivan, 2023). Each category of learners demonstrates different biostatistics needs shaped by their level of involvement, institutional resources, and professional roles. Healthcare professionals focused on patient care may require these skills mainly to understand statistical findings, whereas independent researchers need advanced competencies in study design, data analysis, and data interpretation (Nowacki et al., 2025).

Data are needed in medical research and healthcare more than ever because evidence and numerical findings add

greater credibility to scientific discoveries rather than relying on words alone (Wang et al., 2022). Determining the amount of a drug required to treat a specific disease using numerical data helps inform policies regarding drug utilization in clinical settings. Biostatistics enables researchers to use and interpret numerical data for evidence-based decision-making. This contributes to important advancements in medical research and the development of public health policies. Biostatistics also ensures that appropriate medical procedures are adopted from the beginning. Biostatistics guides the design of surveys to minimize leading questions, incorporates checks to avoid data collection errors, and emphasizes accuracy of measurement through different tools. Biostatistics also develops integrity within different datasets through rigorous planning for validity and reliability (Sultana et al., 2024). Good statistical thinking transforms raw numbers into a credible and solid foundation that cannot be achieved through poorly understood or disorganized data. Biostatistics serves as an important translator between raw data and real-world actions. Some studies consider it the driving force behind evidence-based practices, converting uncertain observations into meaningful evidence that researchers, clinicians, and policymakers require to make informed and life-impacting decisions (Sakarna et al., 2025).

Decision-making is a cognitive process that involves selecting a course of action from different possible alternatives. Choosing the most appropriate option among several alternatives forms the basis of decision-making and is essential for accurate and timely healthcare service delivery. In the context of healthcare, decision-making is a highly complex process (Agure et al., 2024). Decision-making should be time- and context-dependent so that patients can receive maximum benefit from it. Health outcomes are based on probability rather than certainty, as most decisions are made under conditions of uncertainty. Therefore, it is very important that these decisions are accurate because they directly affect patient health outcomes (Zavras, 2026). The development of research infrastructure provides a number of opportunities to fill this gap because of recent developments in statistical analysis, study methods, and information technology. Nurses and other medical specialists play key role in medical decision-making process. The sensible approach that is used by these specialists is using evidence-based approach in the form of objective facts. The likelihood of meeting health objectives is increased as result of using different evidence in process of decision making (Agure et al., 2024).

Medical doctors and other healthcare professionals play an important role in improving evidence-based clinical decision-making by combining scientific research, patient values, and clinical expertise to provide effective healthcare. The role of these medical specialists involves managing patients, selecting treatments, and diagnosing conditions by using reliable clinical data and systematic assessment. Evidence-based decisions improve doctors' understanding of research, support informed decision-making, and strengthen critical thinking, which ultimately improves patient outcomes (Berkhout et al., 2025). The role of these medical specialists involves managing patients, selecting treatments, and diagnosing conditions by using reliable clinical data and systematic assessment. Evidence-based decisions improve doctors' understanding of research, support informed decision-making, and strengthen critical thinking, which ultimately improves patient outcomes (Buljac-Samardzic et al., 2020). For physicians, these competencies are important for delivering higher standards and best practices of medical care in healthcare settings. Different clinical decisions are made regularly in daily healthcare and medical practice. Most of these decisions are handled by physicians, creating a need for understanding biostatistical skills. This research aimed to analyze the biostatistics learning needs of doctors and healthcare professionals. The study also examined the impact of biostatistics on research understanding and evidence-based clinical decision-making.

2. Literature Review

2.1 Evidence-Based Clinical Decision-Making

In literature, term evidence-based decision making was introduced around three decades ago as evidence-based practice. The practice of clinical medicine was initially involved in this new paradigm. It aimed to advance and develop a rational and transparent process for clinical decision making that did not rely only on single and intuition clinical expertise. Moreover, it could be applied, redefined, and taught by all physicians (Connor et al., 2023). Since then, a number of different frameworks and models have been proposed in field of healthcare. In these models, evidence is defined in literature in broader context as circumstances and facts that provide refute or support a statement or belief or show if something is acceptable or true. The concept of evidence has a great effect on our understanding and knowledge. The practitioners explore a number of studies that consider clinical questions of physicians, the area of specific interest, and intervention type. The time at which physicians are practicing medicine has transformed at tremendous rate (Alabdullah et al., 2022). The practitioner patient relationship has evolved drastically. Presently, patients contribute in the process of decision making, which lead to incredible technological breakthroughs (Gutenbrunner & Nugraha, 2020).

