

Evaluation on Awareness and Application of Statistical Process Control (SPC) among Health Practitioners of Rural Tanzania Health Facilities

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Abstract

Background: Statistical process control (SPC) is a collection of tools that when used together can result in process stability and variance reduction in production and services. For effective and efficiency of quality performance, health practitioners must be fully aware of general concept of SPC, its components and how to apply it in their daily work. Health practitioners are the once who will shape the nature of quality of those components to fit the needs and demands of health seekers (customers) through proficient application of SPC in their daily practices. However, different studies reported that, general concept of SPC is unclear to many practitioners and its application does not gratify the needs and demands of those health seekers. The study was aimed at evaluating awareness and application of SPC among rural Tanzania health practitioner.

Method: This article was aimed at evaluating awareness and application of SPC among health practitioners of Rural Tanzania Health Facilities in their daily practices. Non-interventional of cross-sectional explorative method in nature where both quantitative and qualitative data was collected. Thirty five (35) health professionals were conveniently interviewed. Self-administered questionnaires were administered and data was systematically analyzed by excel programs in computer.

Result: The result revealed that, of 35 health parishioners interviewed, (47%) do not completely know the general concept of SPC. On other hand, all (100%) of health practitioners interviewed, had never applied at all SPC in their daily practices. About the tools of SPC, of the 280 required responses, only 22 (8%) indicated that they are aware with check sheet. Few respondents were poorly responded to other recommended tools of SPC. However, there are other forms of SPC tools used in the hospital for quality control. When practitioners were asked on their opinions to apply SPC as way forward to improve their practice in future, a great number (29, 83%) recommended the SPC to be incorporated in clinical practice to improve quality of work.

Conclusion: If properly considered, the result from this mini study will improve efficiencies and effectiveness of performance among health practitioners. The result will also be useful for health facility managers as they will use as a guide for decision making about where improvement and efforts of action to be focused in the first place. However, this study may not sufficiently reflect the real situation of Rural Tanzania Health Facilities as it took place in only one health facility with a very small sample size. For this reason, this study may be a good platform for further study with adequate sample size.

Keyword: Awareness of SPC, standard SPC tools, application of SPC

Introduction

SPC overview

Statistical Process Control (SPC) has been described in many ways by different authors. It is a *statistical quality improvement* endeavoring to reduce variability in processes and products. Deming W. E., (1950) defines APC as a study to understand different variations in processes and populations. He says, it is interactions among variables in processes and populations during operation that promote effective communication between people for mutual action to reduce these variations in process or population.

Statistical process control is a collection of tools that when used together can result in process stability and variance reduction. As per definition of AHRQ (2013), Dale H. B. et al, (2004) & Shridhara B. K, (2002) in TAU handouts, SPC is a set of statistical methods based on the theory of variation that can be used to make logic of any process or outcome measured over a series of time, normally with the aim of identifying improvement or sustaining a high level of performance. In their Journal of Quality & Safety in Health Care, Benneyan J.C et al (2003) explained SPC as “A philosophy, a strategy, and a set of methods for ongoing improvement of systems, processes and outcomes”. For the idea of this study, it is about data collection, analysis, process thinking, and prevention of defects, stratification, stability, capability, and prediction of outcome. In a different time, SPC was interchangeably used as “statistical quality control or Control Chart”. The control charts indicates both combination of an Upper Control Limit (UCL) and a Lower Control Limit (LCL), specifies the variability due to either *natural variations* or *assignable variations* (Russell R. & Taylor W. B., III, 2006).

Contribution of SPC to the quality improvement

The overall purposes of SPC depict on the system process control, identify problems in order to make improvements and to contribute in the Total Quality Management (TQM) goal of continuous improvement (Russell R. & Taylor W. B., III 2006). With this platform, the main purpose is to check the process variations and ultimately, to monitor and reduce its occurrence in production or service processes. As it was outline by Walter A. Shewhart in TAU handouts, variation can be due to two possible causes:-

Common causes (natural variation); referred to natural, inherent variation that can be reduced without making changes to the process such as improving equipment or using other machines. Such variation is often harmless and it may not need economical or technical efforts to reduce it. Such variation is normally said to be *in-control* (Marilyn K. H. & Hart R. F., (2007). *Special causes (Assignable Variations)* in other hand refer to variation caused by external causes such as a broken part of a machine. Such type of causes usually leads to extra unnecessary variation and must therefore be detected and taken away as soon as possible. A process that is not in-control is said to be out-of-control (Madanhire I., Mbohwa C. 2016).

