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Engineering Risk Management into Action: A Six Sigma Model for improving inventory management and implant safety.

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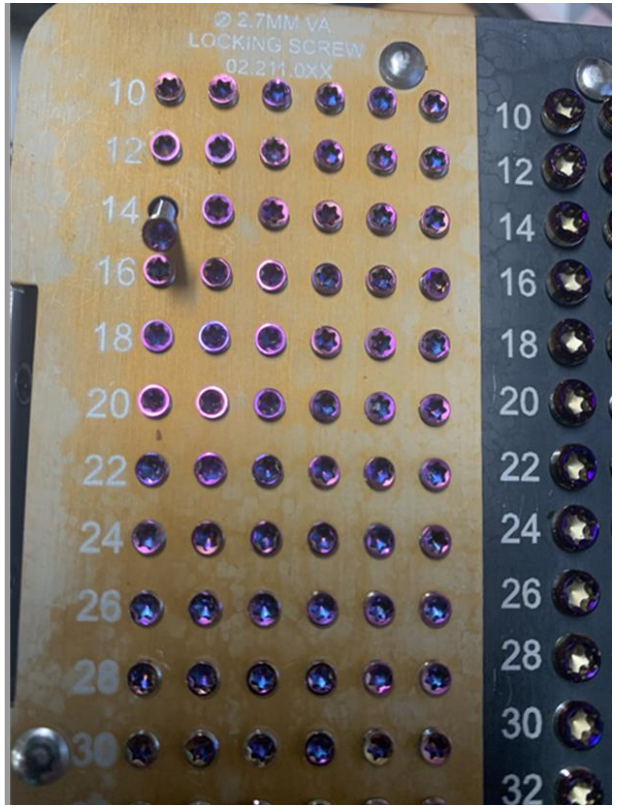
Background & Key Studies: Implant Safety Challenges

Loaned surgical devices reprocessing failures were found in Australia and Brazil[1].

Single-use and NSI, such as screws, are subjected to multiple contamination and reprocessing exposures that results in structural damage and can lead to contamination with biofilm, as well as organic and inorganic soils [9,11,12]. Furthermore, the reprocessing of these implants is impracticable, requiring around 19 h according to the manufacturer SOP [11]. This points to the need to investigate alternate ways of providing single-use implants, such as individual packaging to prevent contamination of unused items.



1. Reprocessing of loaned surgical instruments/implants in Australia and Brazil: A survey of those at the coalface Anaclara Ferreira Veiga Tipple Dayane de Melo Costa Lillian Kelly de Oliveira Lopes Dulcelene de Sousa Melo Junnia Pires de Amorim Trindade Karen VickeryPublished:October 14, 2021 DOI:https://doi.org/10.1016/j.idh.2021.09.003

2. Costa DM, Lopes LKO, Vickery K, Watanabe E, Vasconcelos LSNOL, de Paula MC, Melo DS, Hu H, Deva AK, Tipple AFV. Reprocessing safety issues associated with complex-design orthopaedic loaned surgical instruments and implants. Injury. 2018 Nov;49(11):2005-2012. doi: 10.1016/j.injury.2018.09.006. Epub 2018 Sep 5. PMID: 30236794.

Project Foundation – Applying the Six Sigma DMAIC Model in Sterilization Services

D
Define

M
Measure

A
Analyse

I
Improve

C
Control

- The project's goal was to implement the Six Sigma DMAIC methodology to optimise the inventory management of hospital/loan sets and ensure the safety of orthopaedic trauma implants.
- Improving compliance quality standards in the sterilization process is critical to safeguarding patient safety and preventing cross infections.
- By applying DMAIC principles, the aim was to streamline sterilization department processes, minimise reprocessing cycles, reduce inspection and packing workloads.
- Our analysis focused on surgical implant usage and reprocessing, reducing the risk of infection due to implant degradation and the propensity for surface erosion and biofilm formation.
- Ultimately, this six-sigma project led to a more efficient use of sterilization and operating room resources, improved traceability, and elevated levels of quality, safety, and efficiency in operations involving orthopaedic trauma implants.

