

# **Pre-analytical automation – experience with and potential pitfalls:**

David Stockwell  
Morrison Hospital, Swansea

## Background

In 1995, As a result of Audit commission recommendations, three Chemical Pathology Laboratories in West Glamorgan Merged to form a centralised service. A main central Lab at Morriston Hospital was established with satellite Labs at Neath and Singleton Hospitals

## Organisation Pre 1995



## Morriston - 24 hr Service

- *Rapid Response*
- *Bulk Processing (Non urgent)*
- *Point of Care Admin.*
- *Special analytical techniques*
- *Send away referral*
- *Added value clinical interpretation and validation*

## Singelton - 24 hr Service

- *Rapid Response*
- *Bulk Processing (Non urgent)*
- *Point of Care Admin.*
- *Special analytical techniques*
- *Send away referral*
- *Added value clinical interpretation and validation*

## Organisation Pre 1995

### Neath - 24 hr Service

- *Rapid Response*
- *Bulk Processing (Non urgent)*
- *Point of Care Admin.*
- *Special analytical techniques*
- *Send away referral*
- *Added value clinical interpretation and validation*



# Morrison Central Laboratory - 24 hr Service

- *Local Rapid Response*

## **New District wide service for:**

- *Bulk Processing*
- *Point of Care Admin.*
- *Special analytical techniques*
- *Send away referral*
- *Added value clinical interpretation and validation*

## Singleton satellite - 18 hr Service

Rapid Response – Predominantly In Patients  
Initial Sample Preparation and send on

- Outreach staff on rotation

## Neath satellite - 18 hr Service

Rapid Response – Predominantly In Patients  
Initial Sample Preparation and send on

- Outreach staff on rotation

Staffing: 2 Consultant Chemical Pathologists  
3 Clinical Scientists  
26 BMSs  
13 wte MLAs

The department provides a 24/7 residential service for Singleton, Morriston and Baglan. This year, 1,134,558 patient functional requests were carried out. (614,462 Requests)

*\* In 1995, 25 MLSO's carried out 383,291 functional requests for the 3 sites operating an office hours service with non residential On Call.*

## Dissatisfactions 1995 – 2001

- Delayed in laboratory process times
- Dissatisfactions with workflow processes.
- Overly complex manual sample handling procedures
- Manual sample preparation procedures carried high risk assessment ratings

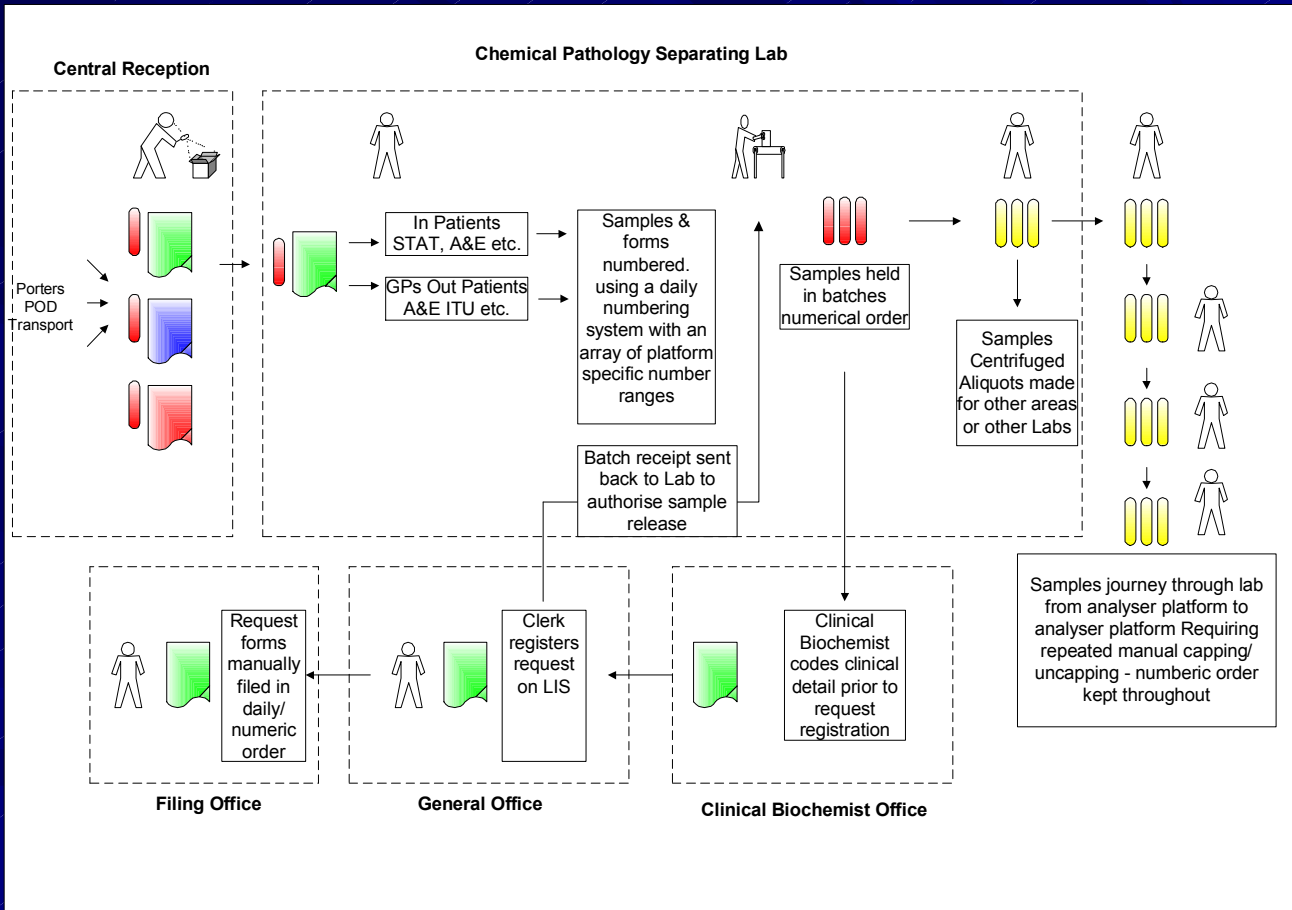
## Dissatisfactions 1995 – 2001 (continued)

- Too many stand alone analytical platforms

*That required:*

- Complicated multiple sample number systems
  - Large number of pre analytical and inter analytical steps and hand offs
- 
- Too many repetitive tasks being carried out inappropriately by qualified staff e.g. uncapping and recapping samples
  - Samples were kept at room temperature for inappropriately long periods of time as they would be moved from analytical platform to another
  - Poor quality labelling on secondary sample tubes for distribution to other laboratory areas or for send away to other specialist laboratories.