Statement of problem

The Statistical Process Control (SPC) as an element of Total Quality Management initiatives was actively pioneered globally in healthcare sectors in around early 1990s for the aim of controlling and managing some preventable hospital errors (Rodriguez N. R and Bucky R., 2010). As it was in other global views, Tanzanian societies define good quality of healthcare in outlook of different components of health facility like good infrastructure, positive practitioners' approach and adequate availability of services (Russell R. & Taylor W. B., III, 2006). The choice of which health facility to attend is basically predetermined by the background knowledge of healthcare seekers on the quality of those components. On other hand, it is entirely the role of health practitioners to shape the nature of quality of those components to fit the needs and demands of those health seekers (customers) through proficient application of Statistical Process Control in their daily practices (Thor J. et al, 2007 and Madanhire I., Mbohwa C., 2016). However, it has significantly been noted that, in some circumstances and in other health facilities, the general concept of SPC is unclear to many practitioners and its application does not gratify the needs and demands of those health seekers (customers) (Russell R. & Taylor W. B., III, 2006). This situation amuses health seekers undergo through long distance, high costs and physical suffering looking for better quality health service from one facility to another facility. The aim of this article was to evaluation the degree to which health practitioners know and apply the Statistical Process Control in their daily practices in Rural Tanzania Health Facilities.

Significance of study

Statistical Process Control has wider range of significances in healthcare facilities. These studies will possibly going to improves efficiencies and effectiveness of performance in rural health facilities if practitioners would apply SPC as insisted in study by Thor J. et al (2007) and Madanhire I., Mbohwa C. (2016). Secondly, the results from this study may be used by healthcare providers and managers as guides for decision making about where improvement and efforts of action to be focused in the first place. Application of the result of this study would in place the use of SPC in practice by health faculties, and this will reduce in great extent the risks that may occur in hospitals and other healthcare facilities. In the economic view, if these facilities apply SPC, they will reduce unnecessary costs that the facilities may incur due to errors of healthcare practitioners (Thor J. et al 2007). The study also would contribute to the reduction of time required to produce the product or service within health facilities. Article writing is among the course requirement to fulfill my doctoral program.

The study general question

To what extent the health practitioners of Rural Tanzania Health Facilities use statistical process control in their daily practices?

Objectives

To assess an awareness of healthcare practitioners on the general concept of SPC

To identify the presence of standard SPC tools in health facilities of Rural Tanzania Healthcare Facilities

To review the application of SPC tools by the practitioners in Rural Tanzania Healthcare Facilities

Literature review

Statistical process control (SPC) is a compilation of tools that when used jointly can result in process constancy and variance reduction (Marilyn K. H. & Hart R. F., 2007). It is expected to improve outcome of performance in health facility by reducing variability in wider aspects areas. Russell R. & Taylor W. B., III (2006) and Benneyan J.C et al (2003) in their studies said, several hospitals use the database from SPC to classify unusual variability in staff and physician performance, cost of care, and prevent events that affect the outcome of a patients care. As shown in this article, SPC can afterward be used to identify variability due to special causes and hub further review to reduce this variability.

The presentation of Pearson Prentice Hall, (2008), outlined the special causes of variation occurring in processes as the one that can be traced to a specific reason and be corrected with a specific effort. The goal of employing SPC is to determine the assignable causes within a process and eliminate them by incorporate the good once.

Marilyn K. H. & Hart R. F., (2007) said, control charts are the important tools of SPC for continuous quality control. Control charts examine processes to prove how the process is performing and how the practice and abilities are exaggerated by changes to the process. This information is subsequently used to construct quality improvements (Xin D., Wardell D., Rohit V. 2006).

The benefits of SPC application in healthcare facilities are significantly noticed by many authors. Dale H. B. et al, (2004) in TAU handouts and Rodriguez N. R. and Bucky R., (2010), Benneyan J.C et al (2003) demonstrated that SPC has made proper utilization of scared resources within many organizations by reducing waste. The great impact has been observed in reduction of time required to produce the product or service.