Current Challenges – Surgical Implants

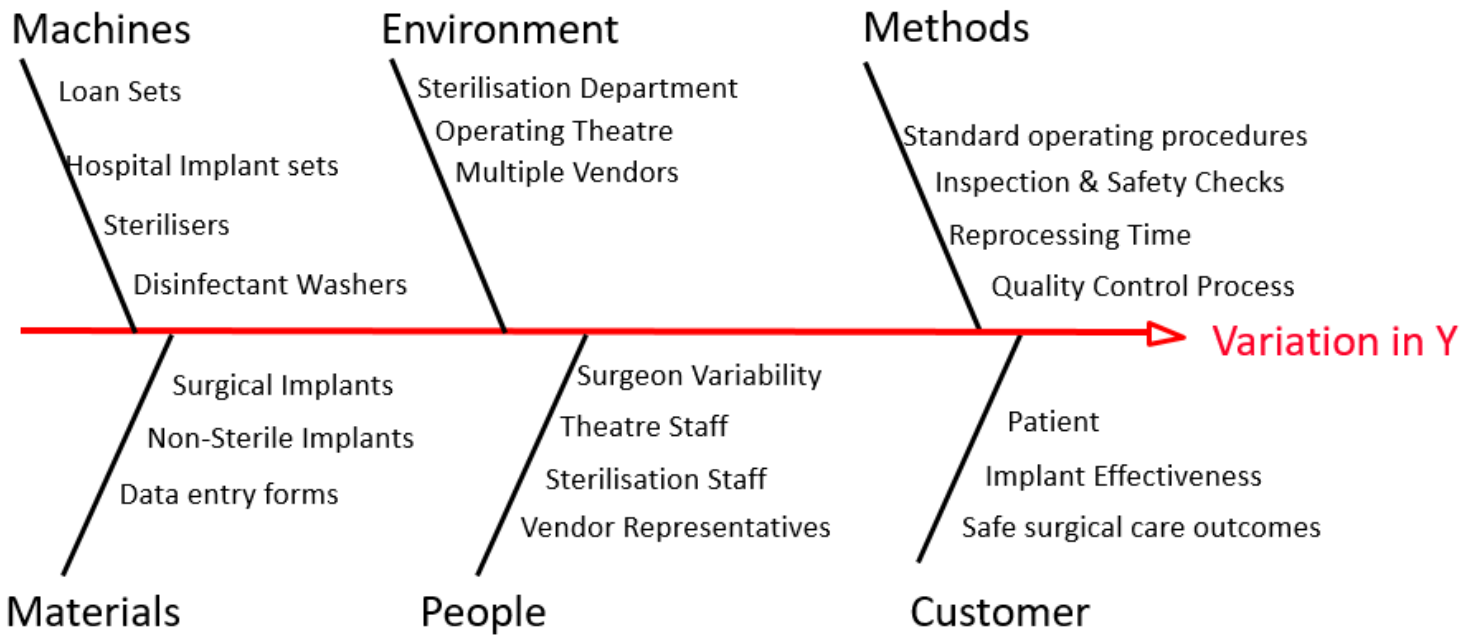
Common Issues in Loan or Hospital Consignment Sets for Implantable Surgical Devices:

- Multiple and complex implants
- Lot numbers were absent or not visible
- No systematic rotation or selection process for usage and or replacement of implanted screws or plates.
- No evidence of consistent checking of implants for contamination and integrity.
- Variable end user preference and clinical use demands.

Risks:

- Repeated OR Exposure - Contamination and infection risk with biofilm development.
- Increase in orthopedic surgical site infections leading to implant failure & removal.
- Missing traceability through the lot number if manufacturing defect or recall is issued.
- Inability to maintain compliance with government regulations for adhering to implant expiry.
- Accountable item – not consistently checked & counted.
- Risk to patient safety with a lack of quality assurance documentation for:
  - Continual reprocessing of surgical implants.
  - Storage, handling and transportation.
  - Age of the implant

Sources of Key Six Sigma Inputs



Inputs fall into categories of people, machines, materials, methods, measurements, environment (physical and work/social)

Fishbone diagrams can be helpful

Six Sigma Project Outline

Define D | Investigate M A | Improve I | Control C

- Hospital Surgical Implant Sets and Reprocessing.
- Surgical Implant Infection Risk – Biofilm development
- Increased susceptibility to surface erosion and degradation
- Impact to revision surgery & surgical implant removal

IN: Surgical Implants utilised in orthopaedic and trauma surgery.

OUT: Surgical Implants not used in orthopaedic and trauma surgery.

Y	Baseline	Goal	Unit	Cost Impact
Remove reprocessing of implants in the 0-usage category	71% nonworking implant inventory of total = 3953	Decrease nonworking implant inventory by 100%	Reduce number of sets with the surgical implant from 7-5	$881,190.10
Reduce reprocessing of surgical implants in the low usage category	28.6% of low usage implant inventory of total = 1593	Decrease low implant inventory by 50%	Phase 2	
Reduce reprocessing of surgical implants in the medium usage category	0.2% of medium usage implant inventory of total = 11	Decrease medium usage sets by 50% post review of new implant system	Phase 3	
High Usage Surgical implants	0.2% = 9	Revise after 0,low, medium usage implant system is stable and sustainability after key stakeholder buy in	Phase 4	
Identify implants not captured in data with Zero usage over the 10 years	% Unknown	Decommission identified implants with Zero usage that has been exposed to ongoing reprocessing	Phase 5	

