

# HOW TO USE THE WARMBATHS NURSING OPTIMIZATION MODEL

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## **Organization of the Excel document**

There are five spreadsheets in the document that are labeled as follows:

- Nursing Capacity
- Raw Time Data
- Task Volume Data
- Maternity Register
- Jan. Sister Schedule

You can toggle between the sheets by selecting the colored tabs at the bottom of the workbook.

## **Definition of Worksheets**

Descriptions of each of the five worksheets are as follows

*Nursing Capacity* – This is the main part of the document. It determines the number of hours of nursing work required in the maternity ward every month based on inputs from the next four worksheets.

*Raw Time Data* – This spreadsheet is used to calculate the average times per task based on a series of time trials.

*Task Volume Data* – This spreadsheet is used to calculate how many times a task is performed each month. For example how many patients per month come in for “Initial Exam (Booked)” versus how many patients come in for “Initial Exam (Unbooked)”.

*Maternity Register* – This is an abridged copy of the data recorded in the “Maternity Register” book that is kept in the Labor & Delivery Ward.

*Jan. Sister Schedule* – This is a copy of the January staff schedule that is kept in a log book in the Maternity Ward.

## **Explanation of Worksheets**

Each of the worksheets and how to use them is described in detail below

## **Nursing Capacity**

*Step* – Each task is numbered for reference purposes and correlates with the numbered tasks on the “Raw Time Data” worksheet.

*Task* – Tasks are defined as individual processes or activities that the nurses devote their time to. These can be very specific (e.g. taking a patient’s heart rate) or very broad (e.g. the complete normal vaginal delivery process). A broader task list will be more simple and easier to complete. A more detailed task list will be more accurate, but with a more complex data collection process. It is up to the researchers how broad or detailed to make the task list. Task names are pulled from the “Raw Time Data” worksheet.

*Location* – This is the location within the Maternity Ward where the task takes place. Location names are pulled from the “Raw Time Data” worksheet.

*Nurse Time per Task* – This is the amount of time, in minutes, it takes to complete a task. The inputs are pulled from the calculated averages in Row 27 of the “Raw Time Data” worksheet. In the current spreadsheet, many of these data points are generated from a single trial or only an estimate, therefore these values cannot be relied upon and more rigid data collection is required before the model is rendered useful. See the next section on the Raw Time Data worksheet for detailed information on how to collect this data.

*Nurse:Task Ratio* – This is the total number of nurses required to complete each task. This data is pulled from the “Nurse:Task Ratio” cell in Row 29 of the “Raw Time Data” worksheet.

*Throughput* – This is the number of patients that can be processed, or tasks that can be completed, each hour. It is an operations term that is calculated by  $\frac{1}{\text{Nurse Time per Task}} \times \frac{1}{\text{Nurse:Task Ratio}} \times \frac{60\text{min}}{1\text{hour}}$ . When throughput is equal to a number less than one, it means more than an hour is required to perform the task. Tasks that take longer to complete will have smaller (slower) throughputs. The task that has the slowest throughput is highlighted in a pink cell. This highlighting is designed to shift between cells as model inputs are changed and a new low is identified.

*Patients or Events per Month* – This is the approximate number of unique patients that are the recipients of each task on a monthly basis, for example how many patients per month come in for “Initial Exam (Booked)” versus how many patients come in for “Initial Exam (Unbooked)”. If patients are not directly involved, it is the number of day per month the task is performed. The data in this column is pulled from the “Task Volume Data” worksheet.

*Task Repetitions*– This is the number of times a patient is the recipient of the same task. If patients are not directly involved, it is the number of times a task is performed each day. The data is pulled from the “Task Volume Data” worksheet.

*Required Nurse-Hours* – This is the number of hours required each month by nursing personnel to complete each task. It is calculated by  $\text{Patients or Events per Month} \times \text{Task Repetitions} / \text{Throughput}$ . The task that required the most nursing hours is highlighted in a pink box. This highlighting is designed to shift between cells as model inputs are changed and a new high is identified. The task highlighted in pink with the lowest throughput is not necessarily the same task highlighted in

pink with the most nursing hours required; this is because nursing hours depend on task volumes. If a task has a low throughput but is not performed frequently, it will not demand a lot of nursing hours.

*Monthly Nursing Hours in Demand* – This is the total numbers of hours that are required for nursing personnel to complete all Maternity Ward tasks each month. It is equal to the sum of all the values in the “Require Nurse-Hours” column.

*Monthly Nursing Hours Available* – This is the number of hours in total that nurses are scheduled to work each month. The value was determined based on the staff schedule for January 2010 and is pulled from the “Jan. Sister Schedule” worksheet.

*Excess Hours Available/Additional Hours Needed* – If there are more nursing hours available than there are hours in demand, the box labeled “Excess Hours Available” will show the excess number of hours available. If there are fewer nursing hours available than there are nursing hours in demand, the box labeled “Additional Hours Needed” will show the number of additional hours requiring nursing coverage.

It would be very difficult to include every possible task in the task list. Some procedures may not be included if they are so rare that they occur only a couple times per month or less. Other tasks, like bathroom and coffee breaks, are difficult to measure accurately. Timing these types of behaviors might be an invasion of privacy and/or lead to staff changes in behavior in such a way that time studies would yield data that is inconsistent with reality when nurses are not under the pressure of a time study.

Because of these constraints on calculating the Monthly Nursing Hours in Demand, it should be noted that this value will *almost always be an underestimate* of the actual number of nursing hours needed to run the ward. A manager who understands the intricacies of the ward should estimate the number of extra hours needed for these additional tasks and include them in the model.

