Business Case

for

Comprehensive Traceability and Governance of Chemotherapy Processes to Guarantee Patient Safety in Cancer Care

1.PURPOSE OF THIS DOCUMENT (EXECUTIVE SUMMARY)

Perhaps one of the most demanding areas for a Health Organization is Cancer treatment, as patient safety is a priority issue and medication costs are high enough for considering the introduction of new, innovative, process optimizations and tools in this area. NHS targets some of its NHS strategic directives to improve patient safety but also to improve efficiency and reduce costs throughout healthcare services.

It is commonly agreed that continuing to operate with current systems and processes, even though there is no known IT solution for automated audits to capture and evaluate errors within the NHS environment, including the lack of granular error data, restricts Trusts in identifying and subsequently improving processes. Moreover, a financial offset is needed to counter the costs for Medication Errors.

This document presents an innovative development by Lug Healthcare Technology, a Spanish company, who seek to introduce their system into the NHS. Their system 'Traza', is designed primarily to deliver Pharmacists comprehensive traceability of the Cytotoxic cancer care drug management, achieving full auditability, relying on a non-error prone, system-guided, production process and a secured patient administration procedure, which eliminates errors in real-time, saves on drug costs and improves staff efficiencies that are all key NHS strategic directives.

The purpose of this document is to present a brief business case to assess a First of Type (FOT) and its implementation, as a pilot project, to validate the system for NHS use and distribution.

Lug Traza has been sold, implemented and is operational in a growing number of European cancer care centres, since 2013/14. Therefore, supporting documents, such as: User Cases, References, Clinical papers are available to verify the observations, statistical values and results achieved by actual users for several years.

2.SOLUTION OUTLINE

"Traza" is a server-based system of integrated modules with workflow and process controls for the Pharmacy and their cytotoxic protocol/regimen chemotherapy preparations and administration. Constant end-to-end automated monitoring provides the Pharmacist full traceability throughout the whole laboratory process. All stages are covered, either successively or specifically:

- **Drug Store**. Drugs entering the Pharmacy store (focused on chemotherapy) are read by their bar-code with lot and expiry dates recorded. In this way, the system knows how to enforce the FEFO (First Expired First Out) policy on drugs for forthcoming preparations.
- **Aseptic Unit**. The unique voice control interface with the Technician and the digital gravimetric scales interface for exact systematic preparation control, guides the technician on the compounding tasks.
- **Separate Quality Control**. Parallel calculations on each preparation and a final (external to the aseptic unit) gravimetric control is performed to ensure the preparation is correct after leaving the aseptic unit.
- **Transfer to Ward or Outpatient or Remote home/care centre**. Preparation data, including patient's data is electronically transferred to the administration facility, no manual process is involved.
- **Administration facility**. Two processes are usually carried out at this stage:
    - Antiemetic preparation, assisted by the system providing continued traceability as that used through the aseptic unit.
    - Patient administration via the infusion pump. Secure administration is achieved by assisting the nurse with a connected PDA that checks all the data related to the treatment e.g. patient's ID, nurse's ID, box/seat ID, preparation ID code, date/time of administration, etc., in addition to interfacing to the infusion pump, to check all treatments have been delivered and ended correctly.

The system also provides automated aids to assist the Pharmacist with the ever-expanding library of complex protocols.

The server-based solution has full security, and, is HL7 (and later FHIR) compliant. This way, Traza will integrate with existing Trust systems for EPR, E-prescription, Blood + Analysis, Schedule, Resource management and other NHS data sets. PDA and Infusion pumps are also fully integrated, thereby allowing Traza to monitor and control the final administration.

3.IMPACTS

Patient safety

MD Anderson states[1] -" *…detects that [its] error rate in the preparation of cytostatic preparations is 7.1%.". If the implementation of new IT and process solutions could reduce this further by 95% it still leaves unaccounted Errors. With each medication error costing IRO £6,357, the unaccounted cost is calculated at £25,428 per 1000 doses.*

Hence, given a modest pharmacy production rate of 15,000 doses p.a., a set aside of £381,420 is needed.

