Evaluation Of Reagents Used In Solution Preparation To Reduce Reworks In Research And Development Laboratories

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Abstract

Research and development laboratories are working with improvements and discovery of new drugs. As part of their activities, they need solutions such as Buffers and Mobile Phases for analytical testing. It was found that a main reason that increase rework in solutions preparations is the unavailability of reagents. Looking for reagents for solution preparation with the correct purity grade and specifications is the main goal they face. Evaluating reagents, purchasing and establishing a tool for reagent reorder will reduce significantly rework and waste generated due to incorrect reagent used.

Introduction

The pharmaceutical industry consists of Manufacturing areas, Quality Control laboratories and Research and Development laboratories. Those areas are focused on the execution of procedures regulated by the Food and Drug Administration for manufacture of pharmaceutical drugs or medical devices. From those three areas, Research and Development can be considered a less risk environment because they are not involved in the manufacturing of a drug or releasing lots, but they are key in any improvement suggested for the manufacturing.

Background

Research and Development Laboratories may have electronic systems to keep traceability of purchased reagents. Reorder is only included for those reagents in the main inventory, but miscellaneous regents needs to be purchased prior to use or when identified missing.

A rework means a solution preparation that failed a criterion from the procedure. There are some sources or error that could led to a rework including weighing, documentation, glassware or reagent which is the focus of this investigation.

Reworked solution preparation due to the use of incorrect reagent (incorrect purity grade) increase the waste generated on the facilities in terms of reagent consumption (large quantity of reagent or solution to dispose).

Objectives

For this project, there are four main objectives:

- Identification of most used reagents for solution preparation to add to main inventory if possible
- Purchase of identified missing reagents
- Look for storage for purchased reagents
- Evaluate a tool for miscellaneous reagent reorder to avoid unavailability.

Problem

Laboratories are looking for improvements in drug manufacturing. A preparation area is committed to the preparation of solutions such as Mobile Phases and Buffers for different.

Methodology

Various business management strategies have been developed to improve the performance of organizations by improving the processes by which they carry out their work[1]. . Those strategies include Lean and Six Sigma for process improvements with a set of principles and practices to obtain high efficiency and reduce waste.

Six Sigma is a data driven statistical approach, embedded in managerial philosophies, that focus on reducing the process variations and improving the bottom line of the process[2].

One Six Sigma methodology is the DMAIC model. DMAIC is a linear scheme of quality improvement summarized in five phases: Define, Measure, Analyze, Improve, and Control. The DMAIC model plan to improve, optimize, or stabilize an existing process with the detection and removal of defects or inefficiencies in the process[2].

Define: A problem is identified and needs to be attended for the improvement in the process.

Measure: This phase, includes the understanding of situations over the problem specified in the Define phase and actual processes are measured to identify how they can be improved.

Analyze: During this phase, the measurement and data collected in the previous phase is analyzed and used to determine the root cause of the problem stated.

Improve: Action is taken to solve the problem for the process improvement

Control: This phase is focused on keeping traceability that the problem is solved, and preventive actions are taken to avoid repeatability of the issue.

Results and Discussion

For the executed assessment and the DMAIC model performed these are the results found:

Define Phase

Analyzed data have shown different factors that resulted in rework for solutions preparations. Those factors include Weighing, Documentation, Glassware and Reagents. Figure 1 shows a fishbone that help determine that the main contributor for reworks in solution preparation is the reagents due to different reasons. That's why this project is focus on evaluation of available and unavailable reagents.

A complete analysis of prepared solutions and reagents used on preparations was performed, capturing large quantity of waste generated due to the use of incorrect reagent in terms of purity grade. Another factor that impact the quantity of reworks is the unavailability of reagents as needed.

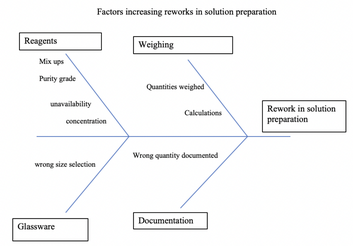

Figure 1. Fishbone of Factors that Increase Rework

Results and Discussion

Measure Phase

Actual processes include the use of available reagent for each preparation after search over the laboratories. Most consumed reagents have been evaluated and determine whether they need to be part of an inventory with reorder program. From a list of 35 evaluated reagents, only 8 reagents can be added to the main inventory due to the high use. The other 27 reagents need to be purchased by the user and look for storage and label them.

