A decision support system for quantitative measurement of operational efficiency in a blood collection facility

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1. Introduction

The Healthcare industry has undergone increasing scrutiny by government and regulatory agencies in the past two decades. As a result, related industries have also been subjected to the demands for cost containment and maximizing efficiency of operations as they attempt to maintain quality and service in this competitive environment [1]. The blood banking industry has responded to such challenges by streamlining operations and reducing expenses. Extended efforts have been placed on keeping the cost of blood products as low as possible. To assist managerial decision makers in daily operations, knowledge of the financial impact of operational decisions would improve the quality of their decisions. These quantitative measures of operational efficiency were applied to four real life operational issues and found to provide valuable quantitative information to the managerial group. These findings are consistent with the theory that knowledge of the financial consequences of a decision enhances the decision making process.

Based on the recent trends noted in the healthcare and the blood banking industries, blood collection facilities are facing with increasing pressures to maximize efficiency of operations and focus their efforts to maintain financial stability, while keeping the cost of blood products to a minimum. The blood banking industry has historically been...
sheltered from the financial pressures facing the healthcare industry. As of late, the industry has been faced with many difficult financial decisions and has been forced to become cost conscious and efficiency driven to remain a viable part of a rapidly changing healthcare environment.

As a result of these economic pressures to analyze and monitor efficiency of operations, the mobile operations team, who is responsible for monitoring this efficiency, needed a working tool which would demonstrate the level of operational efficiency in terms of financial impact on the cost per unit collected. This tool would then provide an opportunity to benchmark efforts made to streamline operational efficiency with a tangible, dollar value, result. The ultimate goal of the operational efficiency in purely financial terms is a lowered total collection and production cost per unit of blood. In turn, an interactive decision support system (DSS) is the tool developed to assist in this situation. The aim of this paper is to describe the development, implementation, and use of an interactive DSS to measure the operational efficiency in a blood collection facility.

2. Background

2.1. Use of decision support systems in medicine

Information systems that support clinical decision making have begun to proliferate in many areas of medicine. Greenes and Shortliffe provide an early paper on the emergence of medical informatics [2]. whereas, Friedman and Abbas present a review of medical informatics between 1976 and 2002 [3]. Over the last decade, as personal computers have become ubiquitous, the design and development of clinical DSSs has become a topic of research and discussion in the medical field. Early research discussing the philosophy and development of clinical DSSs include articles by Heatfield and Wyatt [4], Wyatt [5], and Pryor [6]. Recent publications investigating and reviewing the advance of clinical DSSs include Ball [7], Kaplan [8], and Carroll et al. [9]. In turn, the impact these systems have had on performance and patient outcomes has become the focus of a number of researchers [10–13].

This proliferation in the area of medical informatics includes papers describing computer systems in cardiac life support [14], in the allocation of hospital bed resources [15], in diabetes management [16,17], in primary care applications [18,19], in collaborative medical decision making [20], and in the pharmacological treatment of hypertension [21]. Specific to the blood banking area, numerous papers have been completed regarding decision support in the management of blood inventory and DSSs for hierarchical planning at blood centers. Prastacos published an early paper that provided an excellent overview of blood inventory management papers through 1984 [22]. In a more recent paper, Kozen [23] updates Prastacos work and the area of blood inventory management. Kern and Bennett [24], in their article Informatics Applications in Blood Banking, discuss a number of ways computer and DSS applications have been used in blood banking processes; specifically in donor screening, inventory management, blood ordering and blood usage review, and compatibility testing. Lepage et al. provide a discussion on the role of computerized hospital information systems in improving the blood transfusion practice [25].

In 1979, Brodheim and Prastacos developed the programmed blood distribution system (PBDS) [26]. PBDS was a DSS for regional blood management in the Long Island New York blood collection region and has since been implemented in a number of other regions. These early efforts led to the development of other commercially available software products to assist with the job of blood transfusion and blood banking (e.g. mediware) [27]. However, those software systems are proprietary and carry a large price tag. In addition, the systems lack the ability to perform “what if” or scenario analysis to aid in the decision process making at the blood bank operations level, specifically in the area of operational efficiency and costs per unit. A few works were uncovered discussing the costs associated with blood banking [28–30]. However, the works did not integrate the concept of a DSS into the concept of cost structure. The apparent lack of research and development in this blood bank DSS area augmented the authors’ motivation for writing this paper.

