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Research article

Reaching, Engaging and Advancing Research (REAR); An Assessment of Health Managers' Skills and Knowledge in Data Management, Analysis, Utilization, and Dissemination Kenya, Tanzania and Rwanda

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ABSTRACT

The objective of the study was to investigate the gap between data and evidence-based decisions among healthcare professionals considering the enormous amount of individual and aggregate data collected. Our study assessed the capacity, skills, and knowledge of the Ministry of Health leadership staff to understand data management, analysis, utilization, and dissemination. Three key components were assessed: 1) Knowledge through true/false questions, 2) Level of Skill (and Competency) using a Likert scale, and 3) Understanding of Key Concepts and Tools based on a Likert scale. The 183 study respondents were diverse healthcare professionals from Kenya, Tanzania, and Rwanda. Majority of respondents had not received any training on data management, analysis, interpretation, and utilization techniques, further there was a significant difference between those who had received training versus those who had not(p=0.005). The respondents were competent in work-related experiences but lacked skills and knowledge on: data concepts and tools, study designs, and types of data analysis. These findings explain the gap between data management, analysis, utilization, and dissemination among health professional's cadre. To enhance service delivery and optimal provision of health care, it is imperative to have all health care professionals receive a well-designed training on data management, analysis, interpretation, and utilization.

Keywords: Data Management; Utilization and Analysis; Capacity Building; Health professionals; Workforce Development; Evidence Based

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1. INTRODUCTION

As the drive towards achieving the Sustainable Development Goals (SDGs) intensifies there is an increasing interest worldwide to ensure evidence-informed health decision-making as a means to improve health systems performance.(1–3) Use of evidence-based practices in health systems strengthening and decision-making plays an essential role in improving service delivery.(4) Countries should support evidence-informed practice, and numerous voices have called for more effective and innovative mechanisms to bridge the divide between data analysis and translational application.(3,5–7) An important instrument in facilitating that change and strengthening health systems globally is working to further facilitate capacity strengthening at an individual level such as through improving skills for data analysis, data use, and dissemination.(7) The use of data is fundamental to enhance the responsiveness of health systems. It is also becoming widely accepted that health initiatives and best practices need to be promoted into policy.(1)

Although there has been considerable progress in Africa in regard to improving health research, improvements are not fast enough to meet development goals.(8–10) Furthermore, there is still a lack of critical analysis of the data currently being collected in identifying solutions which can aid in generating more high-quality, policy relevant research. The workforce must also have the knowledge and skill to analyze, interpret, and disseminate data in order to evaluate existing prevention, care, and treatment interventions, and implement evidence-based quality improvement of programs.(11–13) In this regard, we carried out this study to identify current human resource gaps among Ministry of Health management level staff. This study initiated and conducted by the University of West Florida in partnership with the Ministries of Health in Kenya, Rwanda, and Tanzania, was intended as an initial formative study for the Reaching Engaging and Advancing Research (REAR) initiative. The main objective of this study was to determine the knowledge, skill, and perceptions of Ministry of Health management teams on data analysis, management, utilization, dissemination in their respective countries.

2. METHODS

2.1. Participants

The participants of this study included 183 adults in leadership positions at the Ministry of Health in the countries of Kenya, Rwanda, and Tanzania that volunteered to be the part of this large study. The health care professionals ranged from medical doctors and registered nurses to lab technologists/technicians, health information and records officers,

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and non-medical staff. Recruitment of participants was limited to staff at the Ministry of Health in Kenya, Rwanda, and Tanzania.

The assessment survey was constructed and conducted by the University of West Florida in partnership with the Ministries of Health in Kenya, Rwanda, and Tanzania. The structured study instrument intent was to determine the participants' capacity, skills, and knowledge in understanding and analyzing data, as well as utilizing the data to disseminate health initiatives, such as best practices and lessons learned. After the content of the survey was developed, it was initially piloted to a select group of Ministry of Health officials before being distributed to all the eligible staff participants. All respondents were Ministry of Health staff who were in a leadership capacity within their different units and were also involved HIV service delivery. Their leadership roles require them to plan, prioritize, implement, monitor, and evaluate public health actions to reduce morbidity and mortality(14). The HIV epidemic has received considerable investment to ensure data and strategic information are available to understand the epidemic in Kenya, Rwanda and Tanzania(15). Furthermore, there has been an increased advocacy to the implementation and use Health Information Systems (HIS) for management of longitudinal health records especially for HIV patients(16). The survey was available to participants in both an online (created through Google Survey) and paper format, depending on individual preference.

2.2. Ethical Considerations

The survey was offered on a voluntary basis to all eligible staff at the selected Ministry of Health locations, all of whom were provided with full information on the survey including its purpose and nature. Prior to obtaining written consent, the participants were fully informed about the study's confidentiality regarding all personal information along with the fact that no identifying information would be elicited. Participants were also informed that there would be no negative consequences for not participating in the study. The survey was designed to take no more than 15 minutes to complete.

2.3. Data management

Data quality was assessed at the country level to ensure correctness, validity, and completeness of the survey. Data collected from the surveys was coded to ensure compliance with identity and confidentiality protocols.

2.4. Measurements

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The survey was comprised of 19 questions which assessed data management, analysis, utilization, and dissemination using three key components: 1) Knowledge of the respondents through true/false questions, 2) Level of Skill (and Competency) through questions based on a 5-point Likert scale ranging from "Never heard of it" to "Confident," and 3) Understanding of Key Concepts and Tools through questions based on a 5-point Likert scale ranging from "Never heard of it" to "I am an expert on the concept."

2.5. Statistical Analysis

Data collected from the online survey was exported into an Excel format, and data collected from the paper survey was manually entered in a spreadsheet. Data was analyzed using Stata version 12 for Windows applying descriptive and inferential statistics. Specifically, frequencies and percentages were generated for the respective countries in relation to demographic characteristics, knowledge and competencies, work-related experiences, and understanding of data analysis, concepts, and tools. Bivariate associations were examined using the chi-square test and the Fisher exact test as deemed appropriate. Statistical significance was evaluated at 5% level.

3. RESULTS

3.1. Characteristics of Study Participants

The characteristics of the study participants are reported in Table 1. In Kenya, most respondents were female and aged 45-54 years (72.7% and 42.1%, respectively) whereas in Rwanda and Tanzania, most respondents were male and aged between 35-44 years and 25-34 years, respectively. A large number of participants had attained their tertiary level of education; however, only a small proportion of the participants pursued a graduate degree in Public Health [Kenya: 6.8%, Rwanda: 4.2%, and Tanzania: 1.4%]. The respondents of the survey differed in that the majority in Kenya were Registered Nurses (27.3%), Public Health Officers in Tanzania (31%) while in Rwanda they were medical doctors (41.7%). In all three countries, the majority of the respondents had not attended a data management, analysis, and interpretation training in the last one year. Similarly, the majority of the respondents had low numbers of both abstracts accepted to a conference and manuscripts published (See table 1).