Several authors have suggested different tools used in SPC to identify and control any process defect. Among these tools are pareto charts and analysis, cause-and-effect diagrams, frequency histograms, control charts, Scatter diagrams, check Sheet and Graph (Thor J. et al 2007, Madanhire I., Mbohwa C. 2016, Dale H. B. et al, 2004 in TAU handouts, Rodriguez N. R. and Bucky R., 2010, Benneyan J.C et al, 2003). Many studies have recommended SPC as good device to improve quality

of different processes in both production and service (Deming, W. Edward 1950, Rodriguez N. R and Bucky R. 2010, Rami H. F. & Adnan M., 2010, Russell R. & Taylor W. B., III 2006, Dale H. B. et al, 2004)

Methodology

The study type

The study design was a Non-interventional of cross-sectional explorative in nature where the extent of SPC general awareness and application has been scrutinized, and both quantitative and quantitative data will be collected.

The study area

One of the healthcare facility in Rural Tanzania was selected, preferably “Haydom Lutheran Hospital”. This is a second level referral regional hospital located in Northern Rural Tanzania with a bed state <500 and <600 staff. Of this number of staff, approximately 7% involves Professional Medical Doctors, 19% occupies Professional Nurses and the rest involves different technicians like Lab tech., Physiotherapists, Radiologists, Pharmacists, Medical Attendants and others. The hospital has all basic medical and nursing departments with its specialty of services.

The study population and sampling method

In this study, all professional staff was presumably supposed to use the SPC tools in their daily work and they were subjects to the study. Non-probability with convenient sampling was employed to approach the study. Nine (9) Medical Doctors, nineteen (19) Nurses, three (3) Lab Tech, two (3) Physiotherapists, two (2) Radiologists and one (1) Pharmacist have been involved in the study. However, availability of other supplementary SPC tools used in the hospital like charts, figures and diagrams was evaluated through interview and observation.

Sampling technique and tools

Self-administered questionnaires were offered for gathering data about general concept of SPC from professional practitioners. Face to face interview was deployed to assess the existing SPC tools. However, observation, photographing and recording have been done to collect data about SPC tools.

Ethical consideration

Permission was sought from Hospital Administration and Management through written letter. Consent has been obtained and the thorough explanation to the participants about the study and their roles in the study has been clearly made. Unethically related issues were debarred. The freedom to or not to participate in the study has been widely discussed to seek for consent. The personalized/identifying information gathered from the study was strictly protected and will remain anonymous.

Limitation to the study

Time Constraint has been experienced from the preparatory phase through the data collection to the presentation phase of the study. A financial limit has significantly impeded. Low responsiveness of the participants due to unwillingness to the study was eminently noted.

Data analysis

Data has been analyzed systematically using manual and excel programs in computer. The master sheet has been contracted in the excel program and all data has been entered. The information gathered through quantitative review has manually been analyzed and presented in quantifiable way. Other data collected through observation and photographing has been incorporated through scanning and been presented into graphics and figures.

Results

Demographic data

This chapter summarizes the results of this mini study on the “Evaluation on Awareness and Application of Statistical Process Control (SPC) among Health Practitioners of Rural Tanzania Health Facilities”. The study took place in one of the health facility in Northern Rural Tanzania, and thirty five (35) Health Practitioners were interviewed. Of this number, 17th were nurses, 9 were medical doctors, 3 were lab technicians, 3 were radiology technicians, 2 were physiotherapists and 1 was pharmacist. The study considered various levels of education of participants where 2 of them were certificate, 12 were diploma, 18 were bachelor degree and 2 were masters. The different departments of the facility were involved to see if any of which is applying SPC. Figure 1, 2 and 3 represent the demographic data.