2.2. Trends in medical decision support systems and blood banking

The blood banking industry, an integral part of the health care delivery system, is directly affected by the trends and developments in the healthcare industry. Therefore, the introduction of DSS technology into the blood banking industry is a logical step. The authors define a DSS as a computer program application that analyzes data and presents it so that users can make decisions more easily. The authors also feel a DSS should present information graphically and include a graphical user interface (GUI) presented in a common computing environment (e.g. a DSS written in visual basic as a
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The Blood Bank of Hawaii (BBH) supplies all of the civilian hospitals in the State of Hawaii. Its mission is to meet the transfusion needs of the patients of Hawaii by providing the safest and highest quality products from a committed group of healthy volunteer (non-paid) blood donors. There are two fixed collection sites as well as other modes of blood collection including the BBH bus, which is a four bed collection facility on wheels, and blood mobiles where BBH works with organizations and companies to hold 1 day blood drives on their premises. The blood mobiles also operate on the Neighbor Islands (Hawaii, Maui, Molokai, Lanai, and Kauai). From this point forward the authors will refer to blood collection facilities as either fixed (two main Oahu locations) or mobile (any other drive not at the two main fixed sites). In addition, a distinction is made between Oahu and neighbor island mobile drives. Current operations collect 46,000 units of whole blood per year.

3. Design considerations

3.1. Collection and processing requirements

The process for manufacturing a unit of red blood cells involves three main stages, the collection stage, the laboratory testing stage, and the distribution to the hospitals stage. This DSS focuses on the collection stage because operationally, this stage has the largest potential for improvement.

The collection stage consists of pre-registration and donor identification, health history, unit collection (phlebotomy), and post-donation (where donor eats and is monitored for adverse reactions). The collection stage varies at each blood drive and there are multiple decisions unique to the fixed site collection facilities, Oahu mobile collection facilities, and neighbor island mobile collection facilities. In general, blood collection processes vary across virtually all blood collection facilities. This collection process variation does not directly impact the DSS as resources used during collection and the associated costs of collection are of import and not how the blood is collected.

3.2. Financial requirements

In the rapidly changing environment of the Health care system, blood collection facilities are being held accountable for financial decisions. Many blood banks have been forced to analyze their operational efficiency and financial decision making abilities without adequate preparation or tools to do so. The major area of financial scrutiny is in the cost per unit of collected blood. A blood banking operations efficiency is directly related to the cost of a unit of collected blood. In all, cost per unit of collected blood is a major concern to all blood banking entities.

The DSS is designed to address the cost per unit collected at various blood drives, including the fixed sites, the bus, the Oahu mobiles and neighbor island mobiles. The collection and production process were reviewed and the major variables impacting total collection and production costs were identified. These include hours of collection, number of staff, hours of overtime, courier charges, airfare expense, hotel expense, per diem, ground transportation and staff salaries.

3.3. Import of modeling uncertainty

Overall, the blood collection process has numerous uncertainties associated with it. These uncertainties coupled with poor information gathering and information exchange lead to operational inefficiency (e.g. overstaffing, understaffing, waste of materials, accounting discrepancies, etc.). Therefore, there is a need to develop a model to gather and exchange information regarding the blood collection process. The purpose of this model is to calculate the cost per unit of blood collected under various circumstances involving various levels of uncertainty. In turn, graphically providing the financial information needed to improve efforts to maximize the efficiency of the blood collection process.

3.4. Levels of usability

In addition, the model needed to be usable at many levels and have the capability to be linked to the Blood Bank’s database management system. Users would include medical personnel such as registered nurses (RN), medical technicians, and physicians, as well administrative staff such as cost accountants, donor assistants, and financial analysts. With such broad usage requirements, the entire system required a familiar, easy-to-use, east-to-access, interface. The broad usage requirements lead to the decision to create the DSS in a spreadsheet add-in format. This choice was made as almost all employees were trained in using computer spreadsheet applications and the spreadsheet add-in offered a familiar interface, ease-of-use and access that...
could easily be linked to the database management system. Although the DSS presented here is propriety and unique to the BBH, it does lend itself to general usage in other blood banking entities. In all, any blood collection facility must track and analyze their operational efficiency. For the blood banking area, the common measure of operational efficiency is cost per unit of collected blood [31]. Therefore, the underlying metric generated by the DSS is usable across numerous blood banking entities and the DSS could be usable with minor cosmetic modifications depending on user preferences. This research acknowledges that the specific user interface screens are unique to BBH. If another blood banking entity did have similar labor and material requirements to BBH the DSS could be implemented off-the-shelf. However, if an entity required changes to menus or screens or experienced different labor or material requirements the use of a spreadsheet based GUI and visual basic algorithms make the DSS very flexible. Changes could be made by a user versed in visual basic without degrading or destroying the integrity of the overall DSS.