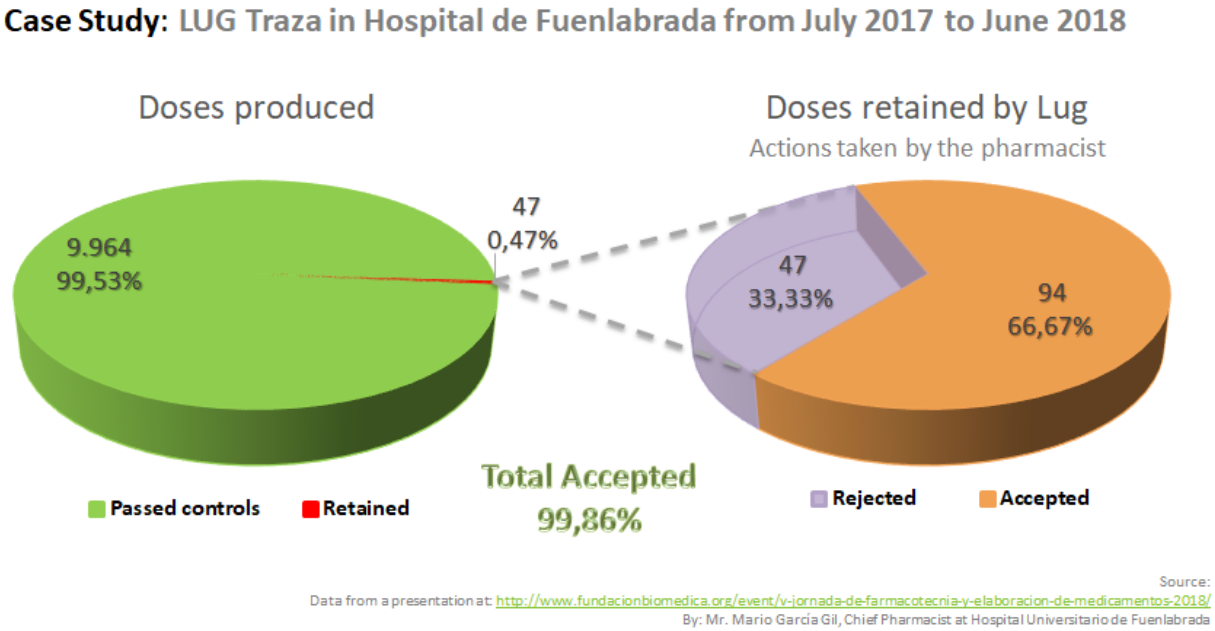
Lug Traza was originated by an "almost-happened" ADE (Adverse Drug Event), when the patient detected an error affecting his next dose just in time for not being given. He subsequently conducted some

[1] *Source: Implementation and evaluation of a gravimetric i.e. workflow software system in an oncology ambulatory care pharmacy; Kelley M. Reece, Pharm.D., Division of Pharmacy; Miguel A. Lozano, M.B.A., CQE, CSSBB, PMP, Office of Performance Improvement; Ryan Roux, Pharm.D., M.S., Division of Pharmacy; Susan M. Spivey, Pharm.D., Division of Pharmacy (all of them: M. D. Anderson Cancer Center, Houston, TX.). Copyright © 2016, American Society of Health-System Pharmacists, Inc. All rights reserved. 1079-2082/16/0201-0165.*

research on chemotherapy production traceability systems, discovering that none existed at that time (2006/2008). Because of this ADE, patient safety is the main driving target for Lug Traza, and traceability is its primary tool.

Our first results on patient's safety are dated back in 2012-2013 and published in the study found at Annex 1.

The following figure explains similar results from a recent study (2017-2018).



