

To Pee or Not to Pee, That is the Question: The Effectiveness of Bladder Scanning in Body Weight Measurement for Patients with Anorexia Nervosa

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Abstract

Weight restoration is critical in the management of Anorexia Nervosa. Achieving accurate body weight readings is crucial during weight restoration of patients with Anorexia Nervosa. This clinical improvement project aims to improve the efficiency in the decision making process relative to weight restoration by exploring a novel method in achieving accurate body weight readings for patients with Anorexia Nervosa.

Lean Six Sigma (LSS) approach was used to facilitate the improvement process. A within-subjects design was utilized in the inpatient setting in an acute psychiatric unit. Each patient was subjected to both urine test and bladder scan for each weigh-in. A paired-samples t-test was conducted to compare the number of hours taken to carry out urine SG test to that of bladder scan.

Efficiency of decision making process is markedly improved with the quick results of obtaining an accurate body weight through the use of a designated bladder scanner as part of the weigh-in procedure. Results also showed significant differences in body weight readings. Medical treatment can be promptly initiated within 20 minutes from the time of order where waiting time has been reduced by 93.25%.

Introduction

Anorexia Nervosa is an Eating Disorder (ED) in which people suffering from it tend to obsess about their weight and dietary intake. They also experience extreme fear of gaining weight or becoming "fat" regardless of their extreme low body weight which could potentially be life-threatening [1]. They are typically characterized by their refusal to maintain a healthy body weight suitable for their individual age, height and build. They often engage in extreme weight loss behaviors to maintain a weight that is far below their individual minimal healthy body weight. Many patients with this disorder are convinced that they are overweight despite their emaciated look and typically starve themselves despite the terrible hunger pains they suffer. In more severe cases, hospitalization may be required to manage medical complications which accompany severe malnutrition due to starvation, and for weight restoration purposes. It is vital that accurate body weight readings are obtained during weight restoration to prevent any form of complications during treatment.

During inpatient treatment, body weight of these patients are measured periodically and monitored closely. Despite their overwhelming fear of gaining weight, most of them try to alter their body weight readings to disguise the effects of ED during treatment. They are likely to engage in deceptive behaviors under the influence of the illness in pretense of being compliant to treatment. Methods include attaching weight bearing objects on their body, excessive drinking of water which is also known as fluid-loading, and keeping a full bladder prior to getting weighed [2,3]. These behaviors contribute excess weight which alters the actual body weight readings.

Urine laboratory test namely Urine Specific Gravity (Urine SG) test is widely used as part of weigh-in procedure in most ED treatment centers internationally apart from fluid restriction and donning of procedure gown prior to body weight measurement [3]. This method is used to investigate any dilution of urine through possible excessive water intake. In the current hospital, Urine SG is tested via laboratory instead of test strips as test strips are not available unlike in other hospitals. This laboratory test method takes at least four hours to generate the laboratory results and is unable to measure any retention of urine in the bladder. If the result showed evidence of possible fluid-loading, the weigh-in procedure needs be repeated till a positive result is achieved before medical interventions can proceed further. This high rework has been observed to contribute to wastage in manpower, time and costs, and customer complaints. Moreover, the body weight readings obtained may not be ideal since body weight has been shown to increase over the course of the day [2]. Another possible method to ensure weight is not taken from a filled bladder is to carry out bladder catheterization to relieve any urine retention prior to body weight measurement. However, this procedure is invasive with risks of infection [4].

To date, a 3D portable ultrasound bladder scanner has shown to be a useful and non-invasive tool for quick estimation of fluid volume retained in the bladder [5,6,7]. This tool has proven to be an accurate alternative to bladder catheterization [5,9].

We are using the Lean Six Sigma (LSS) approach to improve the existing process by reducing waste from operations [10].

The purpose of this project is to find a novel method in obtaining accurate body weight readings for this unique patient population in the quickest way possible to improve the efficiency in treatment process relative to weight restoration. This is done by investigating the effectiveness of utilizing a bladder scanner compared to urine SG lab investigation in the weigh-in procedure.