3.5. Initial assumptions

Certain basic assumptions were made in the design and implementation of the model. These assumptions are as follows: (1) blood collection procedures are consistent at each collection site, (2) the collection and production supply costs are constant, (3) prices for airfares, hotels and car rentals are based on current fares at the time of model design, and (4) the cost per unit per drive is independent of other drives held on that day. These assumptions are unique to BBH. However, in general, assumptions (1), (2), and (3) are common to most blood banking practitioners. Assumption (4) may not be common depending on how the blood banking entity pools overhead expenses and allocates blood banking costs [31].

4. System description

As the DSS is a fully functional input and output model, the system had to be readily accessible. Generally, on-site staff at the fixed sites would have the responsibility of data input and physicians and/or financial analysts would examine the output. However, at the mobile sites, data input responsibility and output examination would be accomplished by those staffing the mobile sites (RN, medical technicians, etc.).

Therefore, the DSS itself had to be self-contained and functional in a mobile computing environment (i.e. laptop computing). With Microsoft Office as the business standard, the choice of a common programming language, Visual Basic, was chosen vs. another proprietary system or language. Specific model algorithms are manifested through the Visual Basic Code. In turn, the specific algorithms and Visual Basic code written for each section of the DSS are contained within their unique sections or at the end of the summary section. The DSS, running as a Microsoft Excel spreadsheet add-in, operates in any Windows 98, Microsoft Office 98 (easily upgraded to Windows 2000 and Microsoft Office XP) environment and functions optimally on Pentium equipped machines with at least 64 megabytes of RAM with a clock speed of at least 500 MHz.

4.1. User interface

Initiating the program via Microsoft Excel consisted of the basic operation of opening an Excel spreadsheet. A few security measures are innate to the DSS itself. For example, as the user opens the spreadsheet a Macro Warning Screen is encountered. This warning is generated by Excel and is a precautionary measure against unwanted macros that many times carry computer viruses with them. Users are instructed to enable the macros and proceed. Further security measures are described as the user interface is detailed. The next section describes the main menu.

4.2. Main menu screen

After a user enables the spreadsheet add-in macro, a screen resembling Fig. 1 appears in the Excel window.

![Fig. 1 Blood collection facility DSS main menu screen.](image-url)
This screen consists of four (4) menu buttons. The following section will describe each button and its functionality.

4.2.1. Input data and run analysis button

The Input Data and Run Analysis button is the controller for inputting drive data, whether that data is pre-drive scenario information or post-drive information. By clicking on the Input Data and Run Analysis button a menu resembling Fig. 2 will appear. The Data Input menu prompts the user to choose which type of data they wish to enter. Logically following, the ‘Yes’ button should be clicked if the data the user wishes to enter is post-drive input data and the ‘No’ button clicked if the data the user wishes to enter is pre-drive scenario input data.

Post-drive input data is defined as data collected during a blood drive and is used mainly for financial and accounting analysis at a later date. Pre-drive input data is any data regarding a future blood drive or future activities at a current blood drive and is used for scenario planning and ‘what-if’ analysis. The pre-drive data input function integrates uncertainty into the DSS and allows the user to model the effects of uncertainty on the blood collection process.

4.2.1.1. Post-drive data input screen

A screen resembling Fig. 3 appears when the user clicks on the ‘Yes’ button. The user then can enter the necessary Post-Drive data into the corresponding cells. Post-drive data includes basic metrics as units collected, hours of production, hours of component production, etc. and are readily available at any drive.