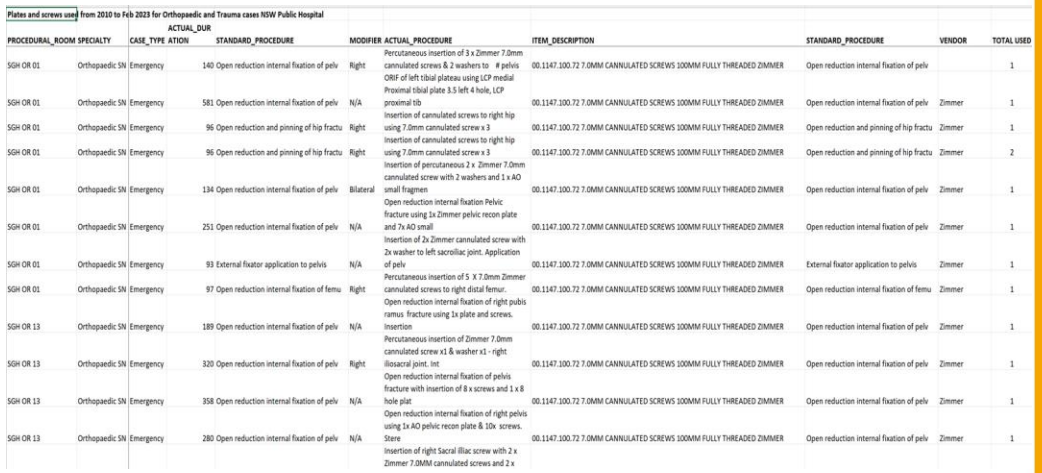
Scope of Data Collection & Source

Deidentified data used to evaluate implant usage

- The dataset encompasses procedural information for patients who underwent orthopaedic trauma surgeries requiring surgical implants within the period 2012 to 2022.

- In adherence to privacy regulations, patient-specific identifiers are removed to ensure individual privacy is upheld.

Data Fields included:



Plates and screws used from 2010 to Feb 2023 for Orthopaedic and Trauma cases NSW Public Hospital

PROCEDURAL_ROOM	SPECIALTY	CASE_TYPE	ACTUAL_DURATION	STANDARD_PROCEDURE	MODIFIER	ACTUAL_PROCEDURE	ITEM_DESCRIPTION	STANDARD_PROCEDURE	VENDOR	TOTAL USED
SGH OR 01	Orthopaedic SN	Emergency	140	Open reduction internal fixation of pelv	Right	Percutaneous insertion of 3 x Zimmer 7.0mm cannulated screws & 2 washers to 8 pelvis	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction internal fixation of pelv		1
SGH OR 01	Orthopaedic SN	Emergency	581	Open reduction internal fixation of pelv	N/A	ORIF of left tibial plateau using LCP medial Proximal tibial plate 3.5 left 4 hole, LCP proximal tib	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction internal fixation of pelv	Zimmer	1
SGH OR 01	Orthopaedic SN	Emergency	96	Open reduction and pinning of hip fractu	Right	Insertion of cannulated screws to right hip using 7.0mm cannulated screw x 3	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction and pinning of hip fractu	Zimmer	1
SGH OR 01	Orthopaedic SN	Emergency	96	Open reduction and pinning of hip fractu	Right	Insertion of cannulated screws to right hip using 7.0mm cannulated screw x 3	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction and pinning of hip fractu	Zimmer	2
SGH OR 01	Orthopaedic SN	Emergency	134	Open reduction internal fixation of pelv	Bilateral	Insertion of percutaneous 2 x Zimmer 7.0mm cannulated screw with 2 washers and 1 x AO small fragmen	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction internal fixation of pelv	Zimmer	1
SGH OR 01	Orthopaedic SN	Emergency	251	Open reduction internal fixation of pelv	N/A	Open reduction internal fixation Pelvic fracture using 1x Zimmer pelvic recon plate and 7x AO small	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction internal fixation of pelv	Zimmer	1
SGH OR 01	Orthopaedic SN	Emergency	93	External fixator application to pelvis	N/A	Insertion of 2x Zimmer cannulated screw with 2x washer to left sacroiliac joint. Application of pelv	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	External fixator application to pelvis	Zimmer	1
SGH OR 01	Orthopaedic SN	Emergency	97	Open reduction internal fixation of femu	Right	Percutaneous insertion of 5 X 7.0mm Zimmer cannulated screws to right distal femur.	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction internal fixation of femu	Zimmer	1
SGH OR 13	Orthopaedic SN	Emergency	189	Open reduction internal fixation of pelv	N/A	Open reduction internal fixation of right pubis ramus fracture using 1x plate and screws. Insertion	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction internal fixation of pelv	Zimmer	1
SGH OR 13	Orthopaedic SN	Emergency	320	Open reduction internal fixation of pelv	Right	Percutaneous insertion of Zimmer 7.0mm cannulated screw x1 & washer x1 - right iliosacral joint. Int	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction internal fixation of pelv	Zimmer	1
SGH OR 13	Orthopaedic SN	Emergency	358	Open reduction internal fixation of pelv	N/A	Open reduction internal fixation of pelvis fracture with insertion of 8 x screws and 1 x 8 hole plat	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction internal fixation of pelv	Zimmer	1
SGH OR 13	Orthopaedic SN	Emergency	280	Open reduction internal fixation of pelv	N/A	Open reduction internal fixation of right pelvis using 1x AO pelvic recon plate & 10x screws. Stere	00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER	Open reduction internal fixation of pelv	Zimmer	1
						Insertion of right Sacral iliac screw with 2 x Zimmer 7.0MM cannulated screws and 2 x				