More than 1M doses have been successfully delivered with this solution with ZERO ERROR passing to the patient, thereby, Guaranteeing Patient Safety.

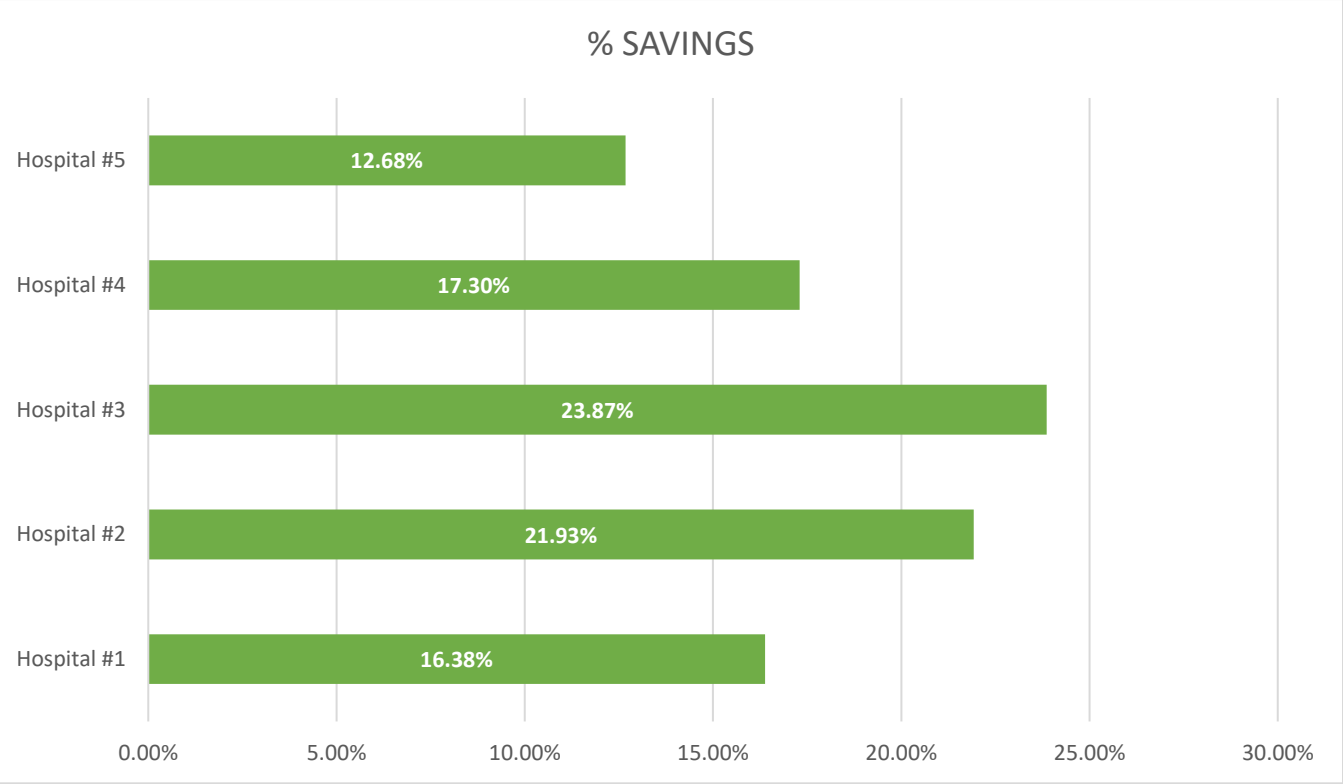
Impact on Staff, the impact on staff during implementation and training is minimal. The solution mimics existing processes, aiding rapid adoption. A full AEMPS[2] (equivalent to British Pharmacopoeia) library of cancer drugs in circulation and their system configurations are available for rapid set-up and assists the Pharmacist induction.