# Pre Analytical Process Map Pre 2002

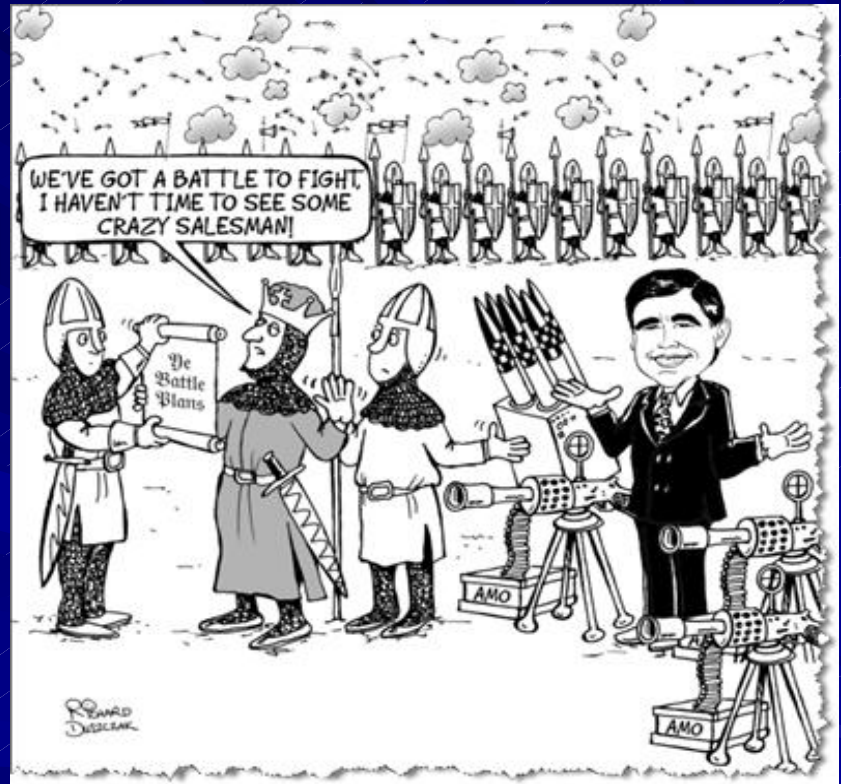


## Dissatisfactions 1995 – 2001 (continued)

- Sample quality was based on a subjective judgment (e.g. haemolysis, lipaemia and icteric index.)
- Non-existent sample tracking audit – particularly required for critical incident / noncompliance investigations
- Peaks and troughs throughout the day in sample presentation to analysers
- Poorly configured economic design with high unnecessary staff movements
- **Phone calls, phone calls, phone calls !!!**

## Conclusion:

We were in a vicious circle and we needed to be in a virtuous circle.