3.2. Knowledge and Competencies

Table 2 lists the findings from the healthcare professionals' self-reported knowledge and competencies on data management, analysis, utilization, and dissemination. A greater number of respondents had an average level of competence (vs minimal, strong, and exceptional) in developing a concept sheet [Kenya: 52.3%, Rwanda: 79.2%, Tanzania: 70.4%], developing hypotheses [K: 52.3%, R: 79.2%, T: 71.8%], developing goals and objectives [K: 44.3%, R: 58.3%, T: 67.6%], identifying outcome measures [K: 46.6%, R: 58.3%, T: 69%], identifying predictor measures [K: 46.6%, R: 45.8%, T: 73.2%], presenting data to different audiences [K: 46.6%, R: 70.8%, T: 45.1%], documenting new ideas [K: 51.1%, R: 70.8%, T: 59.2%], and implementing small test of change and quality improvement methodology [K: 51.1%, R: 50%, T: 63.9%]. However, Tanzania was the only country in which respondents expressed an overall strong or exceptional competence in performing routine collection of data in one's area of work (63.3%).

3.3. Work-Related Experiences

The majority of the respondents in Kenya and Rwanda agreed to the fact that a research project had been conducted in their department within the past five years (45.4% and 50%, respectively) unlike in Tanzania where a majority disagreed (52.1%). Similarly, a greater proportion across Kenya, Rwanda, and Tanzania responded to having the ability to collect data at work daily [K: 47.7%, R: 33.3%, T: 69%] as well as being aware of the best sources available to obtain this information [K: 63.6%, R: 45.8%, T: 76.1%] and analyzing this data [K: 70.5%, R: 37.5%, T: 77.5%]. When collecting data on HIV rates within the community, the majority of the respondents from Kenya and Tanzania agreed to having the knowledge required to complete the project (63.6 and 60.6%, respectively) as well as knowledge of the potential challenges they are likely to face (68.2% and 70.4%, respectively). A greater proportion of respondents in Kenya, Rwanda, and Tanzania agreed to: having the ability to identify tools needed to perform an audit (Data Quality Assurance) [K: 48.9%, R: 41.6%, T: 76.1%], using information to improve the way work is completed [K: 85.2%, R: 66.7%, T: 87.3%], having confidence in explaining data and understanding discrepancies within one's area of operation [K: 72.7%, R: 62.5%, T: 81.7%], knowing the importance of building awareness of quality improvement among employees [K: 82.9%, R: 66.6%, T: 90.1%], having confidence in teaching the health facility staff on how to write an abstract [K: 50%, R: 37.5%, T: 46.5%], having confidence in giving feedback to various facilities in terms of quality improvement based on data performance [K: 71.6%, R: 62.5%, T: 84.5%], having the ability to differentiate between cohort, cross-sectional, and

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observational studies [K: 68.1%, R: 58.3%, T: 57.8%], being able to identify research proposal procedures that require ethical approval [K: 70.4%, R: 62.5%, T: 53.5%], and being able to identify data collection procedures or circumstances that might make ethical approval necessary [K: 70.4%, R: 54.2%, T: 63.4%](See table 3).

3.4. Understanding of Data Analysis Concepts and Tools

The majority of the respondents in all three countries agreed to being able to differentiate between qualitative and quantitative data, define epidemiology, and find and define mean, mode, median, and range. Only Kenya had a higher proportion of respondents who could use the following concepts with confidence: Measures of central tendency (37.5%), descriptive statistics (39.8%), *p*-values (28.4%), confidence intervals (32.9%), sensitivity and specificity (38.6%), types of bias (31.8%), observational studies (37.5%), cross-sectional studies (42%), cohort studies (35.2%), odds ratios (26.1%), and relative risk (27.3%). In Rwanda and Tanzania, the majority of the respondents had heard of statistical analysis packages, such as Statistical Packages for the Social Sciences (SPSS) [66.6% and 40.8%, respectively]. However, in Kenya the majority of the respondents had not only heard of the statistical analysis packages but were somewhat familiar with the packages (29.5%). In Kenya, a greater proportion of the respondents had never heard of bivariate analysis (38.6%) or multivariate analysis (31.8%) whereas in Rwanda and Tanzania, the majority of respondents had heard of bivariate analysis, [50% and 23.9% respectively] and multivariate analysis [62.5% and 33.8%, respectively]. Across all three countries, the majority of the respondents had never heard of the concept of Time to Event Analysis, Kaplan Meier, or Survival Curves with Kenya at (54.6%), Rwanda at (66.6%), and Tanzania at (47.9%).

3.5. Bivariate Comparisons of Training on Data Management, Analysis, Utilization, and Dissemination

Table 5 displays the bivariate comparison between trained and untrained public health workforce across demographic characteristics. There was a significant difference in the respondents' level of education between those who had been trained versus untrained (p=0.026).

Table 6 displays the bivariate comparison between the trained and untrained public health workforce in data management and analysis. In these findings, there was a significantly higher proportion of trained individuals versus untrained who had a strong

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knowledge and ability to: develop a concept sheet (p=0.04), develop goals and objectives (p=0.002), and identify predictor measures (p=0.005). Additionally, there was a significantly higher proportion of trained individuals in data management and analysis who had the ability to present data to different audiences (p=0.018), could perform routine data collection (p<0.001), and could confidently implement a small test of change and quality improvement of methodology (p=0.022).

Table 7 shows there was a significant difference among trained and untrained individuals who agreed with having the ability to: collect data sets or variables daily at work (p=0.015), identify basic sources to obtain information regarding collection of variables needed for them to analyze their data (p=0.031), identify tools needed to perform a research project (p=0.028), and had confidence to teach site staff on how to write an abstract (p=0.014).

In Table 8, respondents who were somewhat familiar with the following concepts had a statistically significant difference between trained individuals as compared to the untrained (p=0.005) specifically for the following questions: Measures of central tendency (p=0.044), “If you don’t brand your work others will brand it for you” (p=0.003), descriptive statistics (p<0.001), and p-value (p=0.04), In addition, there was a significant difference between trained and untrained respondents who were able to use prevalence and incidence (p<0.001), sensitivity and specificity (p<0.001), the concept of cross-sectional studies (p<0.001), and odds ratios (p=0.014). There was a significant difference between trained and untrained respondents who have never heard of Time to Event Analysis Kaplan Meier or Survival Curves (40.3% vs 61.2%, respectively). However, regarding multivariate analysis, a greater proportion of the trained respondents as compared to the untrained had heard of it (p=0.027).

4. DISCUSSION

In all three countries, multiple variables were examined as they related to knowledge and competencies, work-related experiences, understanding of statistical concepts and tools, and training on data management, analysis, utilization, and dissemination.

