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The Use of Middleware Algorithms to Standardize the Results Review Process and Enhance Technologists' Efficiency

By Mark L. Shearer, M.C.L.T., M.T. (A.S.C.P.)

Abstract

Introduction:

The use of middleware has long been suggested as a means by which algorithms can be used to review patient results, without the need for technologist intervention. This would provide the technologist additional time for performing other duties or the ability to review multiple instruments at one time. With the shrinking supply of technologists, such mechanisms will be necessary in order to meet testing demands.

Methods:

Technologists were interviewed, and a consensus list of criteria was developed, that encompassed all the routine chemistry tests performed on our Roche Modular® systems. The technologists were instructed to record the steps taken when reviewing chemistry results. The result was 26 similar but distinctively different sets of steps as each technologist had their own way of performing results review from this a consensus set of steps was constructed into a process map consisting of 51 steps. Timing studies where then completed that included both the time required to review the results and to add messages to results when needed. The time required to investigate, repeat, or otherwise deal with unusual results was not included. The Data Innovations Instrument Manager™ software was installed and the Roche Modulars® interfaced through this middleware. The list of review criteria obtained from the technologist was then used to construct "rules" (algorithm) within the Instrument Manager™. These rules also incorporated the use of the serum indices, as performed by the Roche Modulars®, to add messages regarding specimen hemolysis or lipema to individual test results based on the level of the interferent and the extent to which that analyte was affected by the given level of interferent. Rules were also developed to identify those samples that required the attention of the technologist. These samples included such situations as critical values, discordant results, samples requiring manual dilutions, or samples with suspected clots. Then the rules were validated within the software, and again by the retransmission of data from the instrument to the Instrument Manager.

Results:

With the use of these rules, 28 of the 51 steps within the process map could be eliminated – a 45% reduction in steps required by a technologist to review results. In addition, 98.6% of all patient samples can now be released without a technologist review. This allows their attention to those samples requiring their expertise. Given our patient mix and overall sample volume, we saved 0.5 FTE's. Additional savings were achieved as the system was refined and expanded to other testing areas. Benefits were also derived from a greater level of consistency in results review than could have ever been achieved using technologists alone.

Introduction

The supply of qualified technologists and technicians has been shrinking for the last decade or more. This fact, compounded by diminished reimbursement rates, have driven the Clinical Laboratory to seek methods by which testing levels and quality can be maintained with fewer technical staff members. Middleware has been suggested as a means by which this goal can be accomplished. The purpose of this study was to determine the algorithms required to perform the results review of the routine chemistry tests from our reference location.

Method and Procedures

The Data Innovations Instrument Manager™ v 8.04 was installed on a local network server and was subsequently used to interface the Roche Modulars® to our LIS (Quest Laboratory System). This LIS is used at our reference testing location. The technical staff was surveyed to determine what each tech looked for when performing results review. From this information, a consensus set of criteria was determined. This list served as a basis to construct the algorithms within the Instrument Manager™. (See table 1). Rules were tested first within the Instrument Manager™ and then by retransmitting results from the Modulars® into the Instrument Manager™. Adjustments were made and rules were added in order to accommodate these real life results. Time studies were conducted to determine the mean time required to perform results review on each sample along with the time required to manually enter specimen condition comments such as hemolysis or lipemia.

Results

The implementation of the algorithms allowed the reduction of process steps from 51 to 28 (see figures 2 and 3). This represents a 45% reduction in steps required. Studies showed that the average time required to review chemistry results in the reference laboratory was 7 seconds. Note that this includes only the review time and not the time required to take additional action such as repeat testing, looking for alternate samples, looking up history etc. Additionally it was determined that the number of samples requiring technologist review was reduced from a daily average of 2101 to 13 (see chart 1), a 98.6% reduction. This results in a reduction of tech time by more than 4 hours per day.

Conclusions

The use of middleware is an effective means by which routine results review may be accomplished and provide for more efficient use of technologist time. This approach has since been expanded to cover additional chemistry equipment as well as our hospital location, thus compounding the technologist time saved. Additionally the review of specimen indices, and the associated addition of analyte specific comments can be handled automatically and with a level of consistency that could not be achieved by manual review. While some of the technologist time was lost through attrition, the majority of the time was used to add additional tests to the menu and to improve the completion time for the routine work.