Aseptic staffing efficiencies, current NHS guidelines for each Aseptic cabin recommend three (3) highly trained technicians for each dose preparation. Lug's solution uses one (1) Technician, the system operates a unique voice control interface for the Technician with a digital gravimetric scales interface. This, releases 2/3rd of the highly trained staff to improve cabin occupancy and demand throughput.

Auditability aids, stressing again that the system audits and controls all Clinician, Technician's, Pharmacy and Nursing processes, providing full "Big Data" analysis for audit process assessment. Standard reports are available and customized reports can be tailored for any specific need.

Cost savings, clinical evidence, mentioned below (figure and (*) (**)), is available that shows:

[2] Agencia Española de Medicamentos y Productos Sanitarios (AEMPS) equivalent to British Pharmacopoeia, an alternative data set.



(*) Hospitals #2 and #5 are large, #1 and #4 are medium sized, and #3 is small.
(**) Detailed data is included at Annex 2.

The overall estimations that Lug considers a general statement, based on gathered data since 2012, are the following:

10% saving p.a. in Cancer drug costs.
8% increase p.a. in Chemotherapy sessions due to improved staff efficiencies.

4.COMMERCIAL CASE

As mentioned before, significant efficiencies can be achieved at several points of the chemotherapy preparation process. Aseptic unit staff efficiencies (only 1 person per aseptic unit), reduced drug consumption (store control, remnants reuse and expiration check), increased patient throughput (system assisted administration) and full process safety (no errors administered to the patient); all of these efficiencies are considered consistent enough to base a commercial offers on a true 'win-win' scenario (success-based agreement); being, a small fee per preparation plus an agreed % of audited savings achieved during the audited period (12 months).

However, as a First of Type (FOT) evaluation or pilot, that would be specific to the first hospital to install Traza in the UK, a special commercial case would be offered. Once evaluated and agreed to be distributed to the NHS, new contracts would be based the Standard success-based commercial case.

FOT Case

The FOT Case will be based on a Fixed Price for the duration of the project, initially set up for 1 year. The delivered service would be unlimited regarding the number of preparations made by means of Lug Traza. Most other expected project elements are included, together with, full on-site or remote annual support (as agreed).

Regarding resource costs, the burden of implementing this FOT project is minimal, however, needs to be correctly resourced and prioritised by the Trust. Lug will have a dedicated team to implement the solution, configure the set-up, workflows including drug protocols and train the relevant personnel. The team will continue for as long as it is needed, after which, remote support will be offered. All TPP, devices and hardware are to the Trust's account.

Note: Some Global Pharmaceutical companies are 'Traza' sponsors and may be willing to sponsor the NHS's FOT commercial case in full (Subject to agreement).

Standard Success-based Commercial case scenarios

The fee is based on three options:

a) A fee that consists of a small % of the savings generated each year i.e. "success-based payment". The Trust must provide all the needed information for the savings calculations, which would compare the audited previous and post situations.

b) A fee is fixed and agreed at the beginning. This option has no special requirements and can be equivalent to option a).

c) A fee that is an agreed mix of options a) and b).

5.OPTIONS

Lug Traza comprises a suite of software applications targeted to chemotherapy preparations production and administration. The core of the solution is the traceability system and its aseptic unit production assistant, the administration module is also included in this FOT business case but is optional, although it is highly recommended.

Other additional modules that may be added into this proposal are:

- Lug EPA, e-Prescribing application module, specialized in chemotherapy prescribing. Constantly updated, contains standard treatment protocol libraries that can be shaped to fit any oncologist needs. Fully integrated with Traza for an error-free prescription-to-preparation process.
- Lug OncoKids, a complete Paediatric module that enhances both Lug Traza and Lug EPA with specific features needed for children's cancer treatment and care.
- Lug Trials, the most complete clinical trials management system for a hospital, it covers all the necessary aspects of a clinical trial workflow and documentation, from creation, ethics requirements, to patient enrolment, trial configuration (e.g. blind, double-blind, etc.) and treatment traceability. Lug Trials derives its most significant value when integrated with the traceability features of Lug Traza.