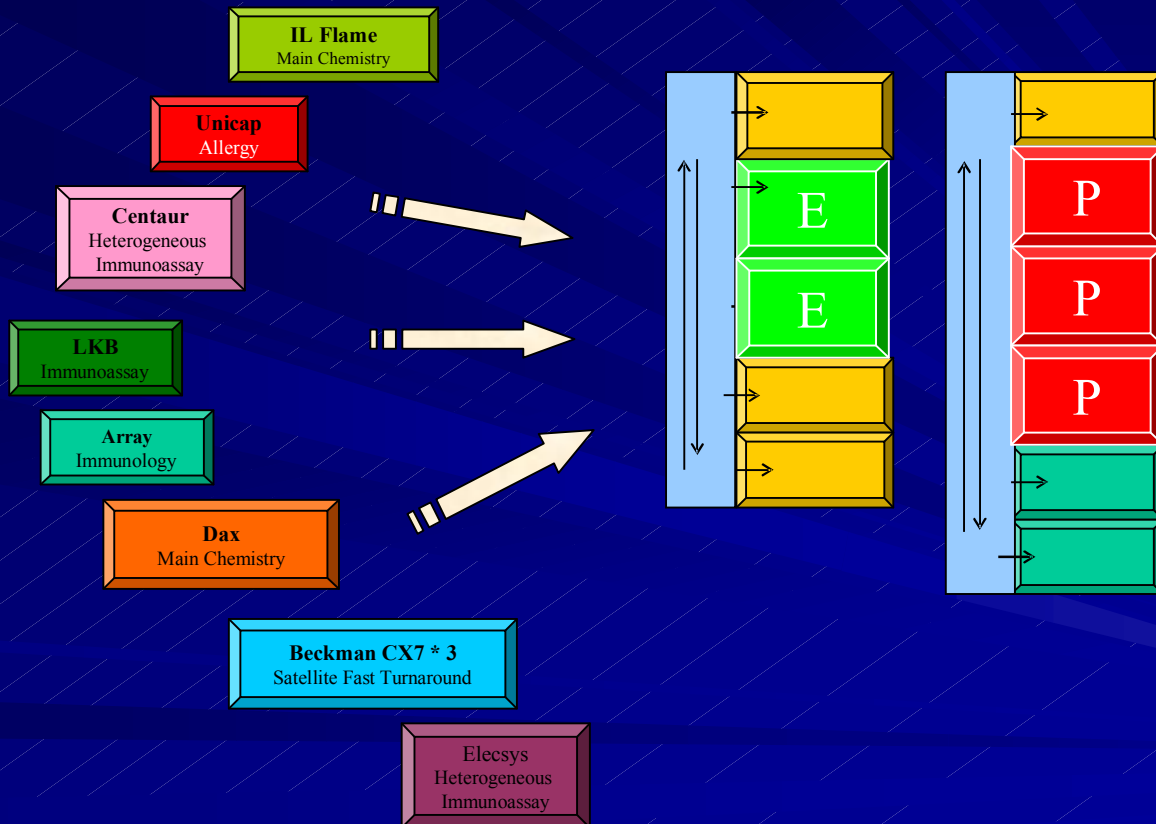


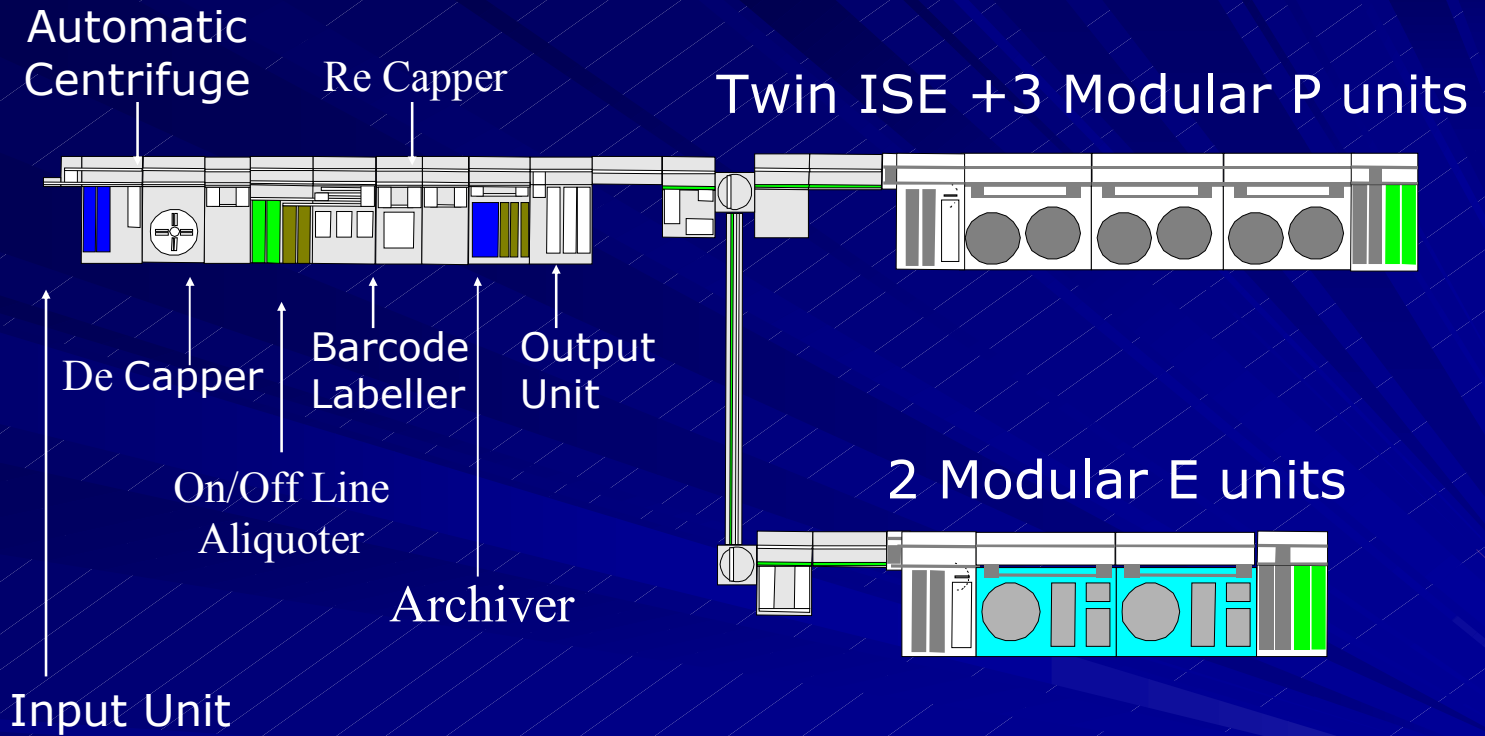
# Descision

- Consolidate high volume mainstream analyses onto a single platform of multiple Chemistry and Immunochemistry Analyser modules
- **Install an integrated automated Pre Analytics**
- Install single modules in satellite laboratories.
- Network main laboratory platform and satellite modules via middleware control software residing on a single server (PSM)
- Commission a new pathology LIS
- **Conduct fundamental redesign of sample processing and workflow within the laboratory around the new technology. (not the other way around)**

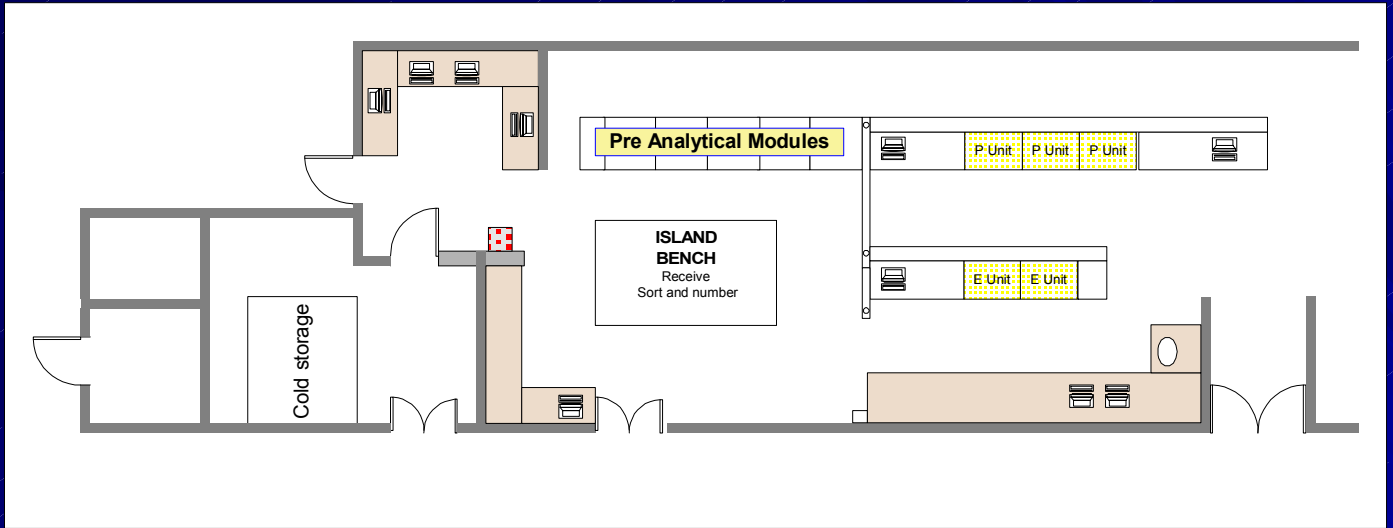
**Remember:** “ if you automate a bad process you get an automated bad process”