Pre-Implementation Flow Diagram - Figure 2

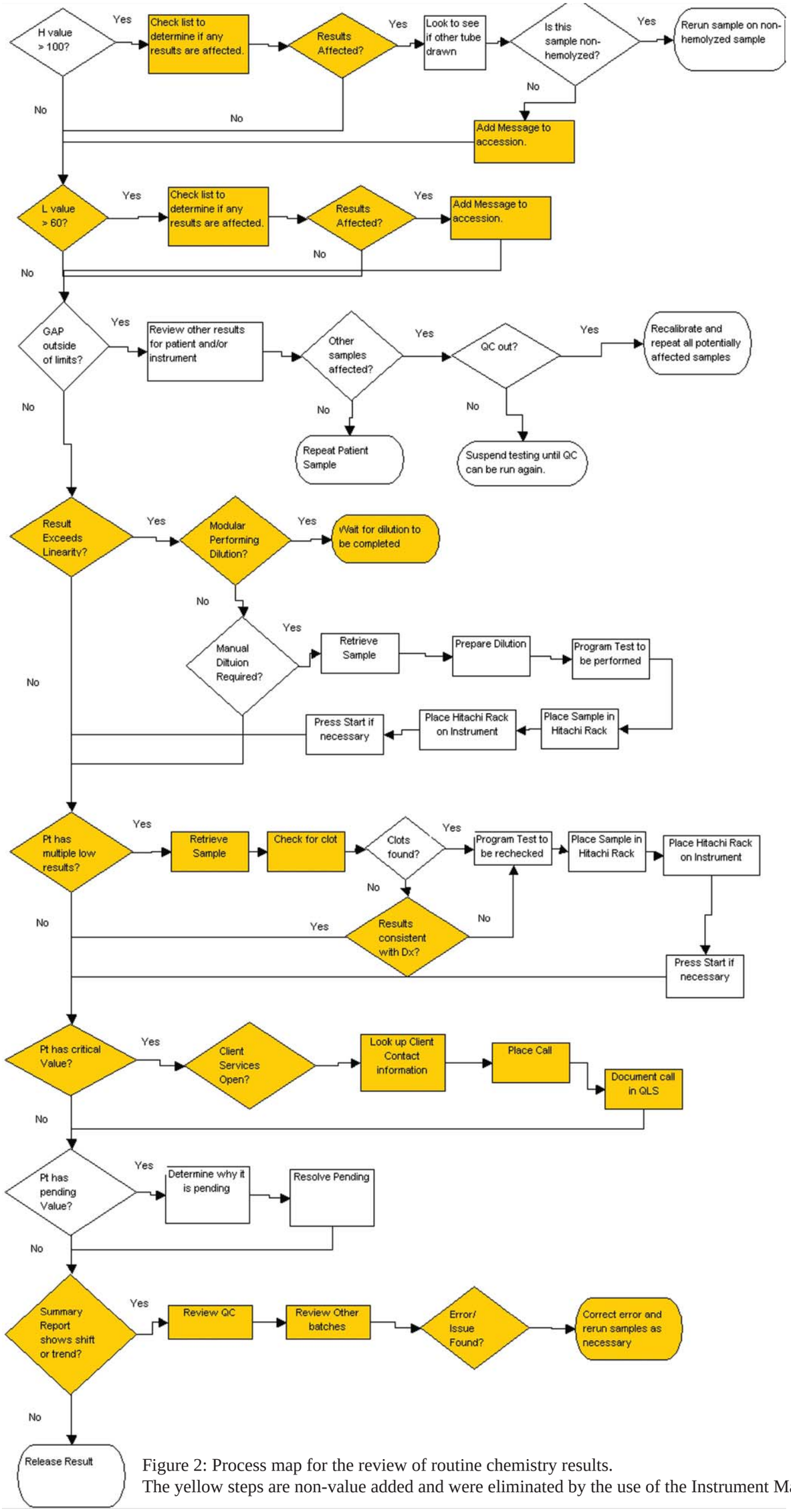
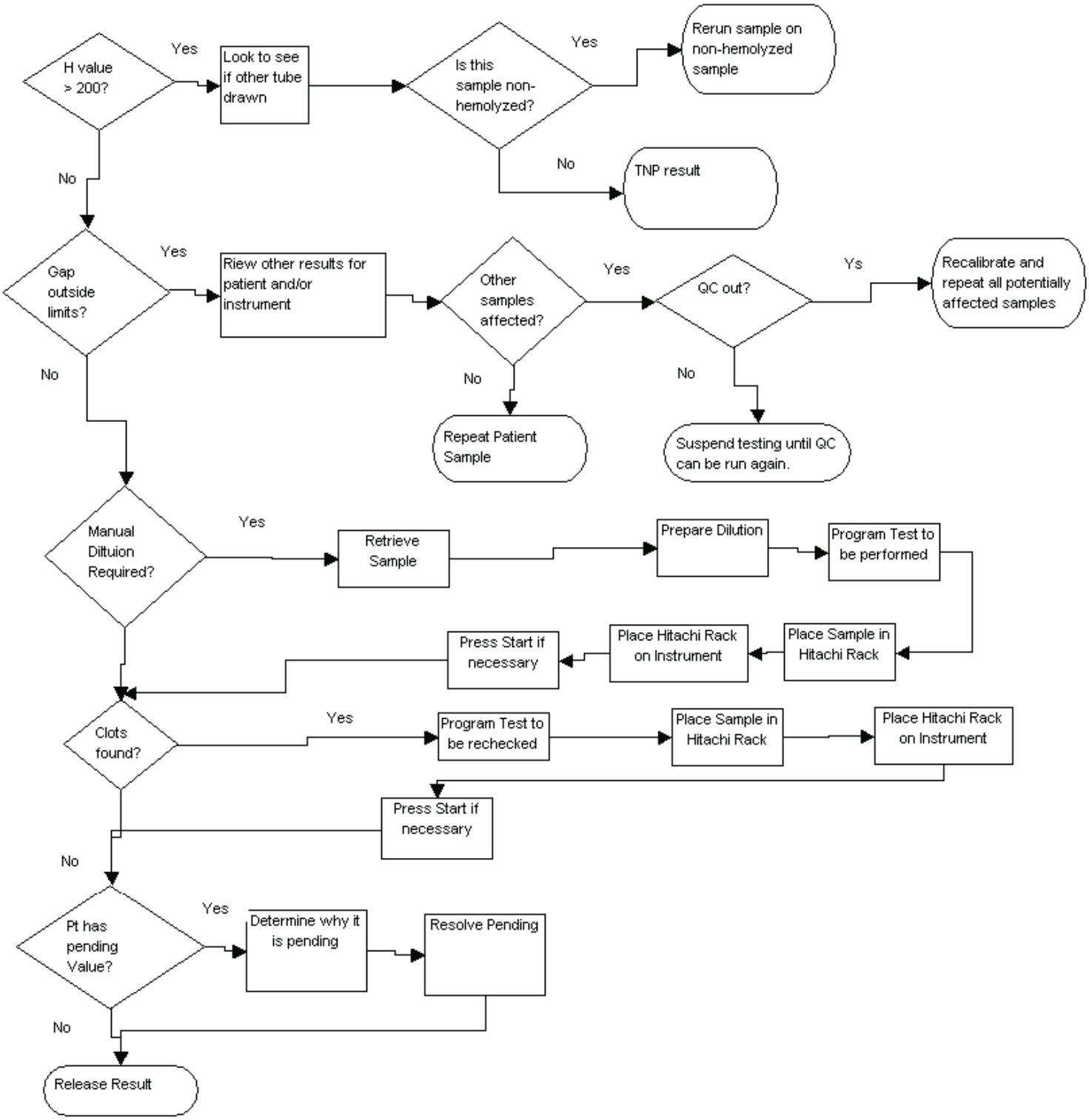


Figure 2: Process map for the review of routine chemistry results.
The yellow steps are non-value added and were eliminated by the use of the Instrument Manager™.

Post-Implementation Flow Diagram - Figure 3



Figures

Results Review Criteria - Table 1