Materials and Methods

Overview of Project

The project utilizes the Lean Six Sigma (LSS) approach. It has five steps namely Define, Measure, Analyze, Improve, and Control (DMAIC) to facilitate the improvement process [11].

Results were evaluated from the within-subjects design, where each patient is subjected to both USG and bladder scan for each weighing. Details with regards to the two tests are as follows:

Urine Specific Gravity laboratory test (Urine SG). Urine sample is collected from each patient immediately prior to weighing and sent to the laboratory for testing. This is on top of putting patient on fluid restriction and donning in procedure gown under close monitoring. Low urine specific gravity results of less than 1.005 is an indication of excess fluid in the body, typically caused by drinking large amounts of water in patients with anorexia nervosa. The laboratory results are used to determine weight accuracy for treatment planning. The results are usually generated in at least 4 hours. Procedure will be repeated within the same day if result is lower than the normal range.

Bladder Scan BVI 3000. Bladder scanning is done on patient immediately post void prior to weigh-in. If Post-Void Residual Urine (PVRU) volume is high, patient will need to void again and bladder scan will be repeated.

Setting

The psychiatric unit in our hospital is the only unit in the South-east Asian region which provides eating disorders services including a treatment centre for partial hospitalization. The psychiatric inpatient unit consists of 15 beds which are also utilized for patients suffering from other mental illnesses. The unit is staffed with multidisciplinary team for both ED and general psychiatry services including registered nurses (nurse to patient ratio of 1: 5).

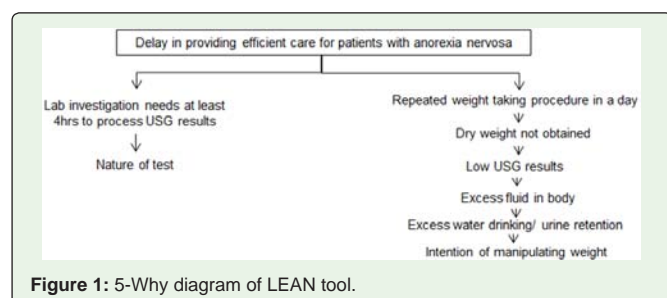


Figure 1: 5-Why diagram of LEAN tool.

Participants

15 female Chinese patients aged 14 to 49 years old diagnosed with anorexia nervosa were recruited during their inpatient treatment between July 2014 and November 2014. Informed consent was obtained prior to the improvement project with anonymity being preserved.

Lean Six Sigma (LSS) approach

The five steps (DMAIC) in LSS approach: (1) Define the problem and identify the desired outcome, (2) Measure the performance, (3) Analyze the data (4) Improve or modify the process and (5) Control the process before they result in defects.

Define, Measure and Analyze

Firstly, the team leader creates an improvement team of 4 members of different roles which is referred to as the 'RI team'. The team leader presents the problem and arranged weekly meetings for the RI team to define the problem and discuss ideas on creating change through this project. Several meetings were held with the coaches from the QI department. These meetings aim at presenting the problem, identifying wastes and ideas for reaching the project aims through utilizing a LEAN tool namely 5 why diagram in the first phase of DMAIC approach illustrated in [Figure 1].

Wastes were identified in [Figure 2]: Types of wastes:

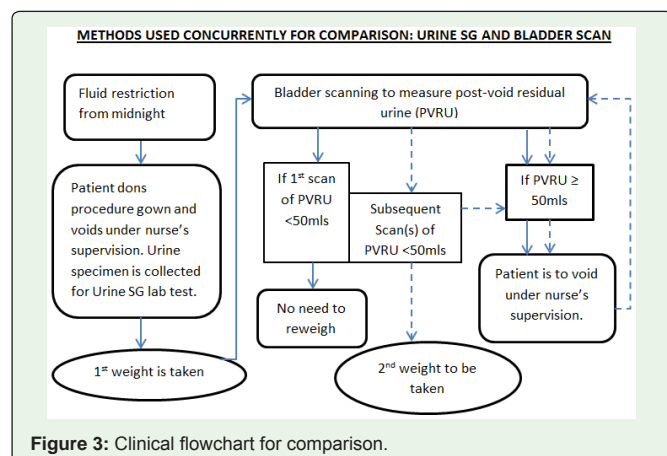
Additional meetings, led by the project leader, were required to reach the full complement of 18 nurses and 4 psychiatrists who are working in the psychiatric unit. Similar meetings were held with 1 ward manager, 3 ward nurse clinicians and 2 nursing leaders. In addition to the meetings previously described, further steps were taken to engage all relevant stakeholders to enhance the clinical improvement process by preparing educational tools such as informational sheets and flowcharts, preparing didactic presentations for use at nursing handovers and communication sessions, including arranging weekly follow up schedules for staffs and patients. Clinical flowchart using the two methods for comparison is shown in [Figure 3].

Positive results are defined as urine SG result of at least 1.005 or more, and bladder scan result of maximum PVRU volume of 50mls or less. If results are positive for both methods, the weight taken is recorded as an accurate weight. If urine SG result is positive but bladder scan result is negative, patients will need repeated weigh-in accordingly.

Education was later provided at scheduled meetings, nursing handovers, and communication sessions. Participating nurses provided constructive feedback to RI team about their experiences during the RI period. Weekly patient revisits and education reinforced the perceived benefits of new weigh-in procedure for an accurate body weight measurement with aim to reduce time wastage

No Waste	Type of Waste	Nature of Waste
1 People	Time	Time wastage due to repetition of process in a day
	Over processing	Manpower usage increased
	Waiting	Variation of time taken to process results
2 Quality	Motion	Repetition of process in a day at different time due to abnormal results
	Time	Time wastage due to long waiting time for results

Figure 2: Types of wastes.



and improve efficiency of decision making process associated with perceived reduction in anxiety or distress levels.

Improve and Control

Execution of the project during the 4-month period, which is also referred to as “RI period”, involved the following steps:

1. Ongoing reviews with psychiatrists caring for patients with Anorexia Nervosa.
2. Modifying the current weight taking procedure to a concurrent two-method weight taking procedure.
3. Encouraging a change of the conventional procedure with long-waiting process to a new procedure with quicker results.
4. Establishing and disseminating simple guidelines of the concurrent 2-method weight taking procedure.
5. Developing guidelines for RI team consultation
6. Demonstrating weight taking procedure and comparison process.

Evaluation of the project was conducted weekly through meetings with the RI team to discuss progress, barriers and solutions before completing the improvement process. Control planning was done after the RI period for sustainability assurance.

Data Collection

Patient demographic and clinical characteristics were obtained from their medical records [Table 1] including the results and outcomes of body weight measurements with preservation of patients' anonymity maintained during data collection.

Results

Data analysis was carried out using Statistical Package for Social Sciences (SPSS) for Windows version 21 (Chicago IL, USA). Paired-samples t-tests were run to compare time taken for urine SG and bladder scan to be carried out, as well as the weight difference obtained from positive urine SG results and negative bladder scan results. For this study, statistical significance was set at $p < .05$.

A total of 15 female inpatients were recruited for this study, with mean age of 24(SD±XX). 104 weighing sets were obtained from the patients, out of which 81.7% (n=85) obtained positive urine SG results.

Table 1: Characteristics of patients.

	N	%
Gender		
Female	15	100
Ethnicity		
Chinese	15	100
Diagnosis		
Anorexia-Restrictive	10	66.7
Anorexia-Binge/Purge	5	33.3
	M	SD
Age	25.07	10.35
Body Mass Index		

Table 2: Results of Urine SG and Bladder Scanning.

No. of Weigh-in (n)	PVRU (+)	PVRU (-)	Total
Urine SG (+)	71	14	85
Urine SG (-)	6	13	19
Total	77	27	104

Of these, 83.5% (n=71) obtained a consensus using the two methods; 16.5% (n=14) had positive urine SG results and negative bladder scan results, requiring repeated weigh-in of patients. Remaining 19 (n=104) showed negative urine SG with positive bladder scan results in [Table 2].