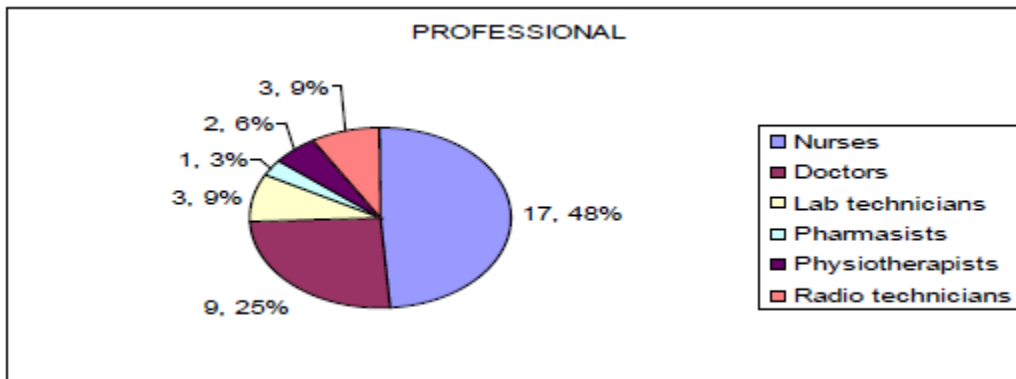


Figure 1. Profession of participants

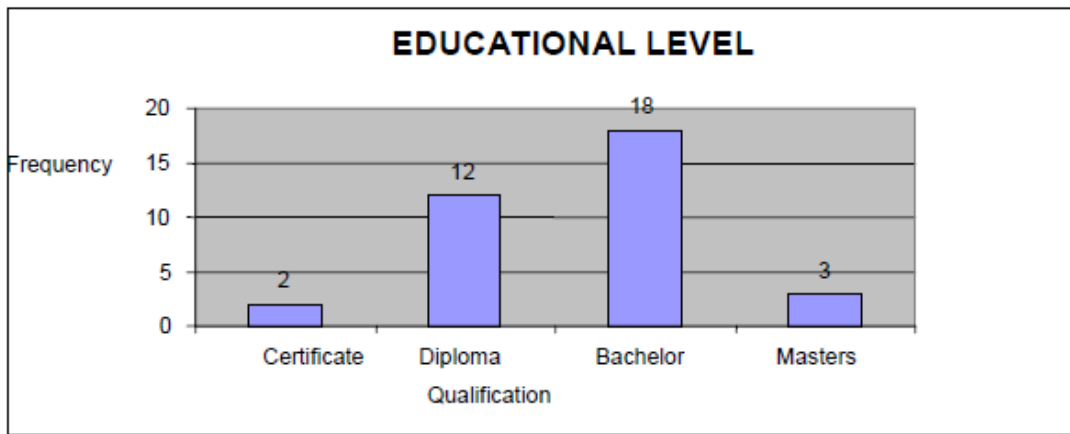


Figure 2. Educational level of participants

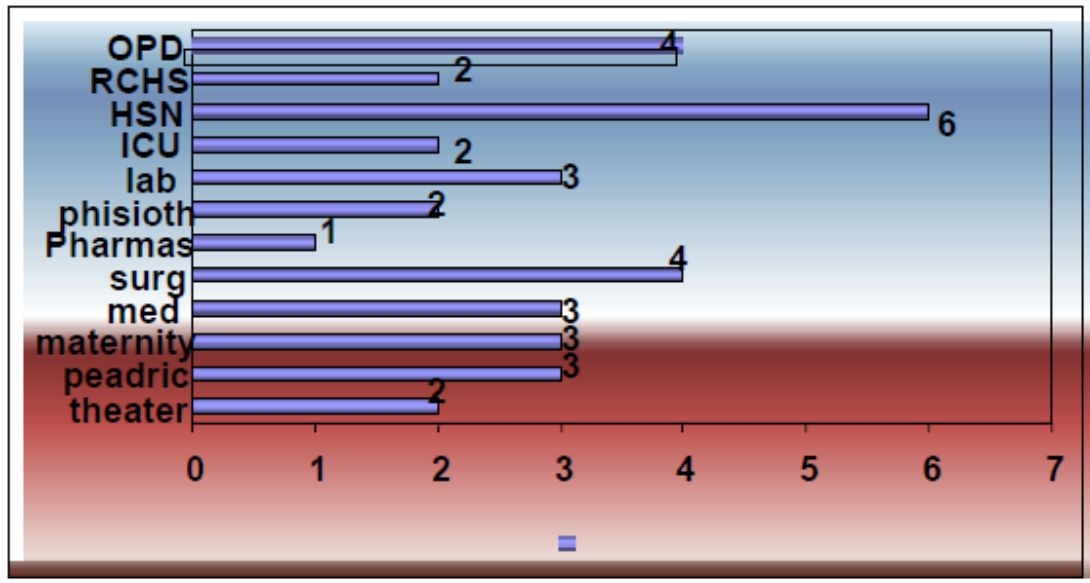


Figure 3. Department involved

Concept of statistical process control

The study interviewed the knowledge and awareness of health practitioners on the general concept of SPC and its application in their daily work. Of all number thirty five (35) participants who were involved in the study, at least 19 (53%) have ever heard the term SPC in their life. 13 (47%) said they did not completely heard the term SPC before. However, none of them (100%), both who heard and not heard had ever applied SPC in their daily work.

4.3: Source of knowledge on SPC

Participants were asked to sketch their origin of information about SPC. Of all respondent who heard the term SPC, 13 (37%), heard from the schools during their studies. 12 (34%) respondents did not responded to this question. Other respondents hear the term from other different sources as shown in figure 4