Our results revealed gaps health worker training in all countries studied as has been noted in other findings.(17)(18) Our findings indicate that most health care workers had inadequate knowledge and skills in data management, analysis, utilization, and management that are crucial in conducting their work as health care managers. Demands on workforce education programs include ensuring the acquisition of competencies in the areas

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of interdisciplinary teamwork, quality improvement, evidence-based practice, patient-centered care, and informatics.(19,20) However, low and middle-income countries (LMICs) face a set of contemporary health care challenges with numerous and complex elements. Our sample was composed of different health care professionals and there was no significant difference between the professions (p=0.062). We also found that there was a significant difference between the level of education (p=0.026) with the majority having a tertiary education as expected for most health care professionals in leadership positions. Health care professionals and health care delivery systems face an array of demands, including expectations for responsiveness in meeting current and emerging health care access and quality needs. A growing population also adds expectations for training and deploying the health workforce to deliver care specific to this population that is accessible, efficient, and of high quality.(21)

Achieving efficient, high quality care is predicated not only on health care system infrastructure but also on the redesign of the skill and knowledge sets by the health care workforce.(12,22,23) The results indicate that health care professionals who had received training on data management, analysis, and utilization were more likely to have increased knowledge, competencies, and skills. The need for capacity building in research and implementation science among the health workforce is reflected in the number of current existing formal educational programs and in-service training programs expanding the opportunities for training and research in global health available to their faculty and trainees mostly funded through International agencies.(24,25) While these programs have already demonstrated added value to clinicians,(26) the emphasis of such programs in research capacity building has been mainly in health care academics(27,28) rather than health care professionals offering direct care to patients or in leadership roles.(29–32)

The impact of these trainings on patient care should be monitored and measured. This may be enabled by ensuring that quality improvement practices are even more systematic and more evidence-based.(33) There is a strong need in the literature for more evidence-based knowledge that is patient-centered.(34–37) The suggested training and its impact on practice can provide this. However, that change can be accomplished only if there is sufficient data management, analysis, utilization, and dissemination capacity within the health care providers in these roles. Capacity building in data management, analysis, utilization and dissemination is a broad concept that encompasses some or many aspects of research ranging from awareness, knowledge, skills, understanding, interpretation, data collection, data use, ethics training, and scientific writing to presentations.(12) While there

is an identified inconsistency in the meaning of the terms data Management, analysis, utilization, and dissemination, within this paper it refers to basic knowledge and competencies at all levels of the research process from question design to dissemination.

The survey data from all three countries suggests that there is a lack of knowledge in various research skills and that there is a strong need for a research training program among the Ministry of Health staff. Our findings further show that the type and classification of the training on data management, analysis, utilization, and dissemination varied across participants even within the same country. For evidence- based research to have a positive effect, the training program must be designed to target the needs of the country and its workforce. However, global health priorities are often based on the requirements of international donor organizations rather than the recipient countries.(5,38) This potentially leads to research which does not meet the needs of target populations, and where the knowledge generated is not incorporated into policy or practice.(7,39,40) The results of this assessment calls for the need of a training model for data management, analysis, utilization, and dissemination to be based on country priorities and to be designed and delivered by the stakeholders through relevant regulatory agencies within the country of interest.

Any capacity building approach should be responsive to the needs of the learning; therefore, an assessment, such as this study, is a first step in a cyclical process which contributes to the overall training and educational strategy for health care professionals.

While our survey was developed and tested through standard methods, the limitation of the study is that the data was collected anonymously. With anonymous data collection, the information gathered is self-reported by the respondents. This design means that there is no available information about those who chose not to participate in the survey, and hence, no knowledge of whether the respondents differ from the non-respondents in any systematic way. In other words, it is unknown whether the data are influenced by non-response bias which may pose a threat to the generalizability of the results. Our study would also have been further strengthened by use of iterative questioning during data collection and triangulating findings from focus group discussions and in-depth interviews to increase the validity of the results.

5. CONCLUSION

The knowledge behind collecting data and executing evidence-based practice can be learned through exposure in the workforce, but being able to present and pass on knowledge learned through research requires additional skills acquired through tertiary

levels of education and training specializing in data management, analysis, and interpretation. Unless good quality, locally relevant evidence-based practice comes from LMICs, the target of the Sustainable Developmental Goals of global health equity cannot be achieved. Strengthening local capacity in data management, utilization, and dissemination is therefore an ethical obligation considering the low number of biomedical publications that emanate from these settings.(1) It is important to develop a capacity-building program that is simple and adaptable tailored to the health workforce of the country. The design of the training program should be evidence-based, informed by both the known barriers of data use by health care professionals that impedes participation and informs local gaps. The training program should be close to practice, with increased collaboration between health improvement and academia. The main benefits and strengths emerging from the capacity-building program includes a growing health care workforce who has the chance to publish and showcase innovations, including opportunity to collaborate and translate evidence-based data into practice.

Author Contribution

PM conceived and designed the study. CN, TM, SM, JS assisted in the development and pre-testing of the data collection tools. PM, CK, CC assisted the study design. KO, MM and PM analyzed the data. CK, CN, VM, SN, JS assisted in the data collection. PM, JPO, ER, SN, CK, SN, KO, TA assisted the analysis and interpreted the data and wrote the manuscript. PM, SD, HF, CN conducted detailed analyses and synthesis of the findings. All authors critically reviewed and approved the manuscript and meet ICMJE criteria for authorship.

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481 Table 1: Demographic characteristics of the participants in Kenya, Tanzania and Rwanda

Variable	n (%)		
	Kenya (N=88)	Rwanda (N=24)	Tanzania (N=71)
Age			
15-24	0 (0)	0 (0)	1 (1.4)
25-34	12 (13.6)	7 (29.2)	27 (38)
35-44	30 (34.1)	14 (58.3)	23 (32.4)
45-54	37 (42.1)	3 (12.5)	18 (25.4)
>55	9 (10.2)	0 (0)	2 (2.8)
Gender			
Male	24 (27.3)	20 (83.3)	50 (70.4)
Female	64 (72.7)	4 (16.7)	21 (29.6)
Level of education			
Secondary	5 (5.7)	0 (0)	15 (21.1)
Tertiary	52 (59.1)	16 (66.7)	21 (29.6)
Technical or Vocational	6 (6.8)	8 (33.3)	6 (8.5)
Other	25 (28.4)	0 (0)	29 (40.8)
Period with current organization			
0-3 months	0 (0)	1 (4.2)	0 (0)
4 months – 1 year	4 (4.5)	2 (8.3)	3 (4.2)
Between 1 year – 2 years	1 (1.1)	5 (20.8)	6 (8.5)
Between 2 years – 5 years	15 (17.1)	6 (25)	33 (46.5)
More than 5 years	68 (77.3)	10 (41.7)	29 (40.8)
Attended a Data Management, Analysis, and Interpretation Training in the last one year			
Yes	23 (26.1)	6 (25)	38 (53.5)
No	65 (73.9)	18 (75)	33 (46.5)
Profession			
Medical Doctor	9 (10.2)	10 (41.7)	5 (7)
Pharmacist/Pharmaceutical Technologist	2 (2.3)	1 (4.2)	0 (0)
Clinical Officer	3 (3.4)	0 (0)	14 (19.7)
Registered Nurse	24 (27.3)	2 (8.3)	20 (28.2)
Nurse Midwife	2 (2.3)	2 (8.3)	0 (0)
Public Health Nurse	7 (7.9)	1 (4.2)	0 (0)
Public Health Officer	16 (18.2)	0 (0)	22 (31)
Lab Technologist/Technician	3 (3.4)	3 (12.5)	2 (2.8)
Health Information and Records Officer	10 (11.4)	2 (8.3)	0 (0)
Other*	9 (10.2)	3 (12.5)	0 (0)
Non-Medical Staff	3 (3.4)	0 (0)	8 (11.3)
Received or in the process of receiving a graduate degree			
Yes	40 (45.5)	10 (41.7)	20 (28.2)
No	48 (54.5)	14 (58.3)	51 (71.8)
Year of educational program completion (2017-ongoing)			
Yes	6 (6.8)	1 (4.2)	1(1.4)
No	82 (93.2)	23 (95.8)	70(98.6)
Abstract accepted to a conference in the past 3 years			
Yes	16 (18.2)	12 (50)	17 (23.9)
No	72 (81.8)	12 (50)	54 (76.1)
Manuscript published in a peer-reviewed journal			
Yes	15 (17.1)	5 (20.8)	6 (8.6)
No	73 (82.9)	19 (79.2)	64 (91.4)

482 * The "Other Medical Professions" category included health promotion, orthopedic technologist, medical social worker,
483 health informatics, health administration, community development, and dental surgeon.

