lemoene smit · LIMS analyst & Project manager

Web based Open Source LIMS for health care laboratories

bi:ka Zulu trad: to report, from clan to clan, bring news of weddings, births, festivals and funerals
Presenting

Professional Open Source
Bika Community
Bio-Informatics requirements
Bika Health functionality
Roadmap
POSS - Professional Open Source Software

Used by FireFox, MySQL etc.
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Used by FireFox, MySQL etc.

Enthusiastic user community

Sponsors · Fee paying clients

Professional service providers
POSS - Professional Open Source Software

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Enthusiastic user community

Sponsors · Fee paying clients

Professional service providers

Participants work towards their own goals, benefiting all
POSS - Professional Open Source Software
Used by FireFox, MySQL etc.

Enthusiastic user community
Bug reports · Feature requests · Translations · Code

Sponsors · Fee paying clients
Major new developments · No licenses to pay

Professional service providers
Aggregate · Merge · Develop · Maintain

All contribute to LIMS design and testing

Participants work towards their own goals, benefiting all
12 Years of Professional Open Source LIMS
12 Years of Professional Open Source LIMS
65,000+ Downloads
380 Subscribers in community
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Universal LIMS
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Universal LIMS

Branches

Inter-laboratory proficiency testing
12 Years of Professional Open Source LIMS
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Universal LIMS

Branches

Inter-laboratory proficiency testing

Water quality management
12 Years of Professional Open Source LIMS
65,000+ Downloads
380 Subscribers in community

Universal LIMS

Branches
- bika_interlab
  - Inter-laboratory proficiency testing
- bika_water
  - Water quality management
- bika_health
  - Health care
Professional Services

Community Services
Professional Services

Implementations
✓ LIMS Analysis & Design
✓ Customisations
✓ Installations
✓ Configuration & Set-up
✓ Training

Community Services
Professional Services

Implementations
- LIMS Analysis & Design
- Customisations
- Installations
- Configuration & Set-up
- Training

Support
- Systems administration
- User and Technical support
  - On-line issue trackers
  - Remote inspection
  - Email and telephonic

Community Services
Professional Services

Implementations
- LIMS Analysis & Design
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Support
- Systems administration
- User and Technical support
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- Email and telephonic

Community Services
Infrastructure - Code repositories · Forums
- Knowledge centres
- User manual
In a Nutshell, Bika Open Source LIS/LIMS...

... has had 5,873 commits made by 29 contributors representing 717,534 lines of code

... is mostly written in Python with an average number of source code comments

... has a well established, mature codebase maintained by a large development team with decreasing Y-O-Y commits

... took an estimated 195 years of effort (COCOMO model) starting with its first commit in August, 2005 ending with its most recent commit 8 days ago
Client Sponsors

Agriculture · Environmental Bio-informatics · Food and beverages Inter-laboratory proficiency testing Water quality · Health
Client Sponsors

Agriculture · Environmental
Bio-informatics · Food and beverages
Inter-laboratory proficiency testing
Water quality · Health
Client Sponsors
Agriculture · Environmental
Bio-informatics · Food and beverages
Inter-laboratory proficiency testing
Water quality · Health

Your logo
HERE
Open Source Platform

Programming language preferred by Google, Yahoo, Shuttleworth, Disney
Open Source Platform

Programming language preferred by Google, Yahoo, Shuttleworth, Disney

ZOPE, Web application server
Open Source Platform

Programming language preferred by Google, Yahoo, Shuttleworth, Disney

ZOPE
Web application server

Plone
Content management framework

Used by eBay, Nokia, Motorola, many governments and universities, NASA, NATO and more
Open Source Platform

Programming language preferred by Google, Yahoo, Shuttleworth, Disney

ZOPE Web application server

Plone Content management framework

Used by eBay, Nokia, Motorola, many governments and universities, NASA, NATO and more

No license fees · Big supporting communities
Open Source Platform

Platform independent
Ubuntu & FreeBSD preferred

PostgreSQL
MySQL
Content Mirror

ZOBD
Webscale Edition

ubuntu
FreeBSD
Open Source Platform

Platform independent
Ubuntu & FreeBSD preferred
Open Source Platform

PostgreSQL

MySQL

Content Mirror

ZODB
Webscale Edition

Platform independent
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498 Of the fastest 500 super computers run Linux (Forbes)

65% of all web servers (Netcraft.com)

Microsoft

Oracle
Network

Secured by state of the art industrial strength Unix firewall and DMZ
Security

- SSH for sys admin, housekeeping
- HTTP (port 80) exposed
- Unix firewall
- ftp/rsync/CIFS to network storage

Site encryption and digital certification if required
Password expiry
Auto log-off
Hardware
Entry level server dedicated to LIMS
Back-up server recommended

Backups
Hourly incremental to network storage
Weekly, monthly off-site per IT Dept policy

Test LIMS instance
Acceptance testing
On-going training
LIMS Benefit areas

Process automation
Barcoding and labelling
Instrument integration
Interfaces with enterprise systems
Reporting and data retrieval
LIMS Benefits