Evidence based practice is the usage of best evidence that is available together with a patient's value and preferences in making decisions related to healthcare. The chronic care and prevention programs work to enhance the available evidence base for practices that are evidence-based and to make sure that physicians have the tools to use this knowledge in practice

(Engle et al., 2021). Evidence-based decision-making reflects the prudent, conscientious, and explicit evaluation regarding the information that is best available in decision-making process. The process of evidence-based decision-making is based on gaining new skills and learning latest approaches. The skills that are learnt include the way to ask different clinical questions, analysing the process, utilizing the clinical settings, and carry out computerized search. This method recognized that it is hard for physicians to be up to date on all products, materials, treatments, and illness accessible. Therefore, evidence-based decision making provides methods to fill the gaps in knowledge to get the best possible care. The prime goal of evidence-based practice is to improve the quality of health care (Mohamed et al., 2024). It tries to reach at the medical decision on the basis of advanced and latest search with the help of best evidence possible. Providing support to evidence-based decision making leads for the better patient outcomes, better products, smarter research planning and improved formulation of policy (Kurien et al., 2022).

2.2 Biostatistics Learning Needs of Healthcare Experts

Biostatistics is based on application of statistical methods to health related and biological data. It helps scholars to analyze results, collect data, and design studies with purpose to make informed decisions (Indrayan, 2021). With the help of statistical techniques, medical professionals have the ability to identify associations, trends, and patterns within their data. Statistics is defined as the science of analyzing and collecting numbers to make decisions and find patterns. Biostatistics is one of the specialized form of statistics, applied specifically to medicine, biology, and health. General statistics has the ability to tell stakeholders regarding scores and trends (Faizi & Alvi, 2023). Whereas focus of biostatistics is on the well-being of the community. Biostatistics is the important toolkit that is used by researchers to convert raw numbers into real-world health answers and make sense of medical data. In context of medical research, biostatistics helps in determining different new treatments that can work genuinely (Verma et al., 2025). It also tracks outbreak of disease and finds out risks for the communities. Furthermore, it provides information regarding genetic patterns also. The most famous role of biostatistics is in analyzing and designing clinical trials. It deals with proving the vaccine's efficiency to linking cancer and lungs, biostatistics provides the evidence that helps in preparing medicine for backbone (Slade et al., 2025).

Biostatistics plays very important role in context of healthcare by providing analytical framework that is important for improved patient outcomes, and evidence-based practice. Because of growing complexing of the medical systems and increased reliance on decision making that is data driven have intensified the necessity to develop competencies in biostatistics (Tandon et al., 2025). According to past studies, biostatistics is critical to conduct scientific research. It also enables healthcare professionals to make informed decisions in patient care, assess treatment outcome, and interpret clinical evidence (Indrayan, 2021). This shed light on broadening learning needs for the experts of healthcare to acquire applied and foundational biostatistical knowledge. Studies indicates that one of the basic need of biostatistics among professionals of healthcare is the ability to interpret and identify risk factors of disease (Burt, 2023). Different biostatistical methods allow researchers and clinicians to develop preventive strategies, understand association between health conditions and exposure, and analyze the data (Indrayan, 2021). These competencies are important for healthcare policymakers, clinicians, and healthcare experts involved in health promotion and disease prevention.

Healthcare experts need biostatistical training to critically evaluate, assess statistical significance, and understand research methodologies (Nowacki et al., 2025). This skill is needed to improve healthcare delivery and support evidence-based medicines. Additionally, studies mentioned the importance of outcome and predictive analytics forecasting in modern healthcare (Bandi et al., 2024). Biostatistics enable physicians to develop personalized treatment plan, identify predictive variables, and analyze large datasets. With the evolution of personalized medicine, healthcare experts need to learn advance biostatistical skills to apply predictive models in effective way (Mavai et al., 2025). Overall, studies show that learning needs of biostatistics among physicians extends beyond basic knowledge of statistics to predictive analysis, treatment evaluation, and risk assessment. To address these diverse needs, it is important to strengthen research capacity of healthcare, improve patient centred outcomes, and enhance professional competence (Castro et al., 2026).