- Lug HDAM, Home Delivery + Adherence Monitoring. This standalone module provides the hospital with a comprehensive traceability solution for managing hospital medications that are required to be delivered to patient's home. Direct deliver from the pharma company to the home makes the system extremely cost efficient.

6.BENEFITS EXPECTED

This section briefly lists the benefits that will be achieved by this project:

a. Comprehensive Chemotherapy traceability

Traceability is a very powerful tool for process control. Lug's Traza uses any existing coding-mark(s) on the drugs to identify them from entering the store, so no re-labelling error is made. Also, labels are only printed at the exact place and moment where/when they are needed, eliminating any confusion. All tracing data is saved for later analysis.

b. Real-time Error 'Alerts' and resolution

As critical tasks and action are fully monitored and guided by the voice-assisted production system, any error is 'trapped' in REAL-TIME and resolved accordingly to the pharmacist decision.

c. Guaranteeing Patient Safety

All errors that the system 'traps' will immediately halt the process until corrected in real-time, these events are automatically audited by the system. Errors can be identified throughout the whole process to patient's administration, so safety is guaranteed.

d. Improved Aseptic Unit staffing efficiencies

Traza offers a fully monitored and guided production system. The system knows in advance the preparation data, so it can properly guide the technician through the drug(s) and the sequences to measure and mix. In addition, gravimetric scales are automatically used by the system to check in real-time the compounding results. The voice-assisted system frees the technician's hand for the critical work with drugs. In this way, only ONE technician is needed per aseptic unit, thus remaining staff can attend other tasks in their area.

e. Save on Cancer drug consumption (c-10%)

Traceability enables Traza to use products based on their expiry date, but also, as compounding elements (e.g. vials, etc.) are traced too, the system knows the amount of drug remaining an its stability after first (partial) use. This feature will enable the use previous remnants for the current preparation, thus saving on drug consumption both ways. Lug has reports based on existing hospitals' data than confirm this estimation.

f. Increased patient throughput (+8%)

The voice-assisted system helping the technician in the aseptic unit, and the use of connected PDA's to ensure safe administration all enabling an increased patient throughput. As previously documented, Lug reports are available that demonstrates these statements.

g. E-Prescription validation

All prescriptions received from the hospital's e-prescribing system are automatically checked for pharmacological production compliance and must fulfil the pharmacist approval procedure to continue to be produced. Errors at this stage are also trapped and audited.

h. Drug expiry and protocol checking

Two vital checks are included in the verification actions of the system. A FEFO (First Expired First Out) policy can be enforced for drug lot selection for compounding. Known protocols rules can also be checked by the system throughout the whole process to the moment of administration.

i. Continuous Quality Control

The system uses traceability, received prescription data, internal calculations and gravimetric scales for monitoring and checking compounding actions. Continuous weighing can also be used for quality control throughout the whole process, nonetheless the minimum step required for quality control is a contrast weighing of the produced preparations.

j. Reduces Technician 'Stress' Level

As the system "knows" preparation data (from received prescriptions), calculates all the intermediate steps and monitors weighs by interfacing to scales, it can safely guide the technician throughout the mixing process. Technicians report that they are very confident in their actions and that they are confident and reassured that all their preparations are compounded correctly, reporting regularly that their 'stress' level are much reduced.

k. Secure and HL7 compliance

HL7 compliance allows for an error-free prescription transcription from the hospital's e-prescribing system into Lug's Traza; no manual process is needed, and the process is highly secure.

l. Auditable compliance to NHS guidelines

The traceability system that lies underneath Lug's systems gather data from all the elements, actions and tasks carried out throughout the chemotherapy preparation processes. Lug's Traza produces standard reports for normal operation supervision, these and other customised report can be used to verify compliance to NHS guidelines on patient's safety.

m. Big Data Analysis for process audits

Customized reports can be produced to fulfil any query, as full data history is gathered by the traceability sub-system of Traza.