# Consolidation of Technologies

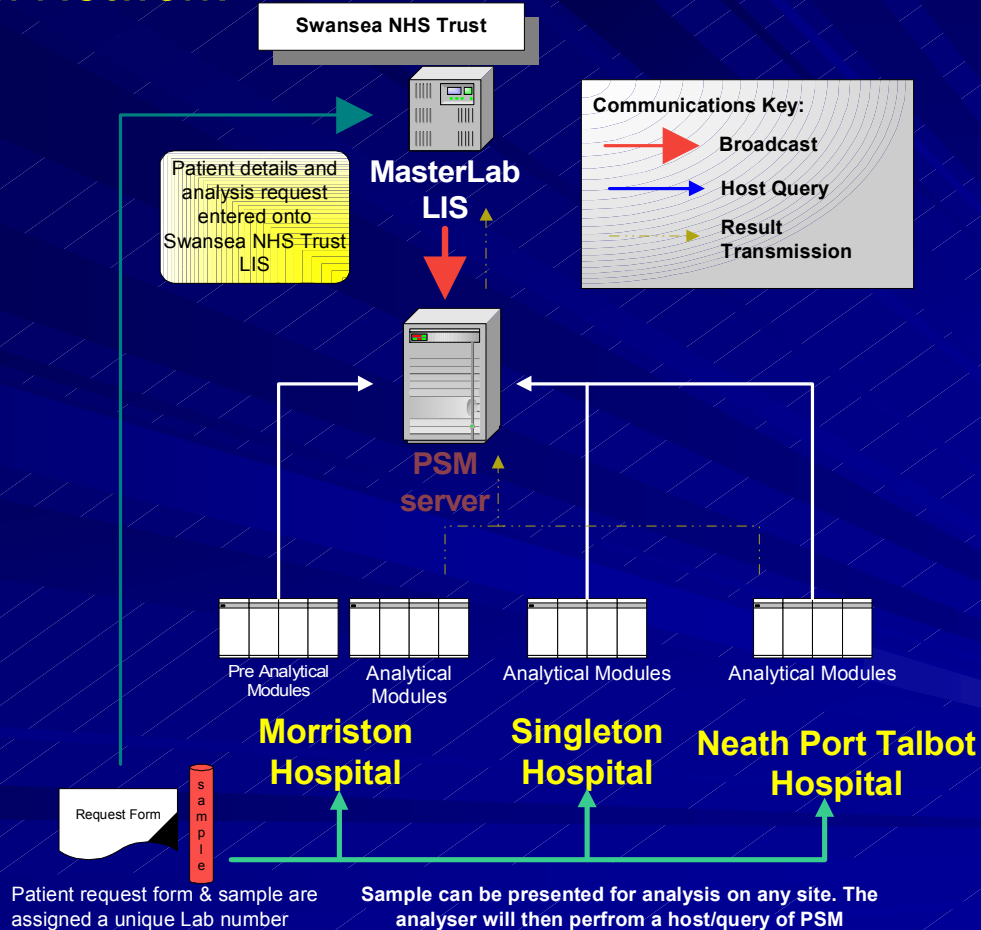




**MPA PPP/EE Configuration at Centralised Lab**



# The PSM Network



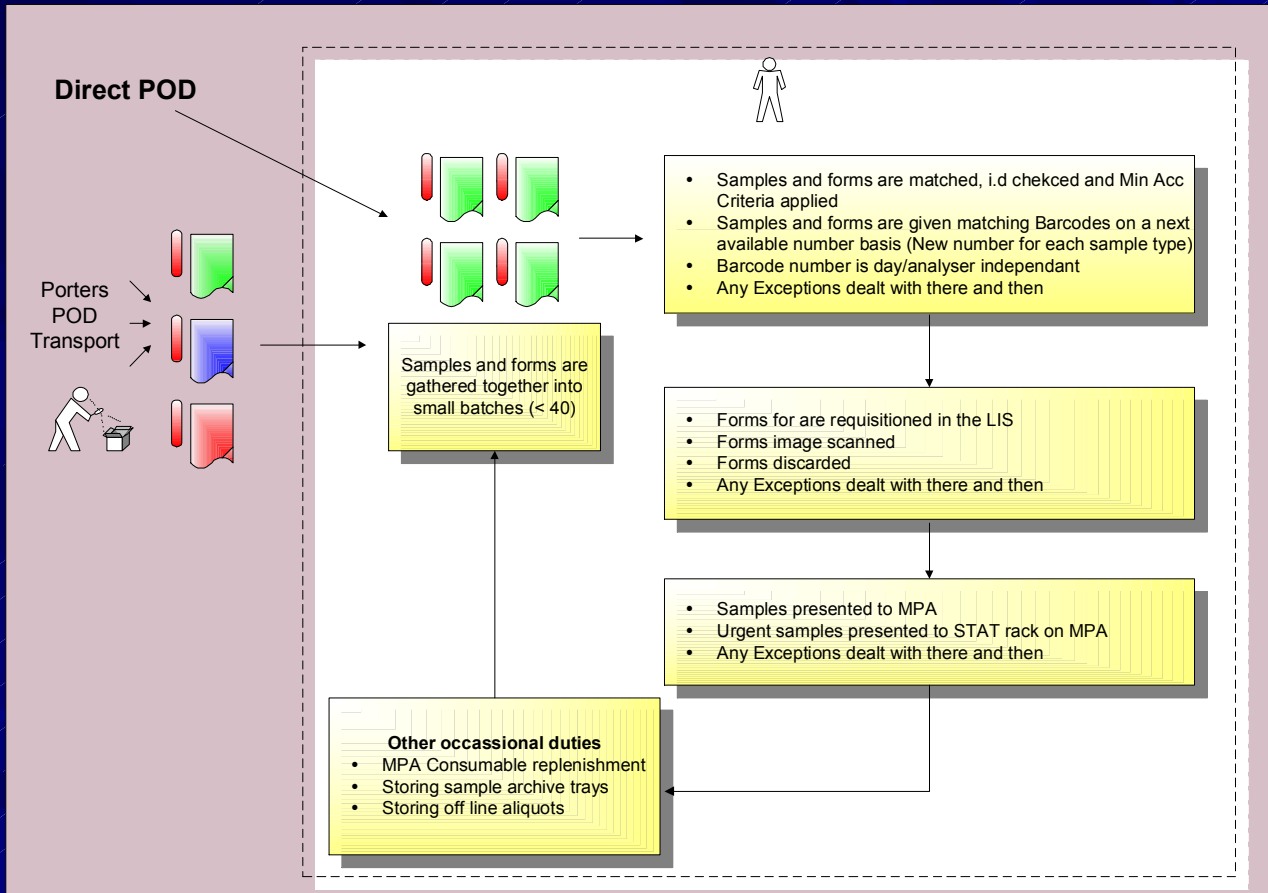
# MPA Overview

# Pre Analytical process map Post 2002

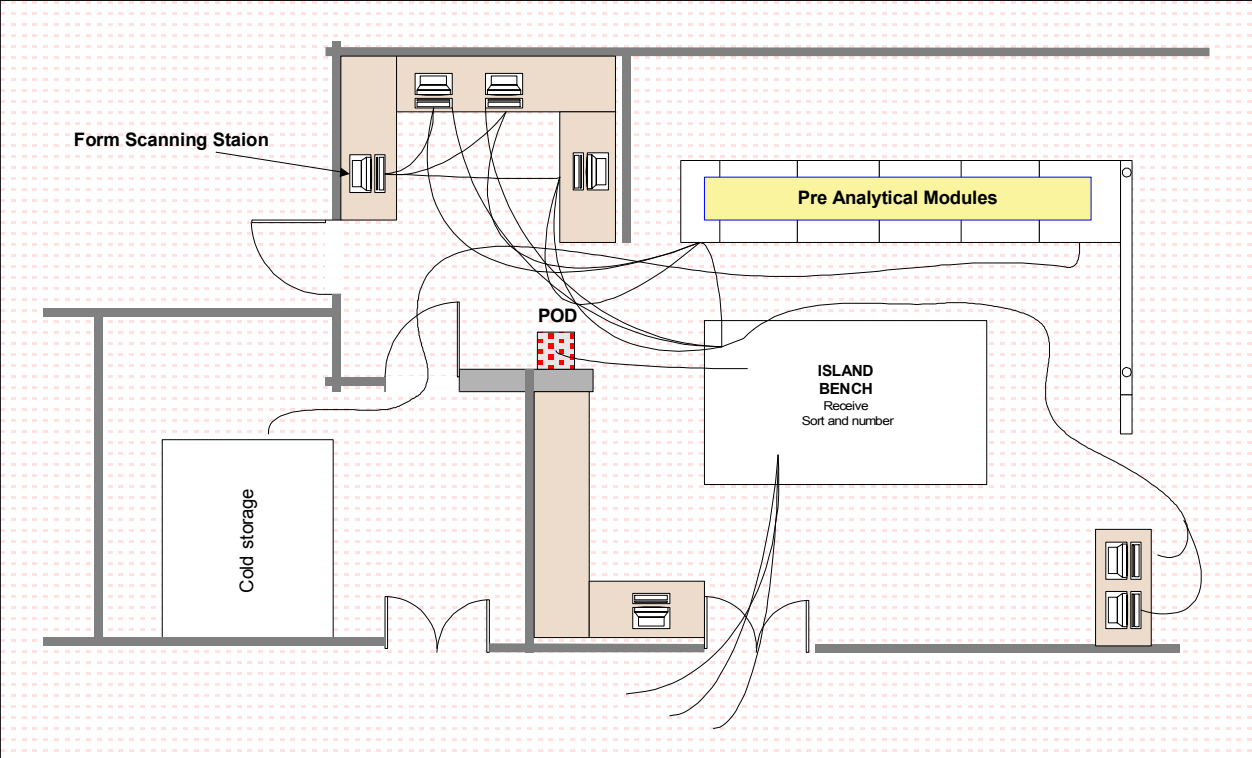
## Motion, Steps and Hand-offs

- Simplify workflow – Lean process
- Reduce unnecessary non value adding steps and handoffs
- Build in ergonomic design to reduce unnecessary movement
- Be prepared to change processes and people to fit around the capabilities of new technologies
- Avoid distracting telephone inquiries
- Train and multi Skill staff
- Reduce Variation

# Redesigned Pre Analytical process map



# Specimen Reception Spaghetti Map



# PSM

1. PSM allows multi site management of all analytical functions from any of the sites.
2. Complete audit trail of the sample.
3. QC results of all analysers are easily viewed and compared.
4. Validation of all tests can be performed.

# PSM multi site management

## **Process:**

Samples can be presented to any analyser on the PSM network. Once completed, the request is removed from the other target analysers on the system. Outstanding tests will be completed when the sample is presented to any of the analysers capable of performing these tests. This includes off line aliquots for tests carried out in other Labs.

## **Advantages:**

Only core tests need to be performed at the satellite laboratories. Non Core tests can be offered at the main laboratory only. Presentation of the sample to this analyser will not result in duplication of any tests.