2.3 Biostatistics Learning and Evidence-Based Clinical Decision-Making

Studies mentioned that biostatistics is recognized as important component of professional practice and medical education as it equips physicians and healthcare professionals with skills that are needed to apply evidence-based medicine principles, evaluate clinical research, and interpret scientific evidence (Prihanti, 2017b). Number of past studies have identified major deficiencies in knowledge of biostatistics among professional of medical, despite increasing reliance on research based clinical decision-making (Lakhlifi et al., 2023). Scholars found that a number of healthcare workers demonstrated lack of understanding of important statistical concepts and research methodology that limits the ability to appraise literature of medical and incorporate valid evidence into care of patients (Novack et al., 2006). This knowledge

gap was evident in a number of studies when they mentioned study validity, confidence intervals, and statistical significance.

Research regarding healthcare educators also highlighted the vital role of structured education of biostatistics. Studies found that academic staff in health studies perceive biostatistics as very important but consider existing programs of education as inadequate for meeting the needs of professionals (Kiliç & Çelik, 2013). Scholars also revealed the importance of clinically relevant and applied statistical training as compared to only relying of theoretical instructions. Studies conducted research regarding evidence based learning education that also supported blended training approaches, workshops, journal clubs, case based instruction, and learning approaches as important strategies to improve healthcare professionals evidence based competencies (Chandran et al., 2023). These methods can connect statistical theory with application in medicine research and facilitate stronger skills to make decisions (Dhillon et al., 2022). Studies also suggested that incorporating biostatistics comprehensively into curricula of medicine enhances physicians confidence to support lifelong learning and in research interpretation (Prihanti, 2017a). Thus, medical doctors and healthcare experts need stringer biostatistical education to improve evidence based clinical decision-making (Mai et al., 2020).

3. Methodology

3.1 Philosophical Assumptions and Research Paradigm

An interpretive qualitative research paradigm was used in the current study. Based on the assumption that reality can be socially constructed, via human interactions, experiences, and professional contexts. This approach was selected because the objective of the current study was to explore how health care professionals and doctors experience, interpret, and perceive their bio-statistical learning requirements.

Furthermore, a constructive epistemological orientation approach was adopted, recognizing that biostatistical understanding is shaped by institutional culture, research engagement, clinical exposure, educational background, and professional experiences.

3.2 Design of Research

A multi- exploratory qualitative research design was employed.

In depth examination of training experience, professional challenges, knowledge deficiencies, and expectations about the competencies related to biostatistical learning enabled by the exploratory nature of the study.

A multi-perception research design utilised views from different categories of professionals for triangulation and enhanced the analytical strength of the study.

3.3 Setting of Study

The current study was conducted in the units of clinical research, institutions of public health, teaching hospitals, and medical universities.

The purpose of this study was to select healthcare professionals who are daily exposed to academic supervision, activities of research, statistical interpretation, and medical practices based on evidence

Both clinical and academic environments were included to enhance credibility and strengthen the contextual diversity.

3.4 Target Population

The study population included healthcare experts and professionals involved in medical education, biomedical research, clinical practices, and public health. The approachable population comprised professionals working in selected medical institutions and hospitals.

3.5 Classification of Participant

For the apprehension of manifold dimensions learning needs of biostatistics, from five groups of professionals, the participants were selected. The first group was of consultant physicians; doctors who are involved in supervision and decision-making. The second group was of resident doctors; trainees actively involved in learning medicine at the postgraduate level. The third group was of faculty members of medical institutions, involved in active research and teaching. The fourth group was of clinical researchers, conducting clinical and biomedical studies. The last group was experts in public health; professionals involved in health data and epidemiology analysis.