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485 Table 2: Knowledge and competencies of the participants in Kenya, Tanzania and Rwanda

Variable	n (%)		
	Kenya (N=88)	Rwanda (N=24)	Tanzania (N=71)

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Knowledge and ability to develop a concept sheet			
Minimal	27 (30.7)	4 (16.7)	8 (11.3)
Average	46 (52.3)	19 (79.2)	50 (70.4)
Strong	13 (14.8)	1 (4.2)	13 (18.3)
Exceptional	2 (2.3)	0 (0)	0 (0)
Knowledge and ability to develop a hypothesis			
Minimal	19 (21.6)	2 (8.3)	9 (12.7)
Average	46 (52.3)	19 (79.2)	51 (71.8)
Strong	20 (22.7)	3 (12.5)	11 (15.5)
Exceptional	3 (3.4)	0 (0)	0 (0)
Knowledge and ability to develop goals and objectives			
Minimal	8 (9.1)	3 (12.5)	2 (2.8)
Average	39 (44.3)	14 (58.3)	48 (67.6)
Strong	37 (42.1)	7 (29.2)	17 (23.9)
Exceptional	4 (4.6)	0 (0)	4 (5.6)
Knowledge and ability to identify outcome measures			
Minimal	11 (12.5)	5 (20.8)	3 (4.2)
Average	41 (46.6)	14 (58.3)	49 (69)
Strong	32 (36.4)	5 (20.8)	17 (23.9)
Exceptional	4 (4.6)	0 (0)	2 (2.8)
Knowledge and ability to identify predictor measures			
Minimal	21 (23.9)	9 (37.5)	6 (8.5)
Average	41 (46.6)	11 (45.8)	52 (73.2)
Strong	24 (27.3)	4 (16.7)	12 (16.9)
Exceptional	2 (2.3)	0 (0)	1 (1.4)
Knowledge and ability to present data to different audiences e.g. conferences, teams			
Minimal	15 (17.1)	2 (8.3)	2 (2.8)
Average	41 (46.6)	17 (70.8)	32 (45.1)
Strong	24 (27.3)	5 (20.8)	31 (43.7)
Exceptional	8 (9.1)	0 (0)	6 (8.5)
Knowledge and ability to perform routine collection of data that shows progress in your work area			
Minimal	7 (7.9)	5 (20.8)	1 (1.4)
Average	34 (38.6)	12 (50)	25 (35.2)
Strong	33 (37.5)	5 (20.8)	28 (39.4)
Exceptional	14 (15.9)	2 (8.3)	17 (23.9)
Knowledge and ability to document new ideas			
Minimal	13 (14.8)	2 (8.3)	0 (0)
Average	45 (51.1)	17 (70.8)	42 (59.2)
Strong	26 (29.6)	4 (16.7)	22 (30.9)
Exceptional	4 (4.6)	1 (4.2)	7 (9.9)
Knowledge and ability to implement small test of change and quality improvement methodology			
Minimal	13 (14.8)	6 (25)	2 (2.8)
Average	45 (51.1)	12 (50)	45 (63.9)
Strong	26 (29.6)	4 (16.7)	20 (28.2)
Exceptional	4 (4.6)	2 (8.3)	4 (5.6)

Table 3: Work-related experiences of the participants in Kenya, Tanzania and Rwanda

Variable	**n (%)**		
	Kenya (N=88)	**Rwanda (N=24)**	**Tanzania (N=71)**
A research project has been conducted in my department within the past 5 years			
Disagree	35 (39.8)	4 (16.7)	37 (52.1)
Neither agree nor disagree	13 (14.8)	8 (33.3)	12 (16.9)
Agree	40 (45.4)	12 (50)	22 (31)
I collect data sets or variables at work daily			

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Disagree	22 (25)	8 (33.3)	5 (7)
Neither agree nor disagree	24 (27.3)	8 (33.3)	17 (23.9)
Agree	42 (47.7)	8 (33.3)	49 (69)
When collecting variables for a data set, I know the best sources from which to obtain this information			
Disagree	9 (10.2)	2 (8.3)	4 (5.6)
Neither agree nor disagree	23 (26.1)	11 (45.8)	13 (18.3)
Agree	56 (63.6)	11 (45.8)	54 (76.1)
I am aware of different sources available for me to analyze my data			
Disagree	9 (10.2)	7 (29.2)	1 (1.4)
Neither agree nor disagree	17 (19.3)	8 (33.3)	15 (21.1)
Agree	62 (70.5)	9 (37.5)	55 (77.5)
If I was tasked with collecting data on HIV rates within my community, I feel that I have the knowledge to complete this project successfully and accurately			
Disagree	12 (13.6)	3 (12.5)	3 (4.2)
Neither agree nor disagree	20 (22.7)	14 (58.3)	25 (35.2)
Agree	56 (63.6)	7 (29.2)	43 (60.6)
If I was tasked with collecting data on HIV rates within my community, I would be aware of potential challenges			
Disagree	9 (10.2)	3 (12.5)	3 (4.2)
Neither agree nor disagree	19 (21.6)	10 (41.7)	18 (25.4)
Agree	60 (68.2)	11 (45.8)	50 (70.4)
I am able to identify tools needed to perform an audit (Data Quality Assurance) project			
Disagree	17 (19.3)	7 (29.2)	3 (4.2)
Neither agree nor disagree	28 (31.8)	7 (29.2)	14 (19.7)
Agree	43 (48.9)	10 (41.6)	54 (76.1)
I am able to identify tools needed to perform a research project			
Disagree	10 (11.4)	3 (12.5)	3 (4.2)
Neither agree nor disagree	17 (19.3)	11 (45.8)	25 (35.2)
Agree	61 (69.3)	10 (41.7)	43 (60.6)
Overall, our use of information (data) helps us to improve the way we do our work			
Disagree	6 (6.8)	0 (0)	1 (1.4)
Neither agree nor disagree	7 (8)	8 (33.3)	8 (11.3)
Agree	75 (85.2)	16 (66.7)	62 (87.3)
I am confident to explain data and understand data discrepancies within my area of operation			
Disagree	10 (11.4)	1 (4.2)	2 (2.8)
Neither agree nor disagree	14 (15.9)	8 (33.3)	11 (15.5)
Agree	64 (72.7)	15 (62.5)	58 (81.7)
Building awareness of the importance of quality improvement among employees should be an ongoing process			
Disagree	8 (9.1)	1 (4.2)	1 (1.4)
Neither agree nor disagree	7 (8)	7 (29.2)	6 (8.5)
Agree	73 (82.9)	16 (66.6)	64 (90.1)
I am confident to teach the health facility staff on how to write an abstract			
Disagree	18 (20.5)	7 (29.2)	6 (8.5)
Neither agree nor disagree	26 (29.5)	8 (33.3)	32 (45.1)
Agree	44 (50)	9 (37.5)	33 (46.5)
I am confident to give feedback to facilities in terms of their quality improvement based on their data performance			
Disagree	9 (10.2)	2 (8.3)	3 (4.2)
Neither agree nor disagree	16 (18.2)	7 (29.2)	8 (11.3)
Agree	63 (71.6)	15 (62.5)	60 (84.5)
I have the ability to differentiate between cohort, cross-sectional, and observational studies			
Disagree	15 (17.1)	3 (12.5)	8 (11.3)
Neither agree nor disagree	13 14.8)	7 (29.2)	22 (30.9)