# Audit

- Track History of any sample will show Time & Date sent from the host computer, when and where it was analysed and which module had generated the results.
- Any QC fails at the time are recorded, as are instrument flags. These flagged results are trapped in a validation queue and must be validated by a BMS prior to release to the host computer. There is a record of each action and who carried it out.
- Straightforward results are automatically released by the system.
- Daily sample horizontal & vertical audits verify data input quality

Workarea

Quality Control

Validation

Master Files

Parameters

Sample tracking

Manual Scan Place

Aliquot

Connections

Archive

- Sample ID
- Patient name
- Patient ID

Sample ID

8192\*

Search

- 24 h
- All
- Days

Track History

Sample ID

819242V

Specimen

Serum

Device	Action	Details	User	Date/Time
Host	Add tests	1,4,5,6...	System	23/05/2005 13:29
MPA-SC (1)	Unknown sample seen	IBM [02048-2]	Connections	23/05/2005 16:08
Sort	Add tests	8100	Connections	23/05/2005 16:08
Routing done by Host	Query performed by analyser	MPA [7048-2]	Connections	23/05/2005 16:08
MPA-SC (1)	Known sample seen	IBM [02048-2]	Connections	23/05/2005 16:08
MPA-SC (1)	Query	7048-2	Connections	23/05/2005 16:08
MPA-SC (1)	Sample seen	[00309-2]	Connections	23/05/2005 16:23
MPA-SC (1)	Known sample seen	UCL [00309-2]	Connections	23/05/2005 16:24
Routing done by Host	Query performed by analyser	Triple P [5309-2]	Connections	23/05/2005 16:25
MPA-SC (1)	Sort	Primary Archive	MPA	23/05/2005 16:26
MPA-SC (1)	Automatic archiving	Archive	Connections	23/05/2005 16:26
MPA-SC (1)	Sample seen	AQS.1 [56-104]	Connections	23/05/2005 16:26

Close

Sample ID
819203R
819204E
819238H
819239M
819240L
819241W
819242V
819243N
819244C
819245D
819246Y
819247J
819248Z
819249F
819250B
819251Q
819252T
819253L
819254W
819255V
819256N
819257C
819258D
819259V

23/05/2005 13:35	BOWEN Margaret	Serum		
23/05/2005 13:36	DAVIES Irene	Serum		
23/05/2005 13:37	LANIGON Dorothy	Serum		
23/05/2005 13:38	MURPHY Linda	Serum		

Details

Host Conn.

Track History

End Day Proc.

Click here to begin



http://psm2/intra...

http://psm2/intra...

Document1 - Micr...

Preanalytic Syste...



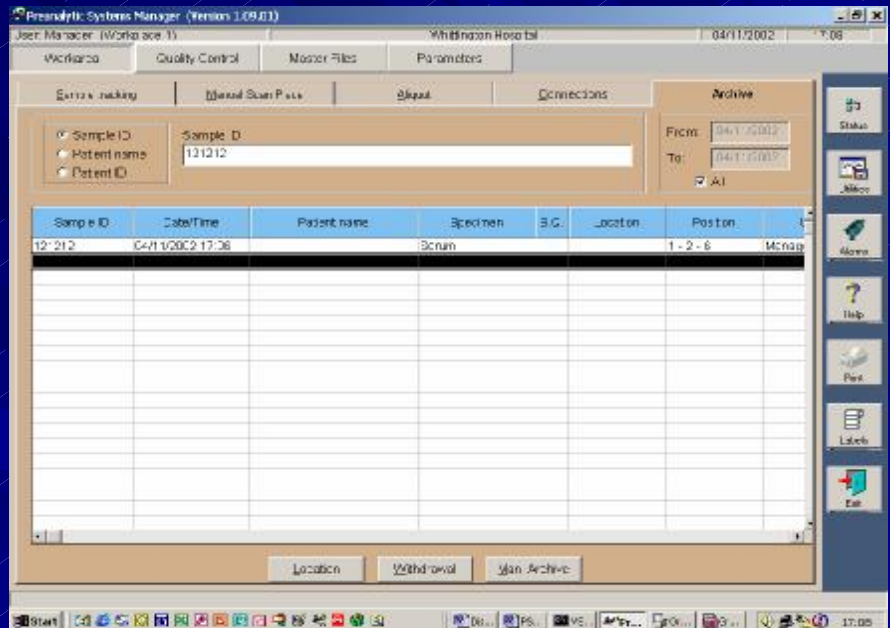
- Status
- Utilities
- Alarms
- Help
- Print
- Labels
- Exit

# MPA and Sample Archiving.

All samples are automatically archived centrally using the MPA. Outstanding tests are presented to the relevant analyser. Labelled bar-coded tubes are prepared at this time. The archive location is recorded so that samples can easily be retrieved.

## Advantages:

There is no need to pre-sort or aliquot most samples which require additional tests from the other laboratories. All samples can be found quickly.



# Potential Pitfalls

# Locally developed enhancements

- ODEPS
- E Aliquots
- P Aliquots
- Enhance Archiving

Save serum for long term storage e.g. Trials,  
police samples & clinical interest samples

# Requests received that are carried out in other departments

Previously....

Manually aliquot sample and write out a copy request form for the other department.

Now....