A paired-samples t-test was conducted to compare the number of hours taken to obtain urine SG result to that of bladder scan. There was a significant difference in the time taken for urine SG test with mean score of 4.74 (SD=0.430) and bladder scan with mean score of 0.258 (SD = 0.0258), $t(70) = 87.5$, $p < 0.01$. This finding supports our first hypothesis that bladder scan, as opposed to urine SG test, saves time and treatment decisions could be made more speedily.

Repeated weigh-in (n=14) is needed to be done following positive urine SG result and negative bladder scan result. For these patients, body weights obtained upon repeated weigh-in with a mean score of 42.19 (SD=10.91) were found to be significantly lower compared to the body weights obtained from their first weigh-in of mean score of 42.39 (SD = 11.02), $t(13) = 3.65$, $p < 0.01$. This would suggest the inaccuracy of urine SG in determining accurate weight of patients. An average of one to two scanning is needed for each weigh-in.

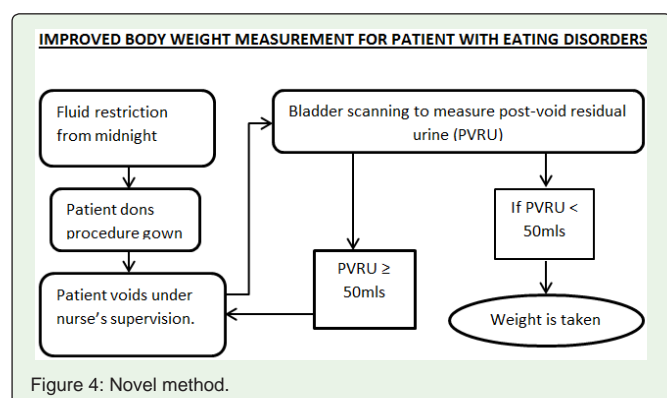
Discussion

The clinical improvement project demonstrated the importance of improving the work process in reducing time wastage, preventing costly inpatient stay and improving outcomes for patients through better care in hospital. By utilizing Lean Six Sigma methodology, the unit can focus on eliminating waste in their current processes and build more sustainable improvements to deliver a safe, quality nursing care for their patients [Table 3].

This improvement process also contributes in eliminating the need for urine specimen (eliminate risks of specimen error) and urinary catheterization (reduce risk of infection). Length of stay is also anticipated to decrease with the efficient weight restoration process. Frequency of weigh-ins will be reduced to only once per day within

Table 3: Results on waste in waiting time, cost and motion.

Variables	Urine SG	Bladder scan	Reduction (%)
Mean duration of waiting time (mins)	255	16	93.7
Maximum cost incurred for each weigh-in (\$)	49	16	67.3
Mean of weigh-in per day (n)	3	2	33.3



standard time frame, which can help to reduce nurses' workload. This reduction in weigh-in frequency per day may also contribute in the reduction of distress in patients which in turn improves customers' satisfaction in treatment process.

This study has explored the utility of a portable bladder scanner method as a possible recommendation in body weight measurement for patients with Anorexia Nervosa and recommends a clinical flowchart for this new weigh-in method [Figure 4]. This method may also be recommended for patients with other types of Eating Disorder such as Bulimia Nervosa so that process is standardized.

Nurses who provide care for patients with Eating Disorder should be assessed periodically on their competence in the use of a bladder scanner and its clinical workflow. A clinical protocol is recommended to have to ensure standardization of care.

Conclusion

The utility of a bladder scanner have shown significant difference in the time taken and weight accuracy compared to the use of the urine SG laboratory test as part of the body weight measurement procedure for this patient population. Medical treatment can be promptly initiated within 20 minutes from the time of order where waiting time has been reduced by 93.25%.

Our findings provide a foundation for trials of alternative interventions to enhance patients' care. Data on qualitative components of the experiences of patients, and nurses of such interventions would provide broader insight.

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