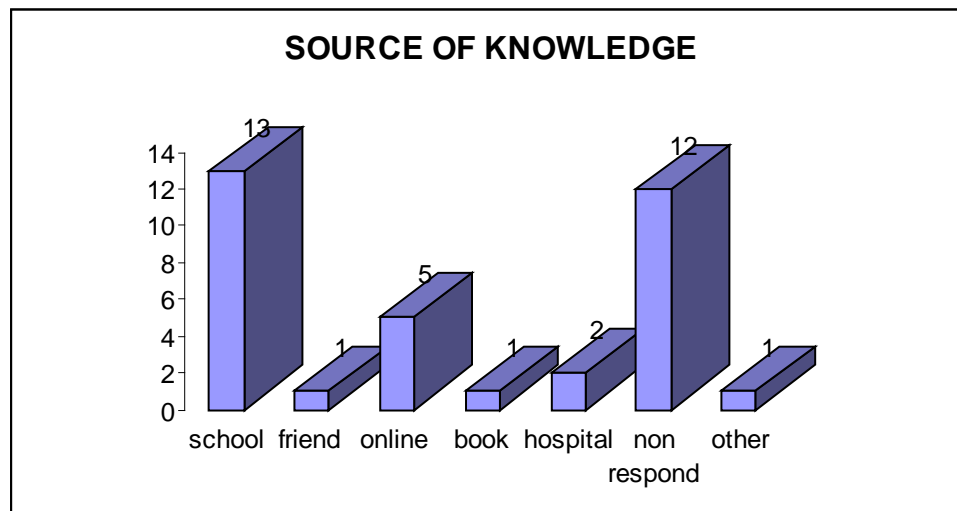


Figure 4. Sources for knowledge on SPC

Tools used in SPC

The different recommended tools for SPC which are used to control work performance in practices were intervened in this mini study. Check sheet, histogram, pareto chart, cause and effect, scattered diagram, control chart, and graph were assessed for their application. The respondents were given opportunity to respond to all tools as many as they have heard/seen or used in their daily work. There are possible 280 responds if at all they could have responded to all. Of all tools, check sheet was seen to be known to majority of respondents 22 (8%) compare to other tools. This was followed by histogram and graph. However, 194 responds were not attempted. In this study, other tools available in the hospital for controlling quality have been observed. Figure 4 below indicates this result.