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Agree	60 (68.1)	14 (58.3)	41 (57.8)
I am able to know which kind of research proposal requires ethical approval			
Disagree	15 (17.1)	2 (8.3)	5 (7)
Neither agree nor disagree	11 (12.5)	7 (29.2)	28 (39.4)
Agree	62 (70.4)	15 (62.5)	38 (53.5)
I am able to identify data collection procedures or circumstances that might make ethical approval necessary			
Disagree	16 (18.2)	2 (8.3)	5 (7)
Neither agree nor disagree	10 (11.4)	9 (37.5)	21 (29.6)
Agree	62 (70.4)	13 (54.2)	45 (63.4)

Table 4: Understanding of data analysis concepts and tools of the participants in Kenya, Tanzania and Rwanda

Variable	**n (%)**		
	Kenya (N=88)	**Rwanda (N=24)**	**Tanzania (N=71)**
I am able to differentiate between qualitative and quantitative research			
Disagree	4 (4.6)	1 (4.2)	7 (9.9)
Neither agree nor disagree	7 (7.9)	7 (29.2)	8 (11.3)
Agree	77 (87.5)	16 (66.7)	56 (78.8)
I am able to define epidemiology			
Disagree	3 (3.4)	4 (16.7)	4 (5.6)
Neither agree nor disagree	8 (9.1)	2 (8.3)	9 (12.7)
Agree	77 (87.5)	18 (75)	58 (81.7)
I am able to find and define mean			
Disagree	4 (4.6)	0 (0)	2 (2.8)
Neither agree nor disagree	7 (7.9)	7 (29.2)	9 (12.7)
Agree	77 (87.5)	17 (70.8)	60 (84.5)
I am able to find and define mode			
Disagree	3 (3.4)	4 (16.7)	1 (1.4)
Neither agree nor disagree	8 (9.1)	4 (16.7)	17 (23.9)
Agree	77 (87.5)	16 (66.6)	53 (74.7)
I am able to find and define median			
Disagree	2 (2.3)	4 (16.7)	2 (2.8)
Neither agree nor disagree	8 (9.1)	4 (16.7)	10 (14.1)
Agree	78 (88.6)	16 (66.6)	59 (83.1)
I am able to find and define range			
Disagree	2 (2.3)	6 (25)	3 (4.2)
Neither agree nor disagree	7 (7.9)	4 (16.7)	10 (14.1)
Agree	79 (89.8)	14 (58.3)	58 (81.7)
Measures of central tendency			
Never heard of it	18 (20.4)	6 (25)	10 (14.1)
Have heard of it	10 (11.4)	7 (29.2)	16 (22.5)
Am somewhat familiar with the concept	22 (25)	7 (29.2)	25 (35.2)
I can use the concept with confidence	33 (37.5)	4 (16.6)	17 (23.9)
I am an expert on the concept	5 (5.7)	0 (0)	3 (4.2)
Descriptive statistics			
Never heard of it	13 (14.7)	0 (0)	6 (8.5)
Have heard of it	21(23.9)	12 (50)	17 (23.9)
Am somewhat familiar with the concept	11 (12.5)	6 (25)	27 (38)
I can use the concept with confidence	35 (39.8)	6 (25)	16 (22.5)
I am an expert on the concept	8 (9.1)	0 (0)	5 (7)
***P*-value**			
Never heard of it	21 (23.9)	1 (4.2)	18 (25.4)
Have heard of it	17 (19.3)	14 (58.3)	19 (26.8)
Am somewhat familiar with the concept	23 (26.1)	4 (16.7)	20 (28.1)
I can use the concept with confidence	25 (28.4)	5 (20.8)	10 (14.1)
I am an expert on the concept	2 (2.3)	0 (0)	4 (5.6)
Confidence interval			
Never heard of it	19 (21.6)	1 (4.2)	13 (18.3)
Have heard of it	19 (21.6)	13 (54.2)	19 (26.8)