Movement from input box to input box is accomplished by using either the tab key or arrow keys on the keyboard. The user may correct errors by navigating using the tab key or arrow keys and simple deleting the information in the box and retyping the correct data in. The user may also clear the entire form using the ‘Clear Form’ button. Caution must be taken in using the ‘Clear Form’ button as its engagement clears ALL data from the form. The user is prompted with a warning message before the data is cleared. If a user wishes to close the form and return to the Main Menu Screen (Fig. 1) the ‘Close Form’ button can be used. Caution again must be taken, as using the ‘Close Form’ button does not save inputted information. When the user is finished inputting data the ‘OK’ button is pressed. This action will take the user back to the Main Menu Screen (see Fig. 1).

4.2.1.2. Pre-drive data input screen

A screen resembling Fig. 4 appears when the user clicks
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on the ‘No’ button in the ‘Data Input Menu’. Post-drive data includes the same basic metrics as in the post-drive menu but serves a much different purpose. The purpose of the pre-drive data input function is the integration of uncertainty into the blood collection modeling process. The user then can enter the necessary Pre-Drive Scenario data into the corresponding cells. Cell movement and correction is akin to the post-drive input screen.

4.2.1.2.1. Modeling via pre-drive input data. Take notice in Fig. 4 that three values for each metric are required. These three values are labeled ‘Optimistic’, ‘Most Likely’, and ‘Pessimistic’ pertaining to levels of a user’s uncertainty regarding the appropriate metric. Three scenarios can be created and analyzed according to the levels inputted by the user. For example, a user uncertain about how number of units to be collected and staffing levels interact could enter various levels of units collected and various staffing levels to create three different operational efficiency scenarios.

4.2.1.2.2. Impact of modeling on operational efficiency. These scenarios provide the user with a means to measure operational efficiency and in turn aid in planning the blood collection process (i.e. how many RN’s are really needed, what is the trade-off between using more donor assistants vs. nursing service specialists, or if blood donation is slow should the blood drive be closed early for the day). The financial impact of uncertainty in the blood collection process is directly modeled via the DSS.

4.2.1.3. Data input requirements and inline help. All input data must be numerical in nature. If input data is not numeric in nature (text or blank) the user will receive a warning message. By clicking on the ‘OK’ button the user will be returned to the respective data input screen at the point of original data entry. The user should take note that the non-numeric data is automatically cleared for proper re-entry by the DSS before returning the user to the data input screen.

In addition, all input data for the Blood Bag% must be transformed from a % basis to a decimal form (i.e. 50% would be input as 0.50). Inline assistance is provided for both data input screens (Figs. 3 and 4). Fig. 5 below displays a portion of what this inline assistance may look like. Inline help is accomplished via excel and no visual basic coding is necessary. excel provides a straightforward manner to provide a cell message. The following are the general steps in providing a cell message:

1) Select the cells for which you want to display a message.
2) On the Data menu, click Validation, and then click the Input Message tab.
3) Make sure the Show input message when cell is selected check box is selected.
4) To display a bold title in the message, type the text in the Title box, up to 32 characters.
5) Type the text of the message in the Input message box, up to 255 characters.

In turn, the sum of the Blood Bag%’s for any scenario must add to 1.0. In the event that the sum of the Blood Bag% cells is not equal to 1.0 an error message will be displayed. By clicking on the ‘OK’ button in the error message dialogue box the user is returned to the respective data input screen at the point of original data entry. The Blood Bag%’s entered are automatically cleared for proper re-entry before DSS returns the user to the data input screen.

4.2.2. Output metrics button
The View Output Metrics button is the controller for viewing output from inputted drive data, whether that output is pre-drive scenario information or post-drive information. By clicking on the ‘View Output Metrics’ button (refer to Fig. 1) a menu resembling Fig. 6 will appear. This menu prompts the user to choose which source of the output metrics they wish to view.

4.2.2.1. Viewing and interpreting post-drive output metrics. The ‘View Post-Drive Output Metrics’ button should be clicked if the user wishes to view the metrics associated with Post-Drive Input Data.
A screen resembling Fig. 7 appears when the user clicks on the "View Post-Drive Output Metrics" button. The user then can print the screen shown by clicking on the "Print Results" button on the screen.

The user can return to the Main Menu Screen (Fig. 1) by clicking of the "Return to Start" button. Note: Clicking the Return to Start button loses no data or metrics. The user may return to the Post-Drive Output Metrics Screen at anytime by following the steps to access the Output View Selection Screen (Fig. 6) and selecting the "View Post-Drive Output Metrics" button.