- Procedural Room – the designated operating room for surgery
- Specialty – the surgical specialty under which the case falls
- Case Type – Classification of the surgery
- Actual Duration – the real-time span of the surgery
- Standard Procedure – the predefined surgical procedure name or code
- Modifier – any alterations so the standard procedure
- Actual Procedure - the precise surgical procedure performed.
- Item Description - detailed list of items used during the surgery.
- Vendor - the supplier of the surgical implants.
- Total Used -the total quantity of items used.
- Rebate Code - Codes applicable for manufacturer rebates.
- Patient In Room Date & Time (PAT_IN_RM_DT_TM)-Timestamp marking the patient's entry into the operating room.
- Surgery Start Date & Time (SURG_START_DT_TM)-Timestamp indicating the commencement of the surgery.
- Surgery Stop Date & Time (SURG_STOP_DT_TM)-Timestamp indicating the conclusion of the surgery.
- Patient Out Room Date & Time (PAT_OUT_RM_DT_TM)-Timestamp marking the patient's exit from the operating room.

Ensure the data is in a format that Excel can read, such as `.csv` or `.xlsx`.
Import data into excel, ensuring each column header represents a meaningful variable, (e.g., implant type, usage frequency, date of use, reprocessing date, etc.)

Establish new sub-categories within the dataset with year-on-year usage patterns for different surgical implants

Add additional columns to classify the usage for each year, the implant types and any other relevant sub-categories. Then, create pivot tables to organize the existing data accordingly and copy these tables into new worksheets dedicated to deeper analysis.

Define the following sub-categories to classify the yearly usage and implant types, allowing for more nuanced data segmentation and trend analysis:

For example, the volume of implant usage was calculated into four distinct sub-groups to identify patterns and trends effectively.

- High Usage >100
- Medium Usage <100-50
- Low Usage <50-1
- No Usage

Use Pivot tables to analyse the data

Setting Up a Pivot Table

Use the Pivot tables option to select by vendor, implant type, usage category and overall usage.
Insert a pivot table by selecting your data range and choosing “insert” PivotTable from the Excel toolbar.
In the pivot table, drag the implant type and usage categories into the Rows area, and count of SKUs into the values area to summarise the usage.

Plates and screws used from 2010 to Feb 2023 for Orthopaedic and Trauma cases NSW Public Hospital													
VENDOR	(All)												
Sum of TOTAL USED	PAT_IN_RM_DT_TM												
ITEM_DESCRIPTION	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
00.1147.100.72 7.0MM CANNULATED SCREWS 100MM FULLY THREADED ZIMMER					1	1	4	3	3		6	2	
00.1147.120.71 7.0MM CANNULATED SCREW 120MM PARTIAL THREADED					2		2					1	
000-0163 PELVIC SCREW STD 116 MM										15	28	26	30
000-0163DP GLOBAL ORTHO INTELLIJOINT SCREW PELVIC G2											2	2	
000-0190 FEMUR SCREW STD 18 MM										8	9	9	13
000-0233 GLOBAL ORTHO INTELLIJOINT SCREW FEMUR G2 26MM											1	1	
000-0366 FEMORAL MAGNET DISC NAILS										1			
00114204020 MINI MAG-FX 4MX20M FULL THRD							3						
00114204028 MINI MAG-FX 4MX28M FULL THRD							1						
00114204036 MINI MAG-FX 4MX36M FULL THRD							1						
00114204048 MINI MAG-FX 4MX48M FULL THRD							3						
00114205048 MINI MAG-FX 5MX48M FULL THRD							1						
00114205155 MINI MAG-FX 5MX55M PART THRD								1					
00114205170 MINI MAG-FX 5MX70M PART THRD								1					
00-1147-060-71 Zimmer 7.0mm cannulated screw 60mm x 32mm							1						
00-1147-065-72 7MM cannulated screw full thread						1	1	1					
00-1147-070-71 32 mm partial thread screw					2	3		1		1	1		
00-1147-075-71 75mm x 7.0mm 32mm partially threaded						1	4	3	2	1	1		
00-1147-075-72 CANNULATED SCREW FULL THREAD LENGTH 75								1	1	1			