Once this table is complete with reliable and accurate data, the optimum nursing staffing level can be determined. This can be done by designing a work schedule where the Number of Nursing Hours Available matches the Number of Nursing Hours in Demand. Alternatively, the Number of Nursing Hours in Demand can be divided by 31 days/month and then by an average of 12 hours/shift, and then again by 2 shifts/day. This will yield the number of nurses that should be on duty per shift.

Managers may want to adjust this number in two ways. The first is straightforward, while the second requires additional data analysis:

- 1) The output of the “Monthly Nursing Hours in Demand” formula described above yields the number of nurses required per shift per day assuming everyone is working a 12-hour shift. If there are nurses who work less than 12 hours, the number of nurses will have to be adjusted up. The output also does not say anything about how many nurses the ward must hire in total. This will depend in each nurse’s availability and how many days per week she is available to work.
- 2) The output of the formula above also assumes that patient demand for nursing services is even across various times of day and days of the week. This might not be the actual case and in fact, it is probably not. Additional analysis can reveal the temporal patterns of when fluctuating patient demand requires the performance of each task. These data can then be used to weight the nursing needs on a weekly, daily, or even hourly basis to determine the staffing needs.

No changes are permitted on the “Nursing Capacity” worksheet. The page is formulated to automatically make calculations based on inputs in the following four worksheets.

### Raw Time Data

Row 1 of the “Raw Time Data” worksheet corresponds with the “Location” column in the “Nursing Capacity” spreadsheet. Similarly, Row 2 corresponds with the “Task” column. Underneath each task there are 3 columns for “Start,” “End,” and “Time.” See Figure 1. These fields indicate where data should be entered for time trials.

Data entered for each task should be collected as accurately as possible via a time study, and not by best guesses or other estimation procedures. In the case of the Check-In process, the stopwatch should start when a nurse first approaches a patient at the reception desk, and end when the interaction is complete. These start and stop times would then be entered into the spreadsheet accordingly. When they are entered, the grey column marked “Time” will automatically populate with the total time it took for the interaction to take place.

For each task there is room to enter up to 20 trials. More rows can be added if desired. As time points are entered for trials 1 through 20, Row 27 will automatically calculate the average of the time point. This average is then carried over to the “Nurse Time Per Task” column in the “Nursing Capacity” spreadsheet. For reference only, the standard deviation is also calculated in Row 28. This can give the user of the data an understanding of how much the time per task varies across the time trials recorded. For each task, the user must also designate how many nurses are required to perform each task. For example, only one nurse is needed to check-in with a patient, but two are required when facilitating vaginal delivery. As Row 29 is updated, the “Nurse:Task” column in the “Nursing Capacity” worksheet will also update.

Row 25, labeled “ESTIMATE,” is bordered by a dotted line. While accurate time data should be collected for each task, it may be useful to analyze various scenarios under different assumptions. For example, nurses often use stethoscopes when administering post-natal care because the datascopes are typically kept in the Labor and Delivery Ward. If it was believed that buying a new datascopes for post-natal care could reduce each nurse visit by three minutes, this estimate could be entered in cell AC25 to see how the reduced time per task affects overall nursing hour needs.

When an estimate is entered in Row 25, the average time per task in Row 27 will no longer be based on the time study data entered in Trials 1 through 20, but instead pull the data directly from this estimate. In addition, the cell will be highlighted in green to remind the user that the program is now basing calculations on an estimate and not actual data.

In summary, the user should enter time points for the start and stop time of each task (or an estimate in Row 25), as well as the number of nurses required for each task. Only these white cells may be changed. All other cells in the spreadsheet are locked to maintain the integrity of the formulas and keep the model intact.

	Reception		
	Check-In		
Trial:	Start:	End:	Time:
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
ESTIMATE			2
AVERAGE			2.0
ST. DEV.			--
NURSE:TASK RATIO			1

Figure 1. Sample field from Raw Time Data worksheet

## **Task Volume Data**

A series of calculations are necessary to estimate the patient demand and number of repetitions for each task. Some of these calculations are performed on the “Task Volume Data” spreadsheet, however, much required data is missing. Cells highlighted in blue indicate that very rough estimates are being used where real data should be filled in. Columns B and C are populated based on calculations within the worksheet. Subsequently, the columns on the “Nursing Capacity” spreadsheet marked “Patients or Events per Month” and “Task Repetitions” will also be updated.

Overall task volume per month is determined by multiplying these two data points. This spreadsheet is unlocked so that the user may enter additional data to produce more accurate values for each of these two data points. However, that means caution must be exercised when using this sheet so that data is not inadvertently changed.

## **Maternity Register**

This spreadsheet shows historical data entered in the Maternity Ward Register in January 2010. Some fields from the original register, such as patient identification number and name, were omitted. The Maternity Ward Register data is used to determine some of the task volumes in the previous spreadsheet. The sheet is locked but the user may find it beneficial to copy this sheet and enter additional months (as well as additional metrics, such as time of arrival and time of discharge) from the maternity ward register data to increase the applicability and sample size, and therefore the accuracy, of the data.

## **Jan. Sister Schedule**

This spreadsheet has the nurse (or “sister”) shift schedule information for January 2010. It is an enhanced version of the monthly schedule kept on file at the reception desk of the maternity ward. While the paper schedule shows the times that each nurse is expected to work, this version calculates the cumulative nursing hours scheduled across the morning and evening shifts for the entire month. The hours are totaled for each shift group (Rows 15, 25, 33, and 41) and across the entire month (Cell CO43). Cell CO43 is then carried over to the “Nursing Capacity” worksheet to update the “Monthly Nursing Hours Available” box in Cell I45.

This worksheet is locked, however the user may find it useful to unlock the data and experiment with the schedule to explore alternative staffing options based on the final number of nursing hours demanded.