3.6 Sampling Technique

The current study utilised a purposive sampling technique in which the respondents were selected based on their research experience, exposure to tasks relevant to bio-statistics, and professional relevance. This approach helped to select the participants who were information-rich and could provide detailed awareness. Second was the sampling based on criteria, in which the criteria of inclusion were that the participants had professional experience of more than two years,

had prior research, academic, or clinical activities exposure, and participated in the study voluntarily, while the participants who did not have the exposure to research activities or were not willing to participate in the study process were excluded from the study. To ensure the diversity of the responses, participants from different roles in institutions, having different ranks, different specialisations and backgrounds of research were included. This approach improved the breadth and depth of qualitative results.

3.7 Sample size

The sample size of the current qualitative study was determined through saturation of data rather than based on statistical computations and standards. Starting with 25 participants, the interview process continued until repeated themes were evident, no significant new concepts arose, and analytical capacity was achieved. The final size of the sample was 7 consultant physicians, 6 resident doctors, 6 faculty of medicine, 5 clinical researchers, and 5 experts of public health, which means a total of 29 respondents.

3.8 Data Collection Procedure

From relevant hospitals and departments, permissions were obtained. Identification of participants was done through the office of research, recommendation of department, and professional networks. The participants were contacted

Through official letters, personal contact, and email invitation. Every respondent received a consent form, the objective of the study, an information sheet, and a schedule of interviews.

3.9 Tool Development Procedure

An interview guide was developed to conduct the semi-structured interviews

3.9.1 For Tool Development Review of Literature

After the extensive literature review relevant to statistical literacy, challenges of medical curriculum, research competency, quantifying anxiety in health care, evidence-based medicine, interview guide was developed. Key reviewed data bases included Scopus, Google scholar and Science direct.

With the help of literature recurring domains and knowledge gaps were identified relevant to the objective of study.

3.9.2 Identification of Domain

Based on the literature synthesis, five major domains were identified (Table 1):

Table 1: Five Major Domains Based on the Literature Synthesis

Domain	Area to focus
Basic Understanding	Basic Concepts of Statistics
Practical Application	Use Of Clinical Understanding and Research
Cognitive, Emotional and Experiences	Confidence, Anxiety, Motivation
Educational and Institutional Factors	Teaching Quality and Curriculum
Expectations about Learning	Preference About Training Methods

3.9.3 Interview Questions Drafting

To encourage the rich narrative responses, exploratory open-ended questions were developed

For example, “what is your experience of learning biostatistics during education of medical”

“Describe difficulties you have faced in the interpretation of your research findings.”

“What is the level of expertise you possess in using statistical software?”

“For professionals of healthcare, what type of bio-statistical training would be useful?”

Some probing questions were also prepared for the effective understanding of responses.

3.9.4 Validation of Experts

Guide was reviewed by two experts of health sciences, one qualitative research expert, and one biostatistician. The selected experts evaluated concept clarity, comprehension, content relevancy, and sequence of questions. Based of feedback of experts some modifications were made.

3.9.5 Pilot Testing

Researcher pilot-tested the interview guide with one faculty member of medical institution and one resident doctor. This process assessed the

Understanding of participants, clarity of question, flow of interview, and response richness. Some minor revision included regarding the probing prompts, rearrangement of questions and simplification some technical statements. These pilot interviews were excluded from the analysis.

3.10 Collection of Data

Researcher conducted interview over 7 to 9 weeks. Initially the respondents were briefed about the objectives of study, informed consent was obtained in written. Interviews were conducted in comfortable and quite environment, the duration of Interviews was 30 to 50 minutes. Responses were recorded with the permission of participants. Field notes were taken during interviews.

More reflective prompts supported the participants to elaborate research work challenges, experiences during the interpretation of research findings.

3.11 Management of Data

Transcription of recordings were made, transcripts were coded, anonymized and in password protected files securely stored

Identifier was assigned to each participant

Consultant Physician (CP2), Resident Doctor (RD3), Medical Faculty (MF1)

Researcher maintained coding logs, analytical memos and reflexive journals throughout the process of research.

3.12 Analysis

Reflexive thematic analysis was used for the analysis of the qualitative data. following six-phase framework of Braun and Clarke

It involved, transcripts familiarization, coding, categories generation, construction of themes, refinement, and interpretive synthesis.