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Am somewhat familiar with the concept	19 (21.6)	4 (16.6)	18 (25.4)
I can use the concept with confidence	29 (32.9)	6 (25)	17 (23.9)
I am an expert on the concept	2 (2.3)	0 (0)	4 (5.6)
Prevalence and incidence			
Never heard of it	11(12.5)	0 (0)	1 (1.4)
Have heard of it	15 (17)	9 (37.5)	13 (18.3)
Am somewhat familiar with the concept	18 (20.5)	4 (16.6)	17 (23.9)
I can use the concept with confidence	36 (40.9)	9 (37.5)	26 (36.6)
I am an expert on the concept	8 (9.1)	2 (8.3)	14 (19.7)
Sensitivity and specificity			
Never heard of it	12 (13.6)	1 (4.2)	1 (1.4)
Have heard of it	14 (15.9)	10 (41.6)	17 (23.9)
Am somewhat familiar with the concept	20 (22.7)	4 (16.7)	23 (32.4)
I can use the concept with confidence	34 (38.6)	8 (33.3)	19 (26.8)
I am an expert on the concept	8 (9.1)	1 (4.2)	11 (15.5)
Understanding statistical packages e.g. SPSS			
Never heard of it	17 (19.3)	1 (4.2)	10 (14.1)
Have heard of it	21 (23.9)	16 (66.6)	29 (40.8)
Am somewhat familiar with the concept	26 (29.5)	6 (25)	20 (28.2)
I can use the concept with confidence	20 (22.7)	1 (4.2)	9 (12.7)
I am an expert on the concept	4 (4.6)	0 (0)	3 (4.2)
Bivariate analysis			
Never heard of it	34 (38.6)	6 (25)	32 (45.1)
Have heard of it	15 (17.1)	12 (50)	17 (23.9)
Am somewhat familiar with the concept	21 (23.8)	5 (20.8)	14 (19.7)
I can use the concept with confidence	15 (17.1)	1 (4.2)	5 (7)
I am an expert on the concept	3 (3.4)	0 (0)	3 (4.2)
Time to event analysis Kaplan Meir or survival curves			
Never heard of it	48 (54.6)	16 (66.6)	34 (47.9)
Have heard of it	17 (19.3)	4 (16.7)	24 (33.8)
Am somewhat familiar with the concept	14 (15.9)	3 (12.5)	7 (9.9)
I can use the concept with confidence	8 (9.1)	1 (4.2)	4 (5.6)
I am an expert on the concept	1 (1.1)	0 (0)	2 (2.8)
Types of bias			
Never heard of it	17 (19.3)	2 (8.3)	10 (14.1)
Have heard of it	18 (20.5)	14 (58.3)	22 (31)
Am somewhat familiar with the concept	20 (22.7)	3 (12.5)	24 (33.8)
I can use the concept with confidence	28 (31.8)	5 (20.8)	11 (15.5)
I am an expert on the concept	5 (5.7)	0 (0)	4 (5.6)
Observational studies			
Never heard of it	14 (15.9)	1 (4.2)	7 (9.9)
Have heard of it	12 (13.6)	13 (54.2)	16 (22.5)
Am somewhat familiar with the concept	18 (20.5)	5 (20.8)	28 (39.4)
I can use the concept with confidence	33 (37.5)	5 (20.8)	12 (16.9)
I am an expert on the concept	11 (12.5)	0 (0)	8 (11.3)
Cross-sectional studies			
Never heard of it	11 (12.5)	2 (8.3)	5 (7)
Have heard of it	16 (18.2)	12 (50)	18 (25.4)
Am somewhat familiar with the concept	16 (18.2)	6 (25)	26 (36.6)
I can use the concept with confidence	37 (42)	4 (16.7)	13 (18.3)
I am an expert on the concept	8 (9.1)	0 (0)	9 (12.7)
Abstract writing and dissemination of information in conferences			
Never heard of it	14 (15.9)	1 (4.2)	5 (7)
Have heard of it	18 (20.5)	17 (70.8)	12 (16.9)
Am somewhat familiar with the concept	27 (30.7)	3 (12.5)	35 (49.3)
I can use the concept with confidence	23 (26.1)	3 (12.5)	13 (18.3)
I am an expert on the concept	6 (6.8)	0 (0)	6 (8.5)
Cohort studies			
Never heard of it	12 (13.6)	0 (0)	1 (1.4)
Have heard of it	19 (21.6)	15 (62.5)	21 (29.6)
Am somewhat familiar with the concept	21 (23.9)	3 (12.5)	28 (39.4)
I can use the concept with confidence	31 (35.2)	5 (20.8)	14 (19.7)
I am an expert on the concept	5 (5.7)	1 (4.2)	7 (9.9)
Odds ratio			
Never heard of it	21 (23.8)	4 (16.6)	18 (25.4)
Have heard of it	22 (25)	13 (54.2)	22 (31)

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Am somewhat familiar with the concept	18 (20.5)	1 (4.2)	16 (22.5)
I can use the concept with confidence	23 (26.1)	5 (20.8)	10 (14.1)
I am an expert on the concept	4 (4.6)	1 (4.2)	5 (7)
Relative risk			
Never heard of it	18 (20.4)	3 (12.5)	14 (19.7)
Have heard of it	24 (27.3)	13 (54.2)	22 (31)
Am somewhat familiar with the concept	17(19.3)	1 (4.2)	21 (29.6)
I can use the concept with confidence	24 (27.3)	7 (29.1)	9 (12.7)
I am an expert on the concept	5 (5.7)	0 (0)	5 (7)
Multivariate analysis			
Never heard of it	28 (31.8)	4 (16.7)	23 (32.4)
Have heard of it	24 (27.3)	15 (62.5)	24 (33.8)
Am somewhat familiar with the concept	13 (14.8)	3 (12.5)	11 (15.5)
I can use the concept with confidence	19 (21.6)	2 (8.3)	8 (11.3)
I am an expert on the concept	4 (4.5)	0 (0)	5 (7)

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Table 5: Bivariate comparison between trained and untrained public health workforce across demographic characteristics of the participants in Kenya, Tanzania and Rwanda

	Training		*P*-value
	Yes, n (%)	**No, n (%)**	
Age			0.324
15-24	1 (1.5)	0 (0)	
25-34	20 (29.9)	26 (22.4)	
35-44	25 (37.3)	42 (36.2)	
45-54	19 (28.4)	39 (33.6)	
>55	2 (3)	9 (7.8)	
Gender			0.159
Male	39 (58.2)	55 (47.4)	
Female	28 (41.8)	61 (52.6)	
Level of education			0.026**
Secondary	13 (19.4)	7 (6)	
Tertiary	27 (40.3)	62 (53.4)	
Technical/Vocational	3 (4.5)	9 (7.8)	
Other	24 (35.8)	38 (32.8)	
Period with current organization			0.471
0-3 months	0 (0)	1 (0.9)	
4 months – 1 year	2 (3)	7 (6)	
Between 1 year – 2 years	6 (9)	6 (5.2)	
Between 2 years – 5 years	23 (34.3)	31 (26.7)	
More than 5 years	36 (53.7)	71 (61.2)	
Profession			0.062
Medical Doctor	6 (9)	18 (15.5)	
Pharmacist/Pharmaceutical Technologist	0 (0)	3 (2.6)	
Clinical Officer	10 (14.9)	7 (6)	
Registered Nurse	18 (26.9)	28 (24.1)	
Nurse Midwife	2 (3)	2 (1.7)	
Public Health Nurse	2 (3)	6 (5.2)	
Public Health Officer	10 (14.9)	28 (24.1)	
Lab Technologist/Technician	1 (1.5)	7 (6)	
Health Information and Records Officer	8 (11.9)	4 (3.4)	
Other	4 (6)	8 (6.9)	
Non-Medical Staff	6 (9)	5 (4.3)	
Received or in the process of receiving a graduate degree			0.907
Yes	26 (38.8)	44 (37.9)	
No	41 (61.2)	72 (62.1)	
Year of educational program completion (2017 – ongoing)			0.422
Yes	4 (6)	4 (3.4)	
No	63 (94)	112 (96.6)	
Abstract accepted to a conference in the past 3 years			0.209
Yes	20 (29.9)	25 (21.6)	
No	47 (70.1)	91 (78.4)	
Manuscript published in a peer reviewed journal			0.052
Yes	14 (20.9)	12 (10.4)	
No	53 (79.1)	103 (89.6)	

Note: *, **, *** represent significance at 1%, 5%, and 10%, respectively

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Table 6: Bivariate comparison between trained and untrained public health workforce across Knowledge and Competencies of the participants in Kenya, Tanzania and Rwanda