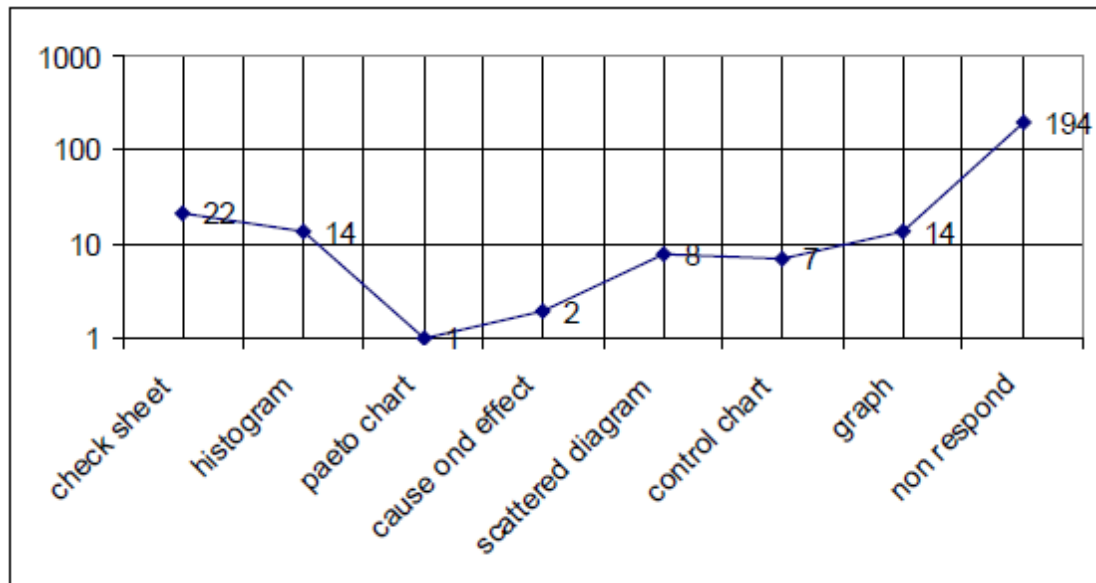
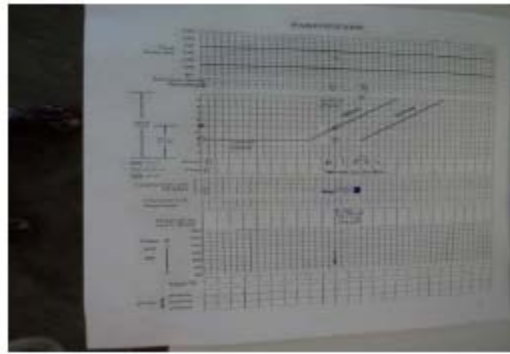


Figure 5. Tools for SPC (Above)

Examples of other different tools used in the hospital for controlling quality (Below a-d)



(a). Annual statistic record sheet.



(b). Partograph



(c). Patient treatment sheet



(d): Physiotherapy treatment sheet

How practitioners use SPC in their work

The study interviewed the practitioners on how SPC could be used in facility daily work. This question was approached differently by respondents. Some say, it is used in statistical control, others said it is used in controlling patients' progress; others said it is used in controlling labor progress and few said; is used in controlling equipment and supplies. The figure below emphasis this finding.