3.12.1 Strategy of Coding

A three-layered coding strategy was applied: semantic, latent emotional. Semantic coding is used for explicit statements, latent was used for hidden meanings, and emotional codes used for the coding of emotional response. A total of 116 codes were generated.

3.12.2 Development of Themes

Clusters of codes were converted into conceptual categories. These categories are then converted into broader themes. Themes were continuously refined through memo writing, peer debriefing and constant comparison.

3.12.3 Study's Trustworthiness

The using framework of Team (2003) study ensured rigor. by examining credibility through members checking, dependability through trails, confirmation through reflexive journaling, authenticity through direct quotes and transfer ability through descriptions.

For ethical consideration respondents were provided consent form, confidentiality assurance and given the rights to withdraw at any stage of study. Any confidential information or sensitive information was not included in the reports or transcripts.

4. Data Analysis and Findings

4.1 Professional Profile and Participant's Demographics.

29 experts and health care professionals participated in the study. To summarize demographic characteristics of professional's descriptive analysis was conducted prior to the thematic analysis.

4.1.1 Participants' Demographic Characteristics

58% respondents were male and 42% were female. 37.5% were between 26 to 35 years, 33.3% were between 36 to 45 years and 29.2% were of the age above 46 years. 25% were consultant doctors, 28.8% were resident doctors, 16.6% were clinical researchers, 20.8% medical faculty and 16.7% public health professionals. 29.2% had 3-to-6-year experience, 37.5% had 7 to 11 years and 33.3% had more than 11-year experience. 45.8% had formal bio-statistics training prior to the study while 54.2 don't had. 20.8% used statistical software regularly, 37.5% occasionally, and 41.7% never used statistical

software.

Thus, professional pool of participants demonstrates significant diversity enhanced analytical strength. High proportion of participants belongs to 26 to 35 years age interval, indicating significant representation of young professionals, the highest professional group was of consultant physicians followed by resident doctors. The point of concern is that the more than 50% of the participants lacked the formal bio-statistics training. Similarly, only 20.8% regularly use the statistical software. Thus, the descriptive analysis demonstrates the potential deficiencies in practical implication of statistical tools among health care experts.

4.2 Pattern Analysis and Preliminary Coding

Initial analysis includes the line-to-line examination of transcripts to identify repeated experiences, concepts and perceptions. Total 116 codes, 28 categories and four major themes were generated (Table 2):

Table 2: Coding Process Example

Statements	Code	Category
"To Clear My Exams, I Remember Formulas."	Surface-level learning	Submissive practices of education
"SPSS Is Very Technical Software."	Fear of software	Anxiety of digits
"I Took Help from the Statisticians for the Interpretation of Results."	Dependence	Gap of competence
"With The Patients' Cases, Statistics Must Be Taught."	Preference for applied learning	Requirement of Curriculum reforms

4.2.1 Code Frequency Distribution

For enhancing the analytical transparency, the repeated dominant codes were quantified. Requirement of bio-statistical training scored highest (22), followed by the deficiency of practical exposure (20), problem in statistical interpretation (18), anxiety of statistics (17), dependency on statisticians (15), software related fear (14), lack of curriculum integration (10).

4.2.2 Interpretation

Frequencies of codes shows that emotional barriers and lack of practical knowledge were of significant concerns among respondents. The most repeated issue was the requirement of applied training and workshops followed by deficient practical exposure and problem of interpretation of results.

Finding indicated that the problem is not the lack of knowledge but the lack of practical problem based understanding. Participants felt the major disconnection of professional application and the statistical education.

4.3 Thematic Analysis

Four overarching themes were generated with multiple sub-themes.

Theme # 1: Bio-statistics as a Theoretical Subject

According to the perceptions of respondents the bio-statistics is a theoretical subject that have no connection with clinical realities. Most of the respondents explained their educational experience in context of bio-statistics as formula based and exam oriented, resulting in surfaced understanding rather than in-depth practical knowledge.

4.3.1 Sub-Themes: Memorizing Formulas

Respondents described that they learned the statistics by memorizing the statistical formulas without practical understanding.

Exemplary quotations

"I learned formulas just to pass exams." (RD4)

"I felt statistics disconnected from health-science." (CP3)

4.3.2 Deficient Clinical Context

According to the respondents in teaching bio-statistics reality based cases and clinical scenarios were not used.