7. RISKS

A risk management appraisal is recommended to identify, address and compensate for risks, such as:

a. Lack of priority by the Trust limits implementation

It is common for any new system or procedure to face some resistance to change, as the organization is normally in full operational state and rejects any source of disturbance. This can be turned into an opportunity, as the new system will greatly improve several key aspects of the involved services.

b. Disruption to pharmacy and ward would be off-set with a controlled phased implementation

In order to minimize any adverse effect on running services, a phased implementation will be set up. This way, familiarity with the new system will be gained at a comfortable pace, and the new procedures will be practised with a reduced number of drugs beforehand. Any drug managed by the system will have its preparation procedures fully tested and approved in advance.

c. Lack of progress due to IT infrastructure, Equipment or Third-Party Products unavailability

The adoption of HL7 protocol suite for interfacing to existing hospital's IT systems (e.g. ERP, HER, etc.) and TPP reverts this risk into an action to be accomplished before fully operational. HL7 simplifies the information exchange between systems and any customization that is identified be agreed and tested beforehand, to approve the protocol messaging for specific functions.

Other risks should be identified at the beginning of the project and managed accordingly. Lug's previous experience will help this task, nevertheless, no additional significant risk are expected.

8.TIMESCALES

This table outlines a general statement as to the approximate length of the project.

Stage	Comment	Time Scale
Feasibility study	Subject to Stakeholder brief	Weeks 1 - 2
Pre-project Phase (PID) for FOT	Documentation, Submission and Approval	Weeks 3 - 4
Milestone	**Approval for Phase 1**	**Week 5**
Legacy Audit	Audit legacy processes, costs and errors	Weeks 5 - 8
Master Data and Equipment implementation	Install equipment, software and data interfaces	Weeks 5 - 8
Phase 1 - Controlled Roll-out	Limited by Drug type, Aseptic unit, Staff and Ward users	Weeks 9 - 21
Phase 1.1 - Induction	User Training and Pharmacist induction	Weeks 9 - 12
Phase 1.2 - FOT Operational	End-2-End Production usage	Weeks 13 - 21
Milestone	**Approval for Phase 2**	**Week 22**
Phase 2 - Full FOT Roll-Out	Scale-up Drug type and User to spec	Weeks 22 – 26
Phase 2.1 – Full FOT Operational	Production Usage for all Users and Drugs	Weeks 26 -40
Phase 2.2 – FOT Completion	Analyse Traza Vs Legacy Audit	Week 41 – 42
Milestone	**ATP and Handover**	**Week 43**

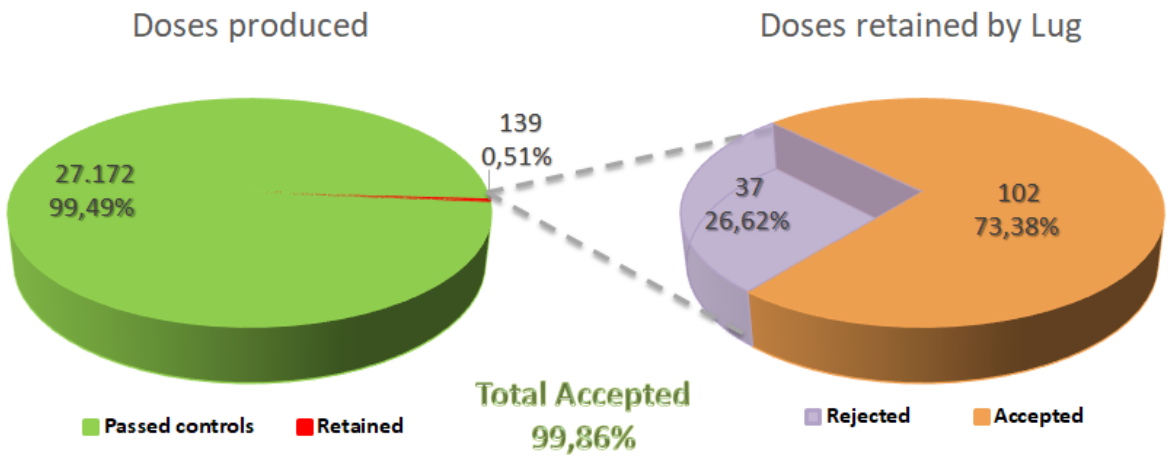
In order to coordinate the efforts for both sides to carry out the installation process and action the proposed timeline of activities, a Lug project manager and a corresponding hospital project manager will lead the project. The project team will include additional people from Lug and the hospital being responsible for the successful implementation of the system within their respective technical skill sets, as Pharmacy (Store and Production, Nursery (Administration), IT (Software integration), etc.