From the post-drive output metrics screen (see Fig. 7) the blood bank operations managers and/or other personnel using the system are able to obtain two important performance measurements for unique blood drive. These performance measurements are:

1) units per nurse per hour
2) cost per unit broken down into direct cost and overhead cost

In addition, the post-drive output metrics screen provides detailed information regarding the post-drive inputs used in calculating the performance measures. Quickly and easily end-users can relate staffing levels, materials usage, and units collected to each other. Reports such as this can be created for each drive and used for comparison during future planning meetings.

4.2.2.2. Viewing and interpreting scenario output metrics. The "View Scenario Output Metrics" button should be clicked if the user wishes to view the metrics associated with Pre-Drive Scenario Input Data. A screen resembling Fig. 8 appears when the user clicks on the View Scenario Output Metrics button.

The "Return to Start" and "Print" commands function in the same manner as in the Post-Drive Metric case (refer to Section 4.2.2.1).

One should take note that the scenario output metrics screen (see Fig. 8) resembles the post-drive output metrics screen (see Fig. 7). The scenario output metrics screen also provides a graphical...
The database was designed to identify the major variables influencing the financial analysis of blood collection at different sites. Four major variables were identified to be:

1) Supply costs for collection and production (fixed and variable costs)
2) Salary and overtime salary expense (fixed and variable costs)
3) Additional expenses incurred on neighbor-island drives
4) Number of days per each neighbor island stay

These variables were combined to create two output metrics: units per nurse per hour and cost per unit. Cost per unit is further broken down by direct and overhead cost. Direct cost is defined as costs directly related to a unique blood drive whereas, overhead cost is defined as a more-or-less "fixed cost" incurred in the overall blood banking business. Eqs. (1) and (2) display the mathematical
formulae for the units per nurse per hour while Eqs. (3)—(5) contain the formulae for cost per unit.

Units per nurse per hour
\[
\frac{\text{blood units collected}}{\text{# of nurses on staff}} \div \frac{\text{# hours of collection}}{1}
\]

where
\[
\text{# of nurses on staff} = \sum (\text{DRA's, NSS's, LPN's, RN's})
\]
given, DRA, Donor room assistant; NSS, Nursing services specialist; LPN, License nurse practitioner; RN, Registered nurse.

Cost per unit = cost per unit overhead costs + cost per unit direct costs

where
\[
\text{Cost per unit overhead costs} = \frac{\text{AC + ISC + SSC + DSC + LSC + CSC + QAC}}{\text{Blood Units Collected in Period}}
\]
given, AC, Administration Cost per Period; ISC, Information Systems Cost per Period; SSC, Shared Services Cost per Period; DSC, Donor Services Cost per Period; LSC, Laboratory Services Cost per Period; CSC, Communication Services Cost per Period; QAC, Quality Assurance Cost per Period.

Cost per unit direct costs
\[
\frac{\text{DCLNC + DPLC + NMC + LC + DC + CC + DIC + TC + CFC + BBC + SCC + PKC + TPC}}{\text{Blood Units Collected in Period}}
\]

Note: Cost per unit overhead costs was set at the beginning of each year based on past year costs and expenses to date.

given, DCLNC, direct collection labor costs—nurses; DPLC, direct processing labor cost—laboratory; NMC, allocated portion of nursing management; LC, lease rent and miscellaneous repairs cost; DC, delivery cost—internal personnel; CC, leased line for computer connection cost; DIC, depreciation of improvements cost and equipment; TC, telephone/fax service cost; CFC, canteen food cost; BBC, blood bags cost; SCC, collection supplies cost; PKC, parking space cost; TPC, transportation cost of staff to DTDC.

Cost per unit direct costs is highly variable and is expected to be less than cost per unit overhead costs. Although, the ultimate calculation of the two metrics is fairly straightforward, the result is directly attributable to the DSS and interactions between the inputs.

4.2.3. Data security and the DSS

Since the DSS is linked to databases containing confidential data, including personnel and financial records, and is accessible to almost any employee, security measures are a necessity. Some basic security measures are inherent to spreadsheet add-ins and the VB programming language. The next sections detail the basic security layout of the DSS including a secure area warning and simple password protection mechanism contained within the spreadsheet application itself.