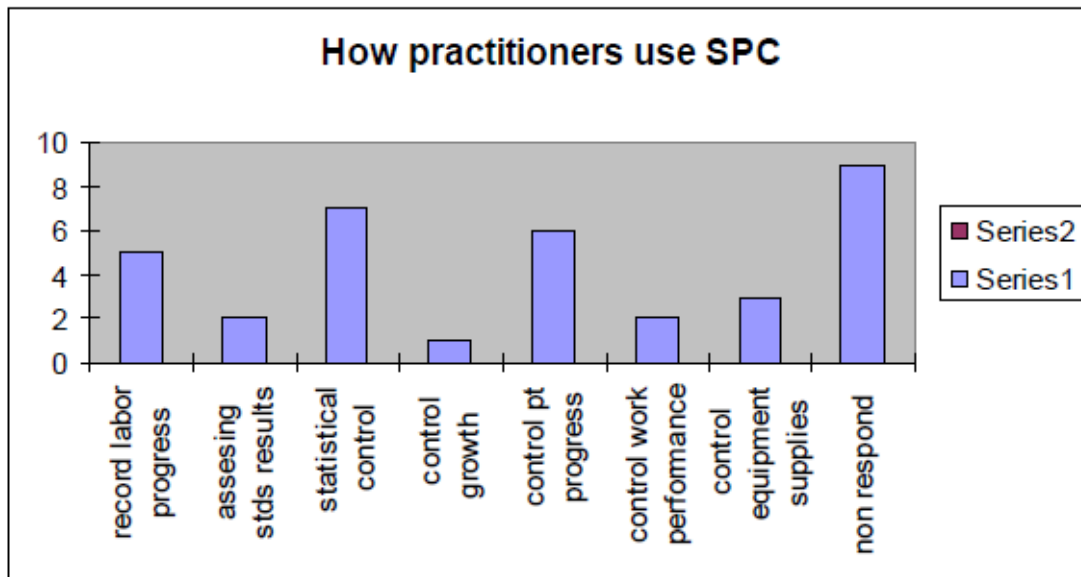


Figure 6. The use of SPC

Can SPC improve quality of work?

The finding from this question was impressing as majority of respondent responded to agree that SPC improves quality of work if applied promptly. Among 35 participants involved, 30 (86%) said, yes SPC improves quality of work if applied in daily work. Figure 6 indicates the result.

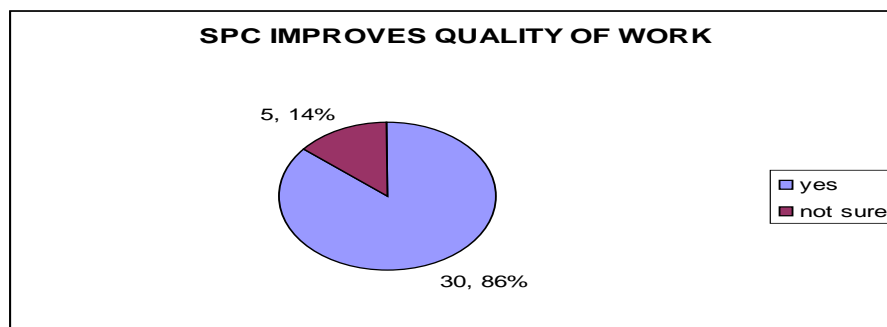


Figure 7. Contribution of SPC in quality improvement

Opinions of Participants on application of SPC

Further dialogues were done to uncover out an opinions of participants on application of SPC as way forward to improve their practice in future. In this particular question, large number of respondents 29 (83%) agreed that SPC has to be commence in clinical practice to improve quality of work. Four (4) respondents among total said they are not sure if it can improve the quality, and the rest did not responded to the question. Figure 7 below indicates the result.