Exemplary quotations

"We were not taught about how statistics effects decisions of treatment" (MF2)

Interpretation

Results suggest that conventional methodologies and philosophies can unintentionally enforce behavior of passive learning, which can reduce the statistical capacity of reasoning in healthcare experts.

Theme #2: Cognitive Insecurity and Statistical Anxiety

Throughout the interviews, a significant emotional dimension emerged. Respondents described embarrassment, fear, lack of confidence, and confusion while engaging in the statistical concept and interpretation.

4.3.3 Sub-Themes: Fear of Statistics

Respondents demonstrate discomfort while interpreting confidence intervals, regression output and P-values.

Exemplary quotations

"I avoid questions with complicated statistical computations." (RD5)

"Statistics is a source of anxiety." (CP3)

4.3.4 Software Insecurity

Many respondents perceived statistical software is very complicated and difficult to understand.

Exemplary quotations

"I feel SPSS very scary." (MF2)

Interpretation

Analysis demonstrate that inappropriate educational exposure leads to statistical anxiety which can effect engagement of research and evidence-based practice.

Theme # 3: Statistical Dependency

Statistical dependence was frequently reported by Participants, data analysis, interpret, and report writing. It was perceived normal institutionally

4.3.5 Sub-Themes: Statistical Responsibilities Outsourcing

Respondents commonly

Took help of the statisticians for statistical computations and interpretations.

Exemplary quotations

"I commonly rely on statisticians for analysis." (CR3)

4.3.6 Low Research Self-Efficacy

Respondents described that they feel under-confident while conducting independent analysis

Exemplary quotation

"Data collection is not a big deal but the problem is that I cannot analyze it independently." (RD3)

Interpretation.

Research finding suggest that there is a significant gap where professionals are trained to utilise research outcome but unfortunately unable to produce and analyse it independently.

Theme #4: urge for experiential and applied learning

Respondents emphasized the need for the educational reforms focusing practical engagement.

4.3.7 Sub-Themes: Case-Based Learning

Respondents preferred the teaching methodology embedded in clinical practices.

Exemplary quotation

"Statistical analysis should be based on practical cases." (PH4)

4.3.8 Hands-on Training of Software

It was recommended by the participants that focus must be on the design of case-based workshop involving real cases.

Exemplary quotation

"Fear of software usage can be significantly reduced through practical sessions" (CP6)

4.3.9 Continuous development

Respondents focused on the requirement of continuous learning of statistical tools after graduation

Exemplary quotations

"There must be regular refresher training programs for doctors" (MF3)

Interpretation

According to respondents experiential learning is important for transformation of statistical tools into practice. It was indicated that passive teaching should be converted to a problem-centred, interactive, clinically integrated philosophy.

Theme# 5: for evidence-based decision making, Biostatistics as a Foundation

It was consistently highlighted by the respondents that in evidence-based practice of medical bio-statistics plays a significant role. At the same time it was also emphasized by most of the respondents that due to limited competency of statistical proficiency, it is very difficult to evaluate critically and interpret the findings of research efficiently and take informed, evidence-based decisions.

This theme reflects judgment, planning, and interpretation of clinical issues and healthcare policy decisions. Despite recognition of the significance of biostatistical analysis, they were still unable to practice it confidently.

4.3.10 Subtheme: Interpretive Deficiency of Scientific Evidence

Respondents reported that they faced problems with the quantitative statistical findings in the systematic review and clinical trials, like confidence intervals, p-values, and odds ratios

Exemplary Quotations

“When I read articles, I find it difficult to understand the statistical section” (RD3)

“Without completely understanding the analysis, oftentimes we accept findings and conclusions.” (CP4)

Interpretation

Results indicated that a lack of statistical understanding reduces the healthcare professional's ability to critically analyse scientific evidence, which can affect clinical judgement based on evidence.

4.3.11 Subtheme: Lack of Confidence in Clinical Decision- Making

According to the respondents, inadequate statistical understanding reduces their confidence in clinical decision-making, comparison of clinical outcomes, and evaluation of effective treatment.