Analyze Phase

The 100% of reworked preparations was due to the use of wrong reagent. As shown in Figure 2, a 29% percent of rework was due to the use of incorrect reagent purchased by the end user (similar name but different concentration), and 71% was reworked due to use of incorrect purity grade. Some reagents found on the inventory with a specific purity grade are less used than reagents with a better purity grade.

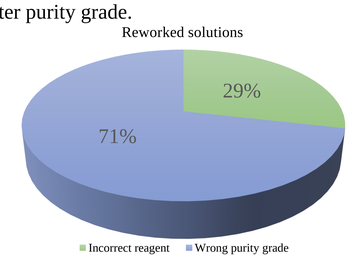

Figure 2. Reworked Solutions over a Period of Two Months

Improve Phase

Reagents were evaluated over two laboratories to analyze the most used and identify which of them can be added to the reagent inventory. It was found that commonly used reagents on current month are not necessarily the reagents needed on the next month. That's why those miscellaneous reagents cannot be added to the current inventory. Those reagents need to be purchased by the end user or purchased by the people that prepare the solutions. For those miscellaneous reagents not commonly used the form showed in Figure 3 which contains the data needed for the purchase of reagents and will be used for evaluation of use to keep visual record with a label similar to that shown in Figure 4.

Miscellaneous reagents to be purchased

Reagent name	Manufacturer	Reagent size	Frequency of use
1.			
2.			
3.			
4.			
5.			
6.			
7.			

Figure 3. Form used to keep Traceability of Miscellaneous Reagents

Reagent Name	**Part number**
Manufacturer	Container Size

Figure 4. Label for Purchased Reagents

Results and Discussion

Control Phase

Miscellaneous reagents were purchased and physically located in the laboratory of preparation, labelled and segregated according to the available space for storage. A tool for track these miscellaneous reagents to avoid unavailability, includes a Spreadsheet with the main information of each reagent, physical location and the execution of an internal audit monthly for determination of reorder. This part of the process is not implemented because it requires user orientation and determination of how the task is going to be executed between the locations. Special attention is needed to those miscellaneous reagent consumptions to evaluate if the basis of the internal audit needs to be changed.

Reagent Name		**Part number**
Manufacturer		Container Size

Figure 5. Label with Visual Aid for Miscellaneous Reagents

Figure 5 shows the proposed label for those miscellaneous reagents. This kind of label will include a yellow dot in the middle or at any side to help visual identification of those reagents that would be part of an internal audit for reorder evaluation.

Conclusions

Reagents identified as miscellaneous cannot be part of the main inventory due to the low frequency of use. Evaluating those miscellaneous reagents with the tool presented over this assessment can reduce or eliminate the reworked solution preparation, reduce the waste generated in the areas and higher up the productivity of those preparing the solutions. For the pharmaceutical industry area, implementation of a tool requires full evaluation of different departments. As proposed on this project it will be given for evaluation in order to improve the productivity in the specified area. It was hard work to get implementation of this assessment because there are few variables that need to be evaluated individually in order to improve the actual process in the Research and Development laboratories.

Future Work

Suggest the proposed ideas of the Control measure to improve work areas while doing an internal audit on a monthly basis for reagent evaluation.

References

[1] Schweikhart, S; Dembe, A. 2009. *The Applicability of Lean and Six Sigma Techniques to Clinical and Translational Research*. J. Investig. Med.; 57(7): 748–755. Available: http://www.doiserbia.nb.rs/Article.aspx?ID=0354-02431900007S#.XieuMC3Mw0o

[2] Pallavi, S.; Anshu, G.; Malik S.C., M.; P.C., J., "Quality Improvement in Manufacturing Process through Six Sigma: A case study of Indian MSME firm". Yugoslav J. Ops. Res. 2019, 29(4). 519-537 .