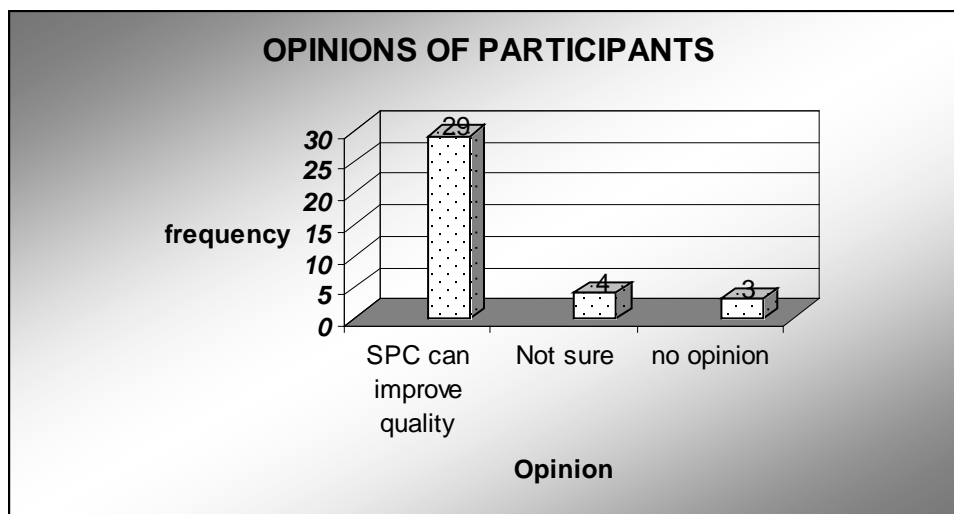


Figure 8. Opinions of Participants on application of SPC

Discussion

Concept of statistical process control

The result of this mini study on this aspect of concept of Statistical Process Control shows that, significant number of health parishioners (47%) completely do not know the general concept of SPC. The study on other hand also indicates that all (100%), health practitioners said, they have never applied at all SPC in their daily practices. However, there are other different forms of SPC used by practitioners in the hospital that the practitioners used and they are not aware whether they are form of APC. These forms include partograph, patient treatment sheets, tally sheets, medicine dispensing and supply sheets, etc. However, some of these tools lack recommended standard displayed in SPC like having upper and lower limit. This finding is contrary to the study by Thor J. et al (2007) that says, effective application of SPC which may bring about improvement in quality of care depends on knowledgeable practitioners on SPC aspects. This study says, a knowledgeable practitioner could be able to identify the area of practice that needs to be improved.

Source of knowledge on SPC

After making inquiries on sources of information on SPC among those who have ever heard the SPC, the finding identified that majority 13 (37%), got information from the school they studied. This finding is inline with those of Chou C. S., (2002) that identified several valuable sources where health practitioner could obtain information about SPC. Of the sources, training institutions have been sited as a primary source, followed by working facilities, website and books. However, in this study, large number of respondents, 12 (34%) has not responded to this particular question, perhaps due to the fact that they do not have an idea on SPC.

Tools used in SPC

The study shown that, check sheet was known more by some practitioners compare to other tools. Of the 280 required responds in this study, only 22 (8%) indicated that they are aware of check sheet. Few respondents were poorly responded to other recommended tools of SPC. This responds are poor as different studies recommended in effective application of SPC. Several studies recommend about seven tools used in proper application of SPC which include check sheet, histogram, pareto chart, cause and effect diagram, scatter diagram, control chart and graph (Deming, W. Edward 1950, Rodriguez N. R and Bucky R. 2010, Rami H. F. & Adnan M., 2010, Russell R. & Taylor W. B., III 2006, Dale H. B. et al, 2004). However, when participants were asked to indicate other tools used in

the hospital instead, they specified partograph, patient treatment sheets, tally sheets, medicine dispensing and supply sheets, etc.

How practitioners use SPC in their work

When practitioners were asked on how they use SPC in their daily work, majority (25, 71%) responded differently. Some said they used in statistical control, others said it is used in controlling patients' progress; others said it is used in controlling labor progress and few said; is used in controlling equipment and supplies. These responses are exactly what other studies recommend about the use of SPC in practices (Deming, W. Edward 1950, Rodriguez N. R and Bucky R. 2010, Rami H. F. & Adnan M., 2010, Russell R. & Taylor W. B., III 2006, Dale H. B. et al, 2004).

Can SPC improves quality of work?

In this question, majority, (30, 86%) of participants responded to agree with fact about SPC as it improves quality of work if applied promptly. This idea is supported by many studies (Deming, W. Edward 1950, Rodriguez N. R and Bucky R. 2010, Rami H. F. & Adnan M., 2010, Russell R. & Taylor W. B., III 2006, Dale H. B. et al, 2004, Madanhire I., Mbohwa C. 2016, Thor J. et al 2007, Pearson Prentice Hall, 2008).

5.6. Opinions of Participants on application of SPC

When more interviews were carry out to reveal opinions of participants on application of SPC as way forward to improve their practice in future, great number of respondents (29, 83%) recommended that SPC can improve quality of health care and must be incorporated in clinical practice to improve quality of work. This finding also has strongly supported adequate number of studies (Deming, W. Edward 1950, Rodriguez N. R and Bucky R. 2010, Rami H. F. & Adnan M., 2010, Russell R. & Taylor W. B., III 2006, Dale H. B. et al, 2004, Madanhire I., Mbohwa C. 2016, Thor J. et al 2007, Pearson Prentice Hall, 2008).

Conclusion

This article aimed at evaluating general knowledge and application of Statistical Process Control among health practitioners of Rural Tanzania Health Facilities in their daily practices. The result from this mini study will improve efficiencies and effectiveness of performance among health practitioners. The result will also be useful for health facility managers as they will use as a guide for decision making about where improvement and efforts of action to be focused in the first place. However, this study may not sufficiently reflect the real situation of Rural Tanzania Health Facilities as it took place in only one health facility with a very small sample size. For this reason, this study may be a good platform for further study with adequate sample size.

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