1. Book sample in for a dummy test (ODEP)
2. Generate a result form printed in reception, this is configured in such a way to be used as a copy request form
3. MPA generates offline aliquot
4. Aliquot & form are matched

## Problem....

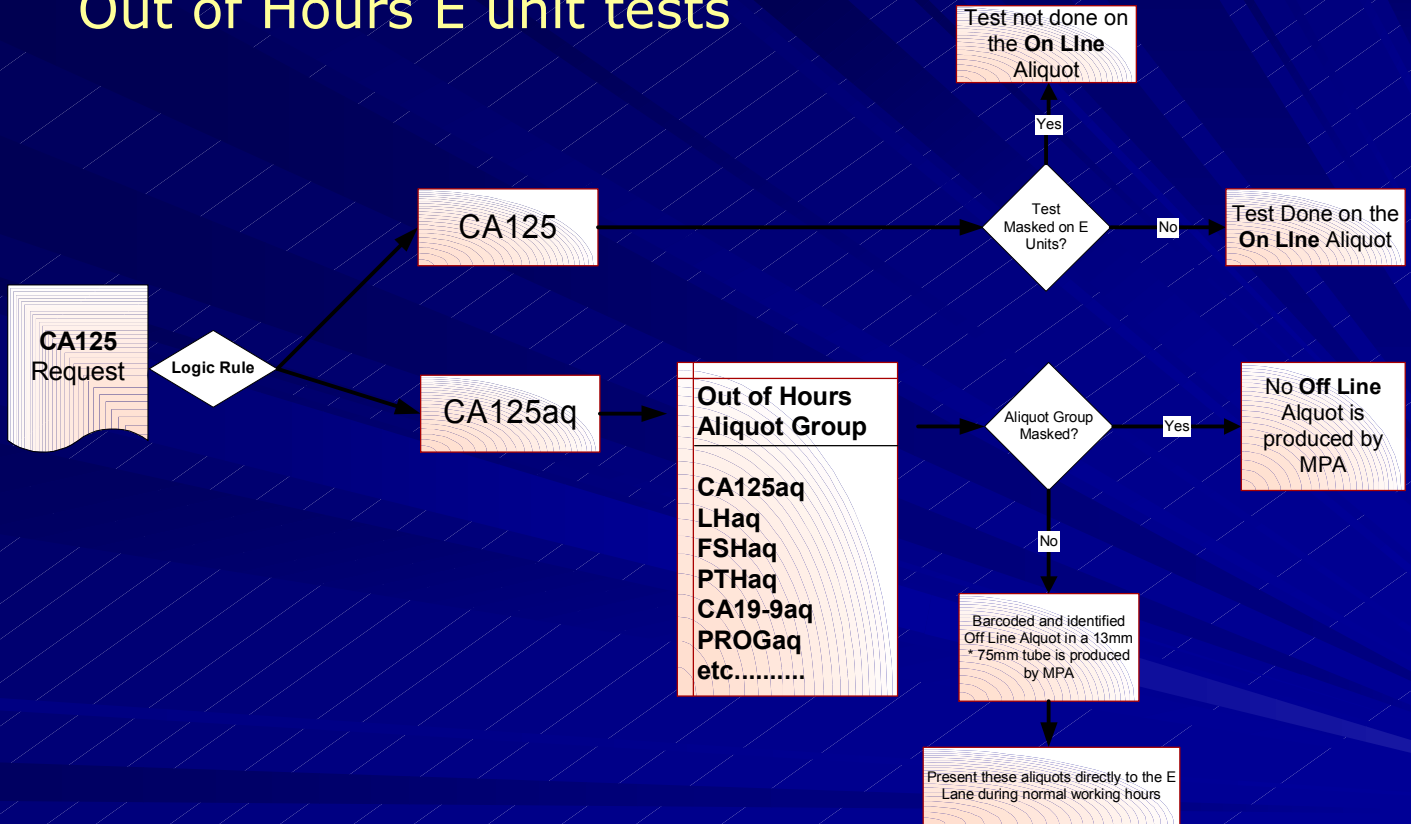
If you present a sample to a MPA/PPP/EE platform via MPA on a 24/7 basis , how do you handle requests for high cost/low throughput tests that you may not want to do at (say) 3am.

E.g. Ca125

Solution ...

You get MPA to make E lane out of hours aliquots

# Out of Hours E unit tests



# P Chemistry Aliquot Group

Properties: Normally Empty, Never Masked

## Problem.

You are running out of a small throughput reagent but you don't want to stop running

## Solution

Create a priority rule

e.g. If Test - {PHENOBARB} add {P Chemistry aliquot group}

# Enhanced Archiving

## Problem:

You need to save and archive a sample longer than your routine period

## Solution:

Create a dummy test e.g “freezer” and give it a sample type that allows archiving of the same sample number in different rack locations.

So, if eg you have a trial sample:

- You present to MPA as usual,
- It is analysed on line and the primary sample is archived
- It now also creates an off line aliquot for freezer that allows a 2nd manual archive position for the aliquot

# Operational Benefits

- Health & Safety
- Fewer Errors
- Far less stress
- Far less telephone calls (Virtuous Circle)
- Fast Turnaround Times
  - Troponin 1.20
  - A&E - 59 Mins
- Significant BMS/BSW staff resource gain has enabled new tasks

*e.g Audit, Point of care, Training, Quality management*

## PSM and the MPA has streamlined the work of the laboratory

- The management of sample handling is simple allowing us to offer only core tests on the satellite sites
- Sample tracking is no longer a nightmare.
- The quality of labelling on secondary tubes is vastly improved.
- Re-routing of samples to other sites if individual modules breakdown is simplified.
- QC can quickly be monitored locally and centrally - performance of all modules can easily be compared.
- Technical validation including QC performance prevents poor quality results reaching the host computer system.