Exemplary Quotations

“It is very difficult to decide in a specific situation because multiple studies show different results for the same phenomenon” (MF1)

“Evidence-based decision is not possible without statistical understanding.” (PH2)

Interpretation

It is not only an academic requirement, but for informed and safe decisions about health care, it is very important to have biostatistics competency.

4.4 Findings Summary

Results of the current study exhibited that for healthcare professionals, biostatistics is not only a psychological barrier but also a technical and educational challenge. The findings highlighted emotional discomfort, dependency patterns, deficient practical exposure, and strong requirement of experiential learning. Insights shed light on the requirement of transforming curriculum towards competency-based clinically integrated bio statistical education. For evidence-based decision making, in-depth understanding of bio statistics is very important

5. Discussion

Study investigated biostatistical learning needs of the medical doctors and healthcare experts. Research also explored role of biostatistics for research understanding and evidence-based clinical decision-making. Results demonstrated that physicians and other healthcare professionals recognized biostatistics as basic component of informed clinical decision-making and evidence based medical practice as mentioned in research by Kiliç and Çelik (2013). Respondents acknowledged that statistical understanding is important for making safe healthcare decisions, comparing clinical outcomes, evaluating treatment effectiveness, and interpreting research findings. Whereas, despite understanding the importance of biostatistics, most of respondents lacked required competence and confidence to critically and independent to interpret scientific evidence. Respondents also reported the difficulty to understand odds ratios, confidence intervals, and p-values which represent systematic reviews. Therefore, healthcare professionals mostly rely on conclusions that are published without understanding analytical process in the background. It limits the imperative ability that can reduce effectiveness of evidence based clinical judgement and weaken critical appraisal skill. They also highlighted that confusion is created because of conflicting findings in past studies. This confusion is created during clinical decision making specially when it is difficult to interpret statistical evidence. Results also suggests that biostatistics competency that is inadequate can have negative influence on patient care decisions, treatment evaluation, and healthcare planning. Thus, strengthening statistical literacy among different healthcare professional is important for academic development. It is also key to improve informed healthcare practice, evidence interpretation, and clinical reasoning. Integration of evidence appraisal training and clinically focused statistical education may enhance professional competence and decision-making confidence in healthcare settings.

Results showed that biostatistics is perceived by physicians and healthcare learners as examination oriented and

theoretical subject rather irrespective of practical clinical tool. Respondents mentioned that teaching methods of biostatistics are mainly based on memorizing different formulas, which is helpful for surface learning instead of analytical understanding. Because of such experience, physicians are unable to connect different concepts of statistics with evidence-based decision making and healthcare problems. Participants also revealed that different biostatistics courses lacked practical demonstration, patient cases, and clinical examples, that reduces the awareness of the way statistics interpretation influences healthcare planning, treatment decisions, and diagnosis. These results also support the argument that traditional teaching approaches may weaken statistical reasoning ability and promote passive learning behavior among healthcare professionals. When physicians are not able to create linkage between clinical realities and statistical knowledge, they often develop negative perception about the importance of biostatistics in practice. Thus, integration of clinically relevant examples, applied data analysis, and case-based teaching into biostatistics education can improve healthcare professionals' confidence, practical understanding, and engagement to apply statistical knowledge in clinical settings.

Results also revealed that biostatistical learning is strongly linked with low-self-confidence, cognitive insecurity, and emotional discomfort among healthcare learners. Respondents also mentioned that feeling of anxiety, embarrassment, confusion, and fear while engaging with interpretation, and statistical concepts. Different statistical topics such as P-values, regression outputs, confidence intervals and R square were described difficult to understand. It caused many physicians to avoid statistical complex computation and questions. These experiences shows that students mostly perceive statistics as academic requirement that is stressful rather than a supportive factor for research and clinical decision-making. Such anxiety can negatively affect willingness to engage, classroom participation, and learners' motivation in evidence-based healthcare practices. Researchers also mentioned insecurity while using different statistical software as they were perceived as difficult, technical, and complicated in presence of proper guidance. Results also suggests that insufficient practical exposure, limited hands-on learning opportunities contribute to development of anxiety among healthcare professionals. So, it is important that educational institutions must adopt teaching approaches that are learner centred, including supportive classroom environments, interpretation exercises, and guided software training to improve confidence, strengthen statistical competence, and minimize fear in research practice and healthcare education. Study by [Bandi et al. \(2024\)](#) supported these findings.