Summary of Usage by Item Description by Year

Plates and screws used from 2010 to Feb 2023 for Orthopaedic and Trauma cases NSW Public Hosp

Summary of 2012-2022 Data

			Sum of TOTAL USED									
Identifier	Usage Category (2012-2022)	ITEM_DESCRIPTION	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total	Usage Category (2
5558	Low usage	Zl-8161-35-070 CORT LOCK SCREW 3.5MM x 70MM	0	0	0	0	0	0	0	1	1	Low usage
5559	Low usage	ZPCS36 CANNULATED LAG SCREWS DIAM. 4MM L36	0	0	1	0	0	0	0	0	1	Low usage
5560	Low usage	ZPCS46 WV CALCANEAL FRACTURE PLATE CANNULATED LAG SCREW MDL 40X46MM	0	0	1	0	0	0	0	0	1	Low usage
5561	Low usage	ZPCS50 WV CALCANEAL FRACTURE PLATE CANNULATED LAG SCREW MDL 40X50MM	0	0	1	0	0	0	0	0	1	Low usage
5562	Low usage	ZPFTS42 4.0 MM DIA. FULLY THREADED SCREW, 42 MM LENGTH	0	0	1	0	0	0	0	0	1	Low usage
5563	Low usage	ZPSS5 5.0 MM SCHANZ SCREW	0	0	1	0	0	0	0	0	1	Low usage
5564	Low usage	A-5850.10/1 2.8 LOCKING SCREWS	8	0	0	5	9	5	4	0	31	Low usage
5565	Low usage	35130422 BIO-COMPOSITE SCREW 8 X 27MM	0	0	0	0	0	0	1	0	1	Low usage
5566	Zero usage	00234701108 3.5mm proximal medial tibial plate right 8 hole s 106mm	0	0	0	0	0	0	0	0	-	Zero usage
5567		Grand Total	4611	5434	5866	6447	7260	8497	8234	8165	67,971	

Zero No of Items/SKUs	454
Low No of Items/SKUs	4,912
Medium No of Items/ SKUs	99
High No of items/SKUs	101
Total Items/SKUs	5,566

Zero Usage Total	-
Low Usage Total	27,463
Medium Usage To	6,856
High Usage Total	33,652
Grand Usage Total	67,971

Establish new sub-categories within the dataset to analyse utilisation patterns for different surgical implants

By implementing these categories and other grouping criteria, we can slice the data for more insightful trends and usage patterns.

Surgical Implant Sub-categories:

- Implant
- Locking Mechanisms
- Locking Screws
- Miscellaneous
- Nail
- Pin
- Plate
- Post – Post Hole
- Screw

Plates and screws used from 2010 to Feb 2023 for Orthopaedic and Trauma cases NSW Hospital
Six Sigma Analysis