	Training		*P*-value
	Yes, n (%)	**No, n (%)**	
Knowledge and ability to develop a concept sheet			0.040**
Minimal	10 (15)	29 (25)	
Average	40 (60)	75 (65)	
Strong	16 (24)	11 (9)	
Exceptional	1 (1)	1 (1)	
Knowledge and ability to develop a hypothesis			0.462
Minimal	8 (12)	22 (19)	
Average	44 (66)	72 (62)	
Strong	13 (19)	21 (18)	
Exceptional	2 (3)	1 (1)	
Knowledge and ability to develop goals and objectives			0.002**
Minimal	3 (4)	10 (9)	
Average	34 (51)	67 (58)	
Strong	22 (33)	39 (34)	
Exceptional	8 (12)	0 (0)	
Knowledge and ability to identify outcome measures			0.074
Minimal	6 (9)	13 (11)	
Average	34 (51)	70 (60)	
Strong	22 (33)	32 (28)	
Exceptional	5 (7)	1 (1)	
Knowledge and ability to identify predictor measures			0.005**
Minimal	6 (9)	31 (27)	
Average	39 (58)	66 (57)	
Strong	19 (28)	18 (16)	
Exceptional	3 (4)	1 (1)	
Knowledge and ability to present data to different audiences e.g. conferences, teams			0.018**
Minimal	4 (6)	15 (13)	
Average	27 (40)	63 (54)	
Strong	27 (40)	33 (28)	
Exceptional	9 (13)	5 (4)	
Knowledge and ability to perform routine collection of data that shows progress in your work area			<0.001**
Minimal	1 (1)	12 (10)	
Average	18 (27)	53 (46)	
Strong	26 (39)	40 (34)	
Exceptional	22 (33)	11 (9)	
Knowledge and ability to document new ideas			0.069
Minimal	4 (6)	11 (9)	
Average	33 (49)	66 (57)	
Strong	21 (31)	35 (30)	
Exceptional	9 (13)	4 (3)	
Knowledge and ability to implement small test of change and quality improvement methodology			0.022**
Minimal	3 (4)	18 (16)	
Average	34 (51)	68 (59)	
Strong	25 (37)	25 (22)	
Exceptional	5 (7)	5 (4)	

Notes: *, **, *** represent significance at 1%, 5%, and 10%, respectively

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Table 7: Bivariate comparison between trained and untrained public health workforce across Work-Related Experiences of the participants in Kenya, Tanzania and Rwanda

	Training		*P*-value
	Yes, n (%)	**No, n (%)**	
A research project has been conducted in my department within the past 5 years			0.659
Disagree	26 (38.8)	50 (43.1)	
Neither agree nor disagree	11 (16.4)	22 (19)	
Agree	30 (44.8)	44 (37.9)	
I collect data sets or variables at work daily			0.015**
Disagree	6 (9)	29 (25)	
Neither agree nor disagree	17 (25.4)	32 (27.6)	
Agree	44 (65.7)	55 (47.4)	
When collecting variables for a data set, I know the best sources from which to obtain this information			0.031**
Disagree	5 (7.5)	10 (8.6)	
Neither agree nor disagree	10 (14.9)	37 (31.9)	
Agree	52 (77.6)	69 (59.5)	
I am aware of different sources available for me to analyze my data			0.058
Disagree	3 (4.5)	14 (12.1)	
Neither agree nor disagree	11 (16.4)	29 (25)	
Agree	53 (79.1)	73 (62.9)	
If I was tasked with collecting data on HIV rates within my community, I feel that I have the knowledge to successfully and accurately complete this project			0.359
Disagree	4 (6)	14 (12.1)	
Neither agree nor disagree	21 (31.3)	38 (32.8)	
Agree	42 (62.7)	64 (55.2)	
If I was tasked with collecting data on HIV rates within my community, I would be aware of potential challenges			0.300
Disagree	3 (4.5)	12 (10.3)	
Neither agree nor disagree	16 (23.9)	31 (26.7)	
Agree	48 (71.6)	73 (62.9)	
I can identify tools needed to perform an audit (Data Quality Assurance) project			0.006
Disagree	3 (4.5)	24 (20.7)	
Neither agree nor disagree	17 (25.4)	32 (27.6)	
Agree	47 (70.1)	60 (51.7)	
I can identify tools needed to perform a research project			0.028**
Disagree	3 (4.5)	13 (11.2)	
Neither agree nor disagree	14 (20.9)	39 (33.6)	
Agree	50 (74.6)	64 (55.2)	
Overall, our use of information (data) helps us to improve the way we do our work			0.515
Disagree	3 (4.5)	4 (3.4)	
Neither agree nor disagree	6 (9)	17 (14.7)	
Agree	58 (86.6)	95 (81.9)	
I am confident to explain data and understand data discrepancies within my area of operation			0.212
Disagree	4 (6)	9 (7.8)	
Neither agree nor disagree	8 (11.9)	25 (21.6)	
Agree	55 (82.1)	82 (70.7)	
Building awareness of the importance of quality improvement among employees should be an			0.449

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ongoing process			
Disagree	3 (4.5)	7 (6)	
Neither agree nor disagree	5 (7.5)	15 (12.9)	
Agree	59 (88.1)	94 (81)	
I am confident to teach the site staff on how to write an abstract			0.014**
Disagree	5 (7.5)	26 (22.4)	
Neither agree nor disagree	23 (34.3)	43 (37.1)	
Agree	39 (58.2)	47 (40.5)	
I am confident to give feedback to facilities in terms of their quality improvement based on their data performance			0.070
Disagree	3 (4.5)	11 (9.5)	
Neither agree nor disagree	7 (10.4)	24 (20.7)	
Agree	57 (85.1)	81 (69.8)	
I can differentiate between cohort, cross-sectional, and observational studies			0.136
Disagree	5 (7.5)	21 (18.1)	
Neither agree nor disagree	16 (23.9)	26 (22.4)	
Agree	46 (68.7)	69 (59.5)	
I am able to know which kind of research proposal requires ethical approval			0.160
Disagree	4 (6)	18 (15.5)	
Neither agree nor disagree	18 (26.9)	28 (24.1)	
Agree	45 (67.2)	70 (60.3)	
I am able to identify data collection procedures or circumstances that might make ethical approval necessary			0.072
Disagree	4 (6)	19 (16.4)	
Neither agree nor disagree	13 (19.4)	27 (23.3)	
Agree	50 (74.6)	70 (60.3)	

Notes: *, **, *** represent significance at 1%, 5%, and 10%, respectively

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535 Table 8: Bivariate comparison between trained and untrained public health workforce across Understanding of
536 Statistical Concepts and Tools of the participants in Kenya, Tanzania and Rwanda