4.2.3.1. Secure data button. This button is the controller button for securing all data and sheets in the spreadsheet. By clicking on this button all data and sheets except for the Main Menu Screen are rendered inaccessible. Any individual that possesses a password can override this button by following the instructions in the View Secure Data section (refer to Section 4.2.3.2).

4.2.3.2. Viewing secure data. The View Secure Data button is used to view secure information used to produce the output metrics. After the View Secure Data button is clicked, excel will prompt the user with a warning message resembling Fig. 9.

If the user wishes to continue the "Yes" button may be pressed. A screen resembling Fig. 10 will appear after the user clicks the Yes button.

The screen in Fig. 10 will prompt the user to enter his/her password. Users who do not possess a password are strongly advised to click the Cancel button, which will return them to the Main Menu Screen (Fig. 1). If a user enters a password that is incorrect, a screen resembling Fig. 11 will be displayed.

![Warning screen example when entering a secure area](Fig. 9)
By clicking on the Yes button users will be returned to the Security Check Screen (refer to Fig. 10). Users who do not possess a password are strongly advised to click the No button, which will return them to the Main Menu Screen (Fig. 1).

5. Status report

The goal of the DSS is to enable the blood banking operations team managers to incorporate financial statistics in their decision making process. Regular operations meetings are held to review recent blood drives and to discuss methods to improve efficiency of collections and customer service. The utility of the DSS was tested using issues raised from these operations meetings.

5.1. DSS testing

The utility of the database was tested by addressing four issues recently raised in these meetings. The questions included:

1. On a neighbor island series with a goal of 200 collected units, is it more efficient to stay 2 days and hold 2 ten hour drives (goal 100 per day) or to stay 3 days and hold 3 eight hour drives (goal 67 per day)?

2. What is the difference in cost per unit collected at a fixed site processing facility vs. a 3 day neighbor island series vs. a 1 day neighbor island drive?

3. Given different levels of staff based on their level of training and education, and their pay scale reflects these levels, what is the difference in cost per unit collected by a team of RN vs. a team of licensed practical nurses (LPN)?

4. Is overtime salary cost a significant factor in determining the cost per unit collected and what is the percentage of total collection and production costs represented by overtime salary?

5.2. Results

Results of the four mobile operations meetings are presented next by question including a detailed discussion of the performance of the DSS and conclusions established therein.

5.2.1. Question #1 analysis

The results of running the DSS based on 2 longer collection days projected that the cost per unit collected was higher than 3 shorter collection days. The overtime salary expense represents 11.8% of total collection and production costs and is a major factor in the cost per unit. Therefore, given an ideal donor recruitment situation, it is preferable to minimize overtime salary expenses and utilize 8-hour collection times. However, in the 2-day scenario, the nursing staff would be available to work at a fixed site on day 3 and therefore this opportunity cost is not reflected. These opportunity costs would be addressed in the analysis of the efficiency of operations over a longer span of time, such as a weekly or monthly report.

As an additional note, each unit of blood is collected as whole blood and can be manufactured into up to 3 blood components (red blood cells, platelets, fresh frozen plasma or cryoprecipitate). The red blood cell component is the major component and can be sold to hospitals. Depending on the market price for the red blood cell component, a gain or loss could be realized from sale. In turn, a second component manufactured from the same unit of whole blood could also be sold (i.e. platelets).

Thus, if financial issues were the sole driving force for conducting mobile drives, the ideal goal would be to maintain the cost per unit collected less than the revenue obtained per red blood cell component. In actuality, other intangible factors, including public relations and fostering a community effort to meet our local blood needs, influence operational decisions and must be weighed against the financial predictions in determining the final decision.

5.2.2. Question #2 analysis

Assuming the parameters of collected units, number of staff, hours of operation, the DSS was utilized to compare the cost per unit for these 3 collection methods.
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The results showed that the cost per unit at the fixed site processing facility was less than the average of a 3 day neighbor island mobile drive. These results are consistent with the general operational assumptions that the cost per unit is lower at a fixed site and higher on a neighbor island mobile drive. However, the DSS’s functionality allows the operational team to make more informed decisions by incorporating the numerical financial information in their analysis.