				Analysis Range			
Identifier	Item Categories	Dimensions	ITEM_DESCRIPTION	2020	2021	2022	Grand Total
3	SCREWS	116MM	000-0163 PELVIC SCREW STD 116 MM	28	26	30	84
5	SCREWS	18MM	000-0190 FEMUR SCREW STD 18 MM	9	9	13	31
260	SCREWS	6.5MMX25MM	010000998 G7 6.5MM X 25MM SCREW	3	5	12	20
261	SCREWS	6.5MMX30MM	010000999 G7 6.5MM X 30MM SCREW	5	13	14	32
492	SCREWS	3.5MM	02.127.180 VA LOCKSCR Ø3.5 SELF-TAP L80 SST	5	6	14	25
493	SCREWS	3.5MM	02.127.185 VA LOCKSCR Ø3.5 SELF-TAP L85 SST	4		11	15
577	PLATE	Dimensions N/A	02.224.222S LCP DHS PLATE 135DEG 2HOLE	7	14	11	32
820	SCREWS	5.0MM	04.005.526S 5.0MM LOCKING SCREW 36MM FOR IM NAILS T25 STARDRIVE		11	12	23
822	SCREWS	5.0MM	04.005.528S 5.0MM LOCKING SCREW 38MM FOR IM NAILS T25 STARDRIVE	1	15	17	33
824	SCREWS	5.0MM	04.005.530S 5.0MM LOCKING SCREW 40MM FOR IM NAILS T25 STARDRIVE		14	11	25
1211	SCREWS	Dimensions N/A	13550000 RELINE SET SCREW	187	148	153	488
1212	SCREWS	6.0MM	13600000 RELINE LOCK SCREW 6.0MM OPEN TULIP		5	29	34
1249	SCREWS	5.5MMX35MM	16015535 RELINE MAS SCREW 5.5 x 35 MM 2C POLYAXIAL	6	10	13	29
1289	SCREWS	5.0MMX35MM	189650355 LOCKING SCREW 5.0X35.0MM FT	10	7	14	31
1290	SCREWS	5.0MMX37.5MM	189650375 LOCKING SCREW 5.0X37.5MM FT	17	17	37	71
1292	SCREWS	5.0MMX42.5MM	189650425 LOCKING SCREW 5.0X42.5MM FT	4	8	11	23
1293	SCREWS	5.0MMX45MM	189650455 LOCKING SCREW 5.0X45.0MM FT	9	10	17	36
1297	SCREWS	5.0MMX55MM	189650555 LOCKING SCREW 5.0X55.0MM FT	10	5	11	26

Summary & Iterative Analysis

Data was extracted from a NSW hospital on all patients that had surgical implants for orthopaedic trauma surgeries and analysed retrospectively between the years of 2012 – 2022.

The data analysis was further dissected and examined for the year of 2022.

The Key findings are as follows:

- A total of 8165 implants were utilised for patients in orthopaedic trauma surgeries – emergency & planned.
- 5566 different types of implants were identified
- 71% of the implants were never used during 2022 & underwent repeated reprocessing over the whole data collection.
- 3953 items were identified as having zero usage during selected year 2022.
- Low usage (0-50) category represented 1593 implants = 28.6%
- Medium usage (50-100) category 11 types of implants = 0.2%
- High usage (100+) category 9 types of implants = 0.2%

Usage Category	Number of Implantable Line Items b	Per Implantantable Line Items Utilised in Instrument Trays	% Usage
	Implantable Category	Volume of items utilised	% of items utilised
Zero usage	Screws	-	
	Plate	-	
	Implant	-	
	Bolt	-	
	Locking Mechanism	-	
	Locking Screws	-	
	Nail	-	
	Pin	-	
	Post	-	
	Rail	-	
	Miscellaneous	-	
	Sub-Total of Zero Usag	-	71.0%
Low Usage 1 ≤ x < 50 be any number greater than or equal to 1 and less than 50.)	Screws	4,776	
	Plate	668	
	Implant	72	
	Bolt	10	
	Locking Mechanism	1	
	Locking Screws	78	
	Nail	186	
	Pinn	2	
	Post	24	
	Rail	-	
	Miscellaneous	12	
	Sub-Total of Low Usage	5,829	28.6%
Medium Usage 50 ≤ x < 100 (number greater than or equal to 50 and less than 100.)	Sub-Total of Medium U	835	0.2%
High Usage >100 (number greater than or equal to 100)	Sub-Total of High Usag	1,501	0.2%
	Grand Total	8,165	100%

Six Sigma Journey SSD

List all surgical implant product codes/sku's in an excel spreadsheet to identify implants used in patients over designated period.

→

Sort surgical implants according to category – plates, screws and sizes etc.

→

Sort implants into usage categories – no, low, medium high usage - to establish user patterns

→

Analyse implant data into usage tables and list of implant as per product code and size

↓

Analyse and determine which implant products can be removed from recirculating inventory

→

Revise Implant Caddy system from 0 usage items to low usage items

→

Sort Caddy system as same implant may be circulating on multiple sets

→

Utilise track and trace system to identify and monitor sets with quality assurance indicators with repetitive implant reprocessing

↓

Collate data to present to executives for endorsement and support

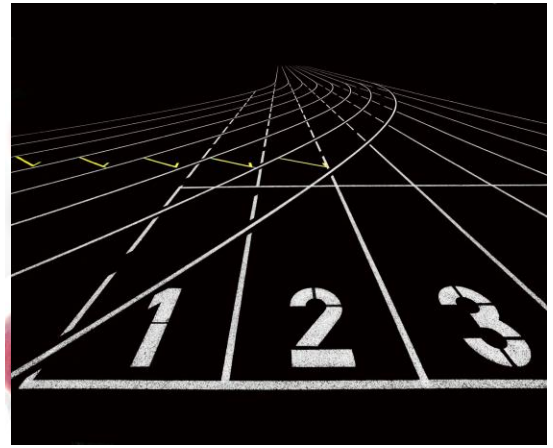
Six Sigma - Key Process Steps for Inventory Efficiency

- 1st Step - Identify the Number of screws per set
- 2nd Step - Identify the Number of Plates per set
- The aim is to remove the screws first as the plates have to be accessible to the aligned screw sizes.
- 3rd Step - Remove the plates.
- The storage system was then designed to allow for accessibility and ease of finding the implants without compromising the patient's safety and potential extension of the intraoperative time.