# Future Developments

# The PSM Network

Swansea NHS Trust

BroMorgannwg NHS Trust

**Communications Key:**

- Broadcast
- Host Query
- Result Transmission

Patient details and analysis request entered onto Swansea NHS Trust LIS

Patient details and analysis request entered onto BroMorgannwg NHS Trust LIS

**MasterLab LIS**

**TelePath LIS**

**PSM server**

**PSM server**

Pre Analytical Modules  
Analytical Modules

Analytical Modules  
Analytical Modules

Analytical Modules

**Morrison Hospital**

**Singleton Hospital**

**Neath Port Talbot Hospital**

**Princess of Wales Hospital Bridgend**

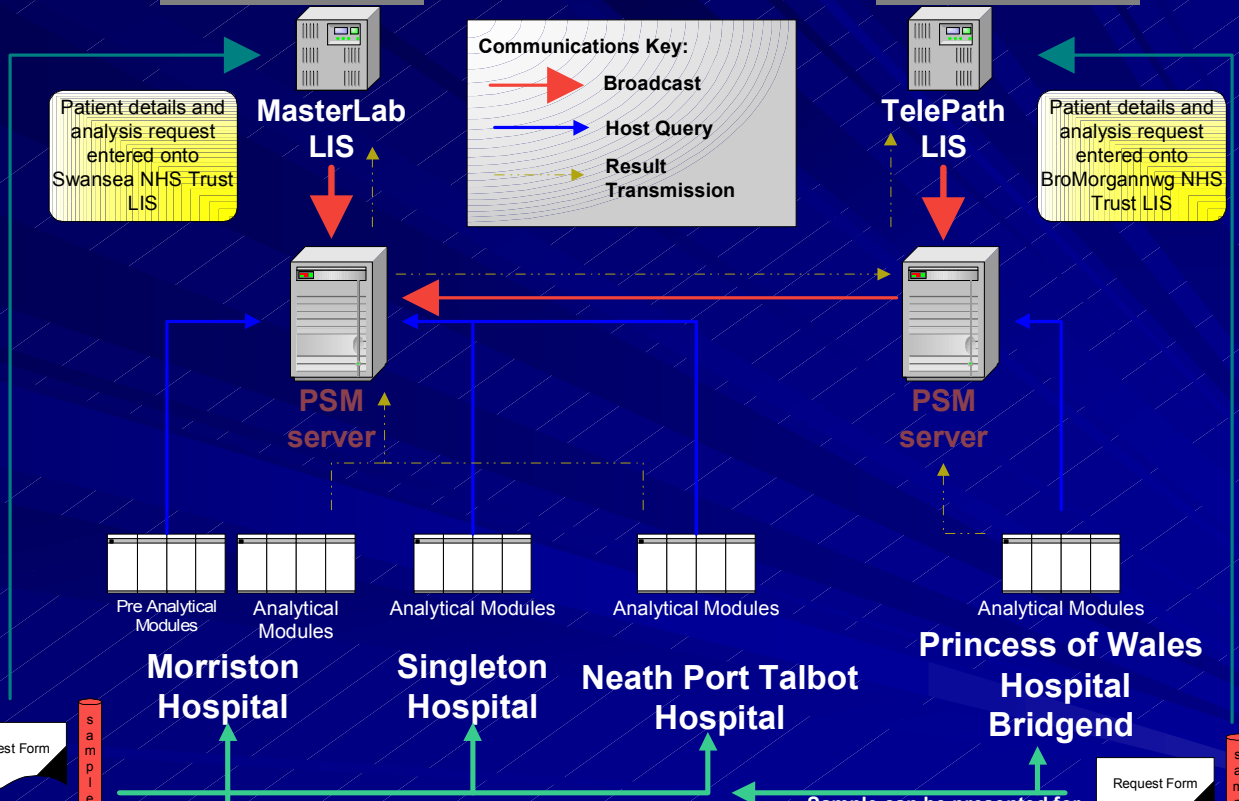
Request Form  
sample

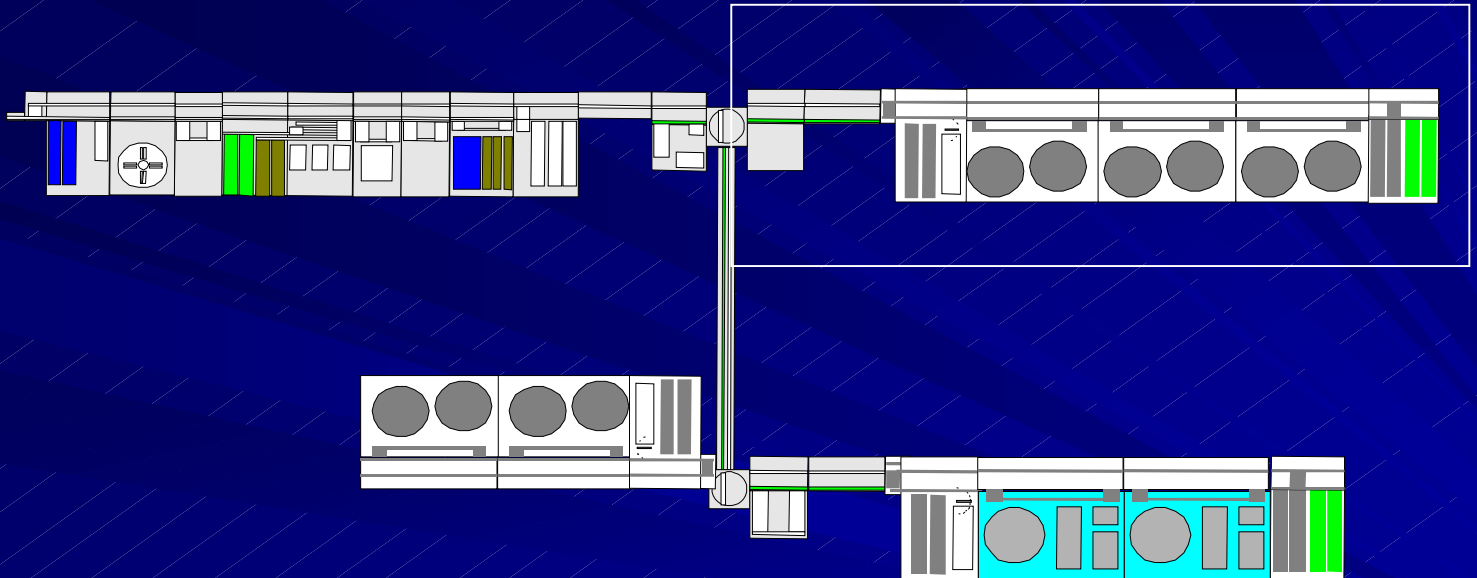
Request Form  
sample

Patient request form & sample are assigned a unique Lab number

Sample can be presented for analysis on any site. The analyser will then perform a host/query of PSM

Sample can be presented for analysis on any Swansea NHS Trust site. The analyser will then perform a host/query of PSM





New Equipment Configuration at Morriston

## Establishment of a Regional Clinical Chemistry service