	Training		P-value
	Yes, n (%)	No, n (%)	
I am able to differentiate between qualitative and quantitative research			0.146
Disagree	4 (6)	8 (6.9)	
Neither agree nor disagree	4 (6)	18 (15.5)	
Agree	59 (88.1)	90 (77.6)	
I am able to define epidemiology			0.278
Disagree	2 (3)	9 (7.8)	
Neither agree nor disagree	9 (13.4)	10 (8.6)	
Agree	56 (83.6)	97 (83.6)	
I am able to find and define mean			0.148
Disagree	1 (1.5)	5 (4.3)	
Neither agree nor disagree	5 (7.5)	18 (15.5)	
Agree	61 (91)	93 (80.2)	
I am able to find and define mode			0.324
Disagree	1 (1.5)	7 (6)	
Neither agree nor disagree	10 (14.9)	19 (16.4)	
Agree	56 (83.6)	90 (77.6)	
I am able to find and define median			0.254
Disagree	2 (3)	6 (5.2)	
Neither agree nor disagree	5 (7.5)	17 (14.7)	
Agree	60 (89.6)	93 (80.2)	
I am able to find and define range			0.424
Disagree	2 (3)	9 (7.8)	
Neither agree nor disagree	8 (11.9)	13 (11.2)	
Agree	57 (85.1)	94 (81)	
Measures of central tendency			0.044**
Never heard of it	6 (9)	28 (24.1)	
Have heard of it	12 (17.9)	21 (18.1)	
Am somewhat familiar with the concept	25 (37.3)	29 (25)	
I can use the concept with confidence	19 (28.4)	35 (30.2)	
I am an expert on the concept	5 (7.5)	3 (2)	
"If you don't brand your work others will brand it for you"			0.003**
Never heard of it	5 (7.5)	24 (20.7)	
Have heard of it	14 (20.9)	32 (27.6)	
Am somewhat familiar with the concept	21 (31.3)	30 (25.9)	
I can use the concept with confidence	18 (26.9)	28 (24.1)	
I am an expert on the concept	9 (13.4)	2 (1.7)	
Descriptive statistics			<0.001**
Never heard of it	3 (4.5)	16 (13.8)	
Have heard of it	9 (13.4)	41 (27.6)	
Am somewhat familiar with the concept	23 (34.3)	21 (18.1)	
I can use the concept with confidence	22 (32.8)	35 (30.2)	
I am an expert on the concept	10 (14.9)	3 (2.6)	
***P*-value**			0.040**
Never heard of it	14 (20.9)	26 (22.4)	
Have heard of it	12 (17.9)	38 (32.8)	
Am somewhat familiar with the concept	20 (29.9)	27 (23.3)	
I can use the concept with confidence	16 (23.9)	24 (20.7)	
I am an expert on the concept	5 (7.5)	1 (0.9)	
Confidence interval			0.065
Never heard of it	9 (13.4)	24 (20.7)	
Have heard of it	15 (22.4)	36 (31)	
Am somewhat familiar with the concept	16 (23.9)	25 (21.6)	
I can use the concept with confidence	22 (32.8)	30 (25.9)	
I am an expert on the concept	5 (7.5)	1 (0.9)	
Prevalence and incidence			0.000**
Never heard of it	3 (4.5)	9 (7.8)	
Have heard of it	7 (10.4)	30 (25.9)	
Am somewhat familiar with the concept	12 (17.9)	27 (23.3)	
I can use the concept with confidence	26 (38.8)	45 (38.8)	
I am an expert on the concept	19 (28.4)	5 (4.3)	
Sensitivity and specificity			0.000**

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Never heard of it	2 (3)	12 (10.3)	
Have heard of it	11 (16.4)	30 (25.9)	
Am somewhat familiar with the concept	17 (25.4)	30 (25.9)	
I can use the concept with confidence	21 (31.3)	40 (34.5)	
I am an expert on the concept	16 (23.9)	4 (3.4)	
Understanding statistical packages e.g. SPSS			0.093
Never heard of it	9 (13.4)	19 (16.4)	
Have heard of it	19 (28.4)	47 (40.5)	
Am somewhat familiar with the concept	19 (28.4)	33 (28.4)	
I can use the concept with confidence	15 (22.4)	15 (12.9)	
I am an expert on the concept	5 (7.5)	2 (1.7)	
Bivariate analysis			0.059
Never heard of it	21 (31.3)	51 (44)	
Have heard of it	18 (26.9)	26 (22.4)	
Am somewhat familiar with the concept	13 (19.4)	27 (23.3)	
I can use the concept with confidence	10 (14.9)	11 (9.5)	
I am an expert on the concept	5 (7.5)	1 (0.9)	
Time to event analysis Kaplan Meir or survival curves			0.027**
Never heard of it	27 (40.3)	71 (61.2)	
Have heard of it	19 (28.4)	26 (22.4)	
Am somewhat familiar with the concept	11 (16.4)	13 (11.2)	
I can use the concept with confidence	9 (13.4)	4 (3.4)	
I am an expert on the concept	1 (1.5)	2 (1.7)	
Types of bias			0.091
Never heard of it	9 (13.4)	20 (17.2)	
Have heard of it	18 (26.9)	36 (31)	
Am somewhat familiar with the concept	15 (22.4)	32 (27.6)	
I can use the concept with confidence	18 (26.9)	26 (22.4)	
I am an expert on the concept	7 (10.4)	2 (1.7)	
Observational studies			0.000**
Never heard of it	5 (7.5)	17 (14.7)	
Have heard of it	14 (20.9)	27 (23.3)	
Am somewhat familiar with the concept	17 (25.4)	34 (29.3)	
I can use the concept with confidence	15 (22.4)	35 (30.2)	
I am an expert on the concept	16 (23.9)	3 (2.6)	
Cross-sectional studies			0.000**
Never heard of it	6 (9)	12 (10.3)	
Have heard of it	13 (19.4)	33 (28.4)	
Am somewhat familiar with the concept	16 (23.9)	32 (27.6)	
I can use the concept with confidence	17 (25.4)	37 (31.9)	
I am an expert on the concept	15 (22.4)	2 (1.7)	
Abstract writing and dissemination of information in conferences			0.000**
Never heard of it	5 (7.5)	15 (12.9)	
Have heard of it	6 (9)	41 (35.3)	
Am somewhat familiar with the concept	27 (40.3)	38 (32.8)	
I can use the concept with confidence	19 (28.4)	20 (17.2)	
I am an expert on the concept	10 (14.9)	2 (1.7)	
Cohort studies			0.002**
Never heard of it	3 (4.5)	10 (8.6)	
Have heard of it	14 (20.9)	41 (35.3)	
Am somewhat familiar with the concept	21 (31.3)	31 (26.7)	
I can use the concept with confidence	18 (26.9)	32 (27.6)	
I am an expert on the concept	11 (16.4)	2 (1.7)	
Odds ratio			0.014**
Never heard of it	15 (22.4)	28 (24.1)	
Have heard of it	14 (20.9)	43 (37.1)	
Am somewhat familiar with the concept	15 (22.4)	20 (17.2)	
I can use the concept with confidence	15 (22.4)	23 (19.8)	
I am an expert on the concept	8 (11.9)	2 (1.7)	
Relative risk			0.006
Never heard of it	10 (14.9)	25 (21.6)	
Have heard of it	18 (26.9)	41 (35.3)	
Am somewhat familiar with the concept	14 (20.9)	25 (21.6)	
I can use the concept with confidence	16 (23.9)	24 (20.7)	

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I am an expert on the concept	9 (13.4)	1 (0.9)	
Multivariate analysis			0.005**
Never heard of it	17 (25.4)	38 (32.8)	
Have heard of it	18 (26.9)	45 (38.8)	
Am somewhat familiar with the concept	13 (19.4)	14 (12.1)	
I can use the concept with confidence	11 (16.4)	18 (15.5)	
I am an expert on the concept	8 (11.9)	1 (0.9)	

Notes: *, **, *** represent significance at 1%, 5%, and 10%, respectively