9. GLOSSARY

ATP	Acceptance Test Procedure
FEFO	First Expired First Out, a type of policy for store management
FHIR	Fast Healthcare Interoperability Resources (Protocol suite), an evolved derivative of HL7
FOT	First of Type
HL7	Health Level 7 Protocol Suite
IT	Information Technologies
PID	Project Initiation Documentation
TPP	Third Party Products, usually software applications

10. ANNEX 1. SAFETY CASE STUDIES

Case Study[1]: LUG Traza in hospital Vall d´Hebron from April 2012 to March 2013



Source:
http://medicaments.gencat.cat/web/.content/minisite/medicaments/professionals/6_publicacions/butlletins/boletin_errores_medicacion/documents/arxius/bem_v11_n3e.pdf

[1] In this study, Lug is called by its previous name (Isish)

11. ANNEX 2. COST SAVINGS CASE STUDIES

Hospitals #1 to #3

2016 Feb-Jun (5 months)	HOSPITAL #1	HOSPITAL #2	HOSPITAL #3
Treatments (CT sessions)	6.267	12.280	1.950
Preparations per Treatment	11.102	20.514	3.315
Medications per Preparation	25.884	41.114	7.291
Used Vials (total)	34.436	55.641	9.410
Theoretical Cost w/o optimization	4.273.270,82 €	7.777.883,10 €	1.247.515,77 €
Minimum Cost (optimized)	3.573.182,48 €	6.072.554,28 €	949.790,82 €
% Cost savings	**16,38%**	**21,93%**	**23,87%**

Note #1: “Theoretical Cost w/o optimization” corresponds to the estimated cost of using whole vials at preparations.
Note #2: “Minimum Cost (optimized)” corresponds to the cost of the prescribed milligrams of medication, no waste is considered here.
Note #3: Actual cost is somewhere in between “Theoretical Cost w/o optimization” and “Minimum Cost (optimized)”, usually about a 10% higher than “Minimum Cost (optimized)”.