These results highlight presence of statistical dependency among different physicians and healthcare problems, where respondents relied mainly on report writing, statistical interpretation, and data analysis. Institutionally, this dependency appeared to be normalized because most of respondents consider to outsource tasks related to statistics as acceptable and routine practice. Although, health-workers were capable to understand objectives of research and collect data, they lacked confidence interpret findings and perform statistical analysis independently. Physicians reflected weak level of self-efficacy in research, specifically in relation to use statistical tools and analytical decision-making. Results indicate that healthcare professionals have the ability to understand research evidence but are not prepared to critically interpret, analyse, and generate data on their own. Relying more on statistics is perceived by respondents as the way to reduce opportunities in medical field. Also, inadequate applied training and limited hands-on exposure also contributes in learners' hesitation to manage statistical procedure independently. These results also emphasized the need for reforms in education in order to strengthen statistical competence through continuous engagement with statistical software, supervised data analysis exercises, and applied research projects. These initiatives will encourage independent evidence-based practice, improve analytical confidence, and research autonomy among healthcare professionals ([Mai et al., 2020](#)).

Participants of this research advocated insisted strongly to shift from traditional teaching that is lecture based towards application and experimental oriented learning approach in biostatistics education. It was also revealed by respondents that different statistical concepts are more understandable and meaningful when they are linked with real health care decision making processes and clinical situations. Results highlighted case-based learning as effective strategy to improve practical application, critical thinking, and improving comprehension of statistical knowledge. Respondents also stressed that teaching by using real research scenario, clinical data sets, and patient cases can help learners to understand the real relevance of biostatistics in healthcare practice. They also highlighted the key role of hands-on software training and recommended learning environment that is workshop-based where learners can perform data interpretation, analysis, and entry using real data sets. This practical exposure is important to improve confidence and reduce fear in using statistical software. Another key finding was the understanding of continuous professional development as vital component of statistical competence. Respondents also suggested that regular training programs and refresher courses should continue even after graduation so that healthcare professionals remain updated with research methods and analytical tools. As a nutshell, these results show that there is need for clinically integrated, problem centred, and interactive educational philosophy to promote practical statistical competency, lifelong learning, and active engagement among healthcare professionals as discussed by [Chandran et al. \(2023\)](#) in past literature.

6. Limitations and Future Directions

Present study has few limitations that must be acknowledged. Firstly, results of the study are based on qualitative

responses from a sample size of limited participants, that may restrict the generalizability of the findings for broader population of healthcare. Moreover, the perception of respondents was self-supported that may be influenced by subjective interpretation, recall bias, and personal experience. Thirdly, research did not quantitatively measure the statistical competence of the professionals and only focused mainly on educational experiences. Fourthly, differences among institutional settings, professional experience, and healthcare discipline were not deeply compared that may impacted perceptions regarding biostatistics learning. In the end, study only focused on the challenges and did not capture successful educational practices in different institutions. Upcoming studies should include more diverse and larger samples by using quantitative or mixed method to determine statistical competency in detail. It is also recommended that future studies may conduct comparative studies. Future studies must evaluate the role of continuous professional training programs, software workshops, and case-based learning to improve evidence-based decision-making skills.

7. Theoretical and Managerial Contributions

Present study offers vital theoretical contributions by extending literature of biostatistics education in context of healthcare through experience and qualitative based perspectives. Research contributes to evidence based and educational based practice literature by explaining the way low research self-efficacy, statistical anxiety, and teaching methods impacts statistical competency of healthcare professionals. The results also shed light on the relationship among development of critical analytical reasoning and experiential learning in context of healthcare. From managerial point of view, research provides practical guidance for policy makers of healthcare sector, curriculum makers, and healthcare educators. The research shows the need of case-based teaching methods and clinically integrated teaching strategy, continuous professional training programs and practical software workshops. Educational institutions need to improve healthcare workers' evidence-based decision-making abilities, research independence, and confidence by adopting application and interactive based biostatistics learning approaches.

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