Findings

The department management and quality instrument tracking system, when cross reference with the implant product codes showed that the selected sku's out of the no usage category of implants, had not been used in over 13 years and had undergone repeated sterilization reprocessing during this time.

Many of the implants did not have a traceable lot number to determine if the 5-year expiry had been exceeded.



There was no systematic rotation or replacement of the surgical implants and the same type of implant can be distributed over 5 different sets.
The same instrument product code was found in more than 7 Orthopaedic caddy sets.

Improved Safety & Traceability

- Lot & Reference Numbers can be manually added to the tracking label
- Expiry date and processing dates are easily visible on label. This helps monitor usage and stock rotation.
- Improved quality assurance safety with the implementation of Type 5 chemical integrators for pack control.
- Biological Monitoring as per hospital policy.

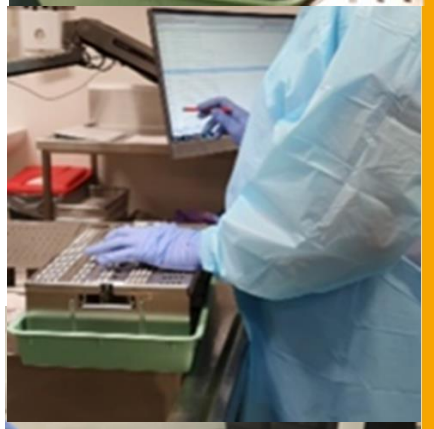
Workflow Time and Motion Study Findings

Tray O1161-01 AO Large Fragment Stainless Steel Screw Set

Procedure	Mode	Duration:
Cleaning Phase	Standard Practice	• Start: 10:57am • Finish: 11:02am. • Duration: 4 mins 17 secs
	Best Practice AS 5369:2023 Policy	• Start: 11:04am • Finish: 11:33am. • Duration: 29 mins 1 sec

Procedure	Mode	Duration:
Packaging Phase	Standard Practice	• Start: 2:01pm • Finish: 2:09pm • Duration: 8 mins 5 secs
	Best Practice AS 5369:2023 Policy	• Start: 2.11pm • Finish: 2.37pm • Duration: 25 mins 32 secs

*360 screws – AO large fragment stainless steel set.



Workflow Time and Motion Study Analysis

In this demographic there is 90% of hospital sets and 10% of loan sets.

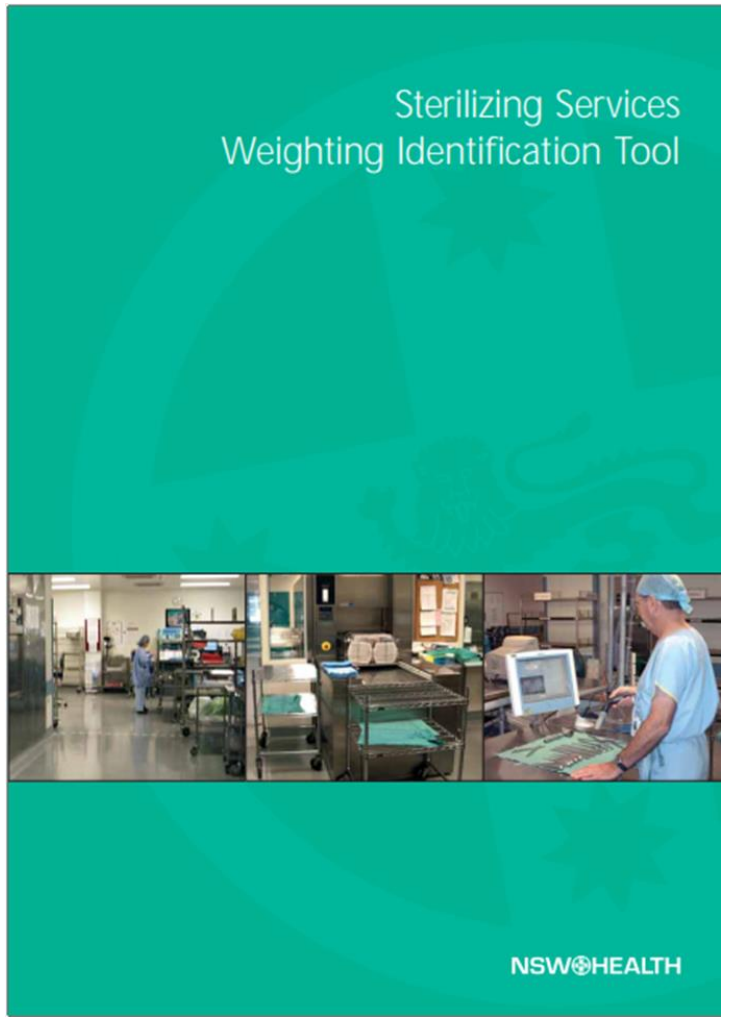
This can be variable from hospital to hospital.