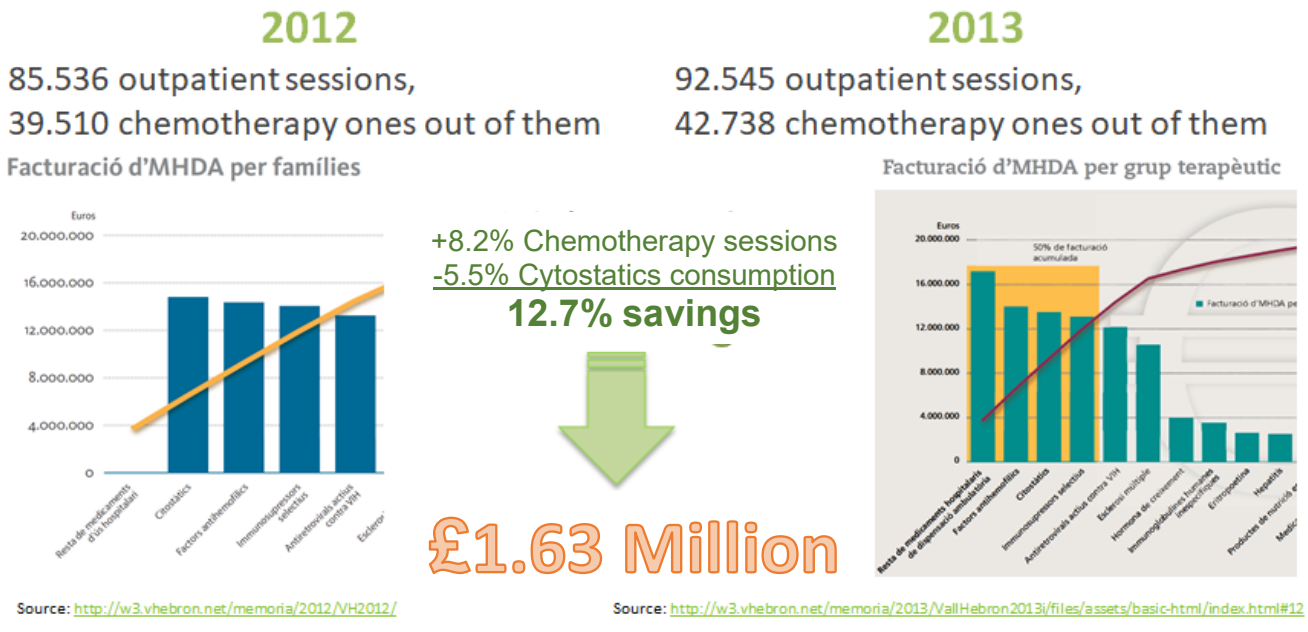
Hospital #4

PERIOD OF STUDY: February-June 2016 vs February-June 2018

	PRESCRIBED		CONSUMED		DIFFERENCES			PREPARATIONS		
	MGS	COST	MGS	COST	% MGS	COST	% €	TOTAL	LUG	% LUG
FEBRERO-JUNIO 2016	2.801.299	1.110.677,05 €	3.047.270	1.305.989,70 €	8,78%	195.312,65 €	17,59%	4.073		
FEBRERO-JUNIO 2018	2.944.057	2.020.026,26 €	2.911.740	2.153.594,98 €	-1,10%	133.568,73 €	6,61%	4.455	2.651	60%
COST DIFFERENCE AS IF 2018 WERE PRODUCED AS 2016 (Same relative differences)						355.221,78 €				
COST SAVINGS FEB-JUN 2018						221.653,05 €				
						10,29%				
ESTIMATED ANNUAL SAVINGS 2018						531.967,33 €				
MEAN PREPARATION COST 2016						320,65 €				
MEAN PREPARATION COST 2018						483,41 €				
Mean cost per prep variation						50,76%				
Mean cost per milligram variation						73,05%				
ESTIMATED MEAN COST PER PREP 2018 W/O LUG						533,16 €				
ESTIMATED MEAN COST PER PREP 2018 AS IF 100% LUG						449,55 €				
ESTIMATED MAXIMUM ADDITIONAL COST SAVINGS 2018						362.002,66 €				
POTENTIAL MAXIMUM COST SAVINGS 2018						17,30%				

Note #1: First findings. Raw data from which reflected figures were aggregated deserve further analysis for clearing up some inconsistencies related to hospital's store accounting procedures.

Hospital #5



Source: http://w3.vhebron.net/memoria/2012/VH2012/

Source: http://w3.vhebron.net/memoria/2013/VallHebron2013i/files/assets/basic-html/index.html#12

Note #1: The figures are based on publicly available data, sourced by the hospital. They may be influenced by other factors, no only the introduction of Lug Traza (called ISISH SW Suite at that time).
Note #2: Lug Traza was introduced during several months in 2012-2013, so the mentioned amounts may be influenced by this fact. Nevertheless, the savings ratio trend is well reflected.