5.2.3. Question #3 analysis

The nursing services department operates with employees of several different education and training levels. This nursing degree and level of training are reflected in the pay rate. For example, the nursing degree requiring the most education and training is a RN and garners the highest pay. The licensed practical nurse degree requirements are less stringent than that for a RN degree and in turn LPN’s earn less.

However, operationally, both RN’s and LPN’s perform the same job tasks. The majority of the job description for both level of nurses is to perform donor health histories and blood collections at all sites. In fact, an observer would be unable to distinguish the RN staff from the LPN staff at a blood drive. Therefore, the question is raised that if the BBH can accomplish it’s stated goals of blood collection without sacrificing quality and safety of service to donors, should the nursing staff be composed of a majority of LPNs?

Assuming all other parameters are held constant, the information was run through the DSS and the results showed that for a collection goal of 100 units at a fixed site, with a staff of 10 LPN’s, the cost per unit would be less than with a staff of 10 RN’s. This conclusion may seem elementary to a cost accountant but is more opaque to managers trained in the field of medicine.

5.2.4. Question #4 analysis

Based on a collection goal of 100 units on a 2 day neighbor island mobile drive with a 10 hour collection time period, 2 h of overtime would be incurred. Therefore, the overtime salary expense represents 11.8% of costs on a neighbor island mobile drive. For a unit collected at a fixed site facility, overtime salary represents 13.8% of total collection and production costs.

6. Lessons learned

The DSS proved to be a useful tool to the mobile operations team at a blood collection facility. It provided the financial information to justify conclusions that were previously assumed to be true through experience. It allowed the managerial decision makers to quantify the financial impact of each decision and to raise additional questions which will further efforts to improve efficiency.

For example, in the application of question 2, the exact quantitative information that a neighbor island mobile drive costs more per unit collected at the fixed site allows the managerial team to begin to consider other efficiency issues such as how many times a year is it feasible to collect these more expensive units, would it be better to have a fixed collection site on the neighbor island, and should operations consider hiring neighbor island nurses to collect the units.

From the four initial questions, the DSS provided the financial information to show that neighbor island stays of 3 regular hour days cost less than neighbor island stays of 2 extended hour days. It demonstrated that the cost per unit collected at the fixed processing facility was less than units collected on a 3-day neighbor island mobile stay. In addition, it would cost less per unit if the collection team were staffed with LPNs only. Finally, the DSS showed that overtime salary represents 11.8 and 13.8% of mobile drives held on the neighbor islands and at the fixed processing center, respectively.

The DSS is a valuable tool to provide the cost per unit information. Not only does it confirm or refute operational principles that are assumed to be true, but also encourages the operational team to question current standards of procedure and expand their efforts at maximizing operational efficiency.

7. Conclusions and future plans

In the rapidly changing environment of the Healthcare system, industries such as blood collection facilities are forced to be accountable to financial decisions, a situation which did not exist in the same form a decade ago. Many blood banks have been forced to analyze their operational efficiency and financial decision making abilities without adequate preparation or tools to do so.

The DSS presented here was designed with the intent to address real life situations at a blood collection facility. It quickly became evident that the DSS is an effective and practical tool to analyze operational efficiency. It is vital to the information collecting and processing phase, which facilitates the analysis phase and enables reasonable decision making skills. Application of the DSS to the four sample questions which were raised from the
mobile operations meetings demonstrated that this tool provided valuable financial information and added to the quality of decision making ability of the group.

In a non-profit community blood center, the financial analysis is not the sole or major driving influence to the decision making process, for there are many other tangible and intangible variables which guide operations. Other factors which contribute to the decision to hold drives with less than optimal financial efficiency include holding high school drives to encourage young donors to become regular blood donors as a long-term commitment, drives aimed at attracting first-time donors, drives sponsored as a community project by Eagle scouts, and drives held on neighbor islands. In planning these drives, knowledge of the dollar amount of opportunity cost per drive is an essential component to determining the acceptable percentage of these drives in relation to the total number of drives held per year.

Although the final decision may not reflect the optimal financial decision, it is essential to have this information available as one of the multiple factors contributing to the ‘whole picture’. In today’s financially driven healthcare environment, it is increasingly important for blood banks to develop tools to gather data and address on-going mobile questions as they attempt to optimize operational efficiency and remain solvent in a competitive environment.

References