$34.33/hr is the average for the majority of the sterilisation technicians.

From the implant category analysis, 0 usage was identified in 5 implant sets

Quantifying Six Sigma Results: Costing Method

- The New South Wales Health Weighting Tool was used as an estimated reflection of current reprocessing costs.
- Most hospitals in Australia use a weighting of $1.50 AUD, where as this hospital project utilised a lower estimate of $1.25 AUD.
- This weight identification tool costing could have a higher cost impact to other hospital facilities.
- Overall, the six-sigma project has contributed to a more efficient, safer impact to patient safety as well as preserving the burden of labor placed on the staff with the advanced complexity and dynamics of surgical instrumentation/implant reprocessing.



Six Sigma Project Cost Analysis

Set Number	Description	Usage in 2022	Total Usage Till Oct 2023	Processing Cost/Use (per NSW Health Weighting Tool)	Total Processing Cost (2022)	Inventory Removal Savings	Net Cost After Removal
01161-01	AO Large Fragment Stainless Steel Set	16 times	13 times	$1767.50 (per process)	X 29 times =$51,243	$35,870.10	$15,273.90 (per year)
01668-02	Universal Small Fragment Set	68 times	65 times	$4360.00 (per process)	X 133 times $579,880	$405,916	$173,964 (per year)
01161-02	AO Large Fragment Stainless Steel Set	18 times	14 times	$1767.50 (per process)	X 32 times $56,560	$39,592	$16,968 (per year)
O1668-03	AO Large Fragment Stainless Steel Set	59 times	72 times	$4360.00 (per process)	X 131 times $571,160	$399,812	$171,348 (per year)
01668-01	Universal Small Fragment Set (2017)	215 times between 2017-2022		$4360.00 (per process)	Only one set until 2022		

- 360 screws – AO large fragment stainless steel set.
- 931 screws – Universal small fragment tray.

Implant Inventory Removal Savings = $881,190.10

The weighting tool was used as a reflection of the current costs but does has some bearing on cost reflection. Most hospitals use a weighting of a $1.50, where as this hospital uses a lower estimate of $1.25. This costing could have a higher cost impact to other facilities. Overall, the project has contributed to a more efficient, safer impact to patient safety as well as preserving the burden of labor placed on the staff with the advanced complexity and dynamics of surgical instrumentation reprocessing.

Ensuring Sustainability Improvements through Six Sigma Methodology

- To promote the sustainability of the new implant storage system, each step was carefully implemented into a systematic re-organisation of individually packaged surgical implants.
- The project needs to test drive the new system removing 100% of the no usage category before proceeding with the reorganisation of the low usage, medium usage implants, high usage implants.
- Review and revise the new storage system at each phase.
- Double check the data for the previous years to ascertain extended patterns of no usage and does this remain the same over the years ? rather than analysing just the more recent year data usage.

Quality Improvement Strategies

- Reducing the unused inventory will improve surgical implant re-processing overall
- Increase the capability to correctly check functionality and cleanliness of implants
- Establishes better and easier packaging processes for implant rotation and storage
- Improved safety and quality management in implant traceability
- Quality assurance monitoring & enhanced sterility checks
- Increased efficiencies with over all handling and reprocessing of implant instrument sets

Comparing year on year usage trends for Continuous Improvement

- Quality Improvement is a continuous process, and it is key to review the yearly data to determine which implants have zero usage to enable the continued refinement of the safety of the system.
- To ensure that all key stakeholders are informed of the ongoing continuous improvement process, it is vital to implement a comprehensive communication strategy.
- This strategy should include regular updates at stakeholder meetings, detailed data reports summarising usage trends, safety performance, and decisions taken regarding the removal and repackaging of implants into the new storage system.
- Additionally, it is essential to involve stakeholders in discussions about the criteria for discontinuing zero-use implants, considering both the potential for future need and the implications for inventory management and cost savings.
- Through these measures, we can reinforce our commitment to quality and safety, fostering a culture of excellence and trust within the healthcare organisation and among our stakeholders.