- Dramatically improved capacity
- Improved turnaround times (TAT)
- Higher accuracy
- Higher levels of certainty
- Traceability and accountability
LIMS Benefits

- Data at your finger tips
- Interfaces with other departments
- Track Productivity
- Enhance Quality Control
- Low cost of reporting
- Less paper

Continued...
Web-based Benefits

✔ Even higher capacity
✔ Dramatically improved TAT
✔ High client satisfaction
✔ Central Web Content Management
✔ Easy installation
  Users require browsers only
✔ Lower systems administration costs
Web-based Benefits

- Lower hardware requirement
- Ease of access
- Ease of use
- Geographically distributed deployment

Users require browsers only

Multiple sites

Easy translation

- English: 100%
- Portuguese (Brazil): 97%
- Spanish: 93%
- Afrikaans: 93%
- Catalan: 74%
- Spanish (Peru): 71%
- Polish: 70%
- Chinese: 64%
- German: 55%
- Turkish (Turkey): 52%
Open Source Benefits

✔ Lower hardware and sys admin costs
✔ No annual license fees
✔ Unlimited users
✔ Best of Breed designs
✔ No vendor lock in. No fixed upgrade cycle
✔ Customisation
How does it work?
BioBank Management System

Kit Assembly and Distribution
- Patients' EMR
- Patient Consent
- Shipping
- Sample Storage
- Cell line management
- Lab management. LIMS
- Sequencing
- Document management
- Accounts. Supplies. HR. ERP
- Data mining
- Others to come...

Shared DB or Standardised Data Bus

HL7 HIPAA...
LIMS as BioBank Management System

Phase I - LIMS based
- Kit Assembly and Distribution
- Patient MDS*
- Patient Consent
- Shipping
- Sample Storage
- Lab management
- LIMS Document management
- Invoicing

Phase II
- Patients
- EMR
- Cell Lines
- Sequencing
- Data mining
- Accounts
- HR
- ERP
- Others to come...

*MDS - Minimum Data Set
Gaps

Sample storage and inventory management

Screenshot courtesy of FreezerPro
Gaps

Request And Ordering

Shipping And Tracking

Protocol Management

Data Retrieval And Reporting

Programmatic Access (API)

Icons courtesy of caTissue - OpenSpecimen
The Knowledge Centre will be updated regularly with helpful information relating to the LIMS and lab information and should be contributed to by lab staff too. Not only can it be use to collect LIMS reference manuals, training videos, 'how to' documentation, FAQs - frequently asked questions, glossary of terms and helpful internet resources, but also SOPs, Safety documentation, material data sheets, accreditation information, etc.

Feed for all documentation.

<table>
<thead>
<tr>
<th>Latest Reference Manuals</th>
<th>Latest SOPs</th>
<th>Latest Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Bika 3 User manual" /></td>
<td><img src="image" alt="Protocolpedia" /></td>
<td><img src="image" alt="CFA - Continuous Flow Analysis" /></td>
</tr>
<tr>
<td>16 Oct 2011</td>
<td>29 Dec 2011</td>
<td>17 Dec 2011</td>
</tr>
<tr>
<td>All 1 Reference Manuals...</td>
<td><img src="image" alt="Estimation of time for bacteria growth" /></td>
<td>All 1 Analysis...</td>
</tr>
<tr>
<td></td>
<td>29 Dec 2011</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Latest Accreditation</th>
<th>Latest Glossary</th>
<th>Latest How-tos</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="ISO 17025 at ISO.org" /></td>
<td><img src="image" alt="ISO/IEC 17025" /></td>
<td><img src="image" alt="How to get system issues attended to fast" /></td>
</tr>
<tr>
<td><img src="image" alt="Interlab PT resources" /></td>
<td><img src="image" alt="PT - Proficiency Testing" /></td>
<td>All 1 How-tos...</td>
</tr>
<tr>
<td>16 Oct 2011</td>
<td>16 Oct 2011</td>
<td></td>
</tr>
</tbody>
</table>
Case study: Caribbean Public Health Agency (CARPHA)

- 5 Caribbean Regional Health Institutes
- Provides services to 21 member countries
- Laboratory services
  Bacteriology, Virology, Parasitology, Molecular biology, Immunology, Serology, Mycology, Antibiotic resistance, Clinical Chemistry
- Surveillance and health analysis
  NCDs, disease outbreaks, water quality, environmental health, ...

http://carpha.org
http://lims.carpha.org
Clinical cases management

And...
- Medical history
- Immunization
- Drug history
- Travel history
Clinical cases management

**Pop-up selectors on search boxes**

### Provisional diagnosis

<table>
<thead>
<tr>
<th>Code</th>
<th>Provisional diagnosis</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>785.50</td>
<td>Shock NOS</td>
<td>Shock, unspecified</td>
</tr>
<tr>
<td>785.59</td>
<td>Shock w/o trauma NEC</td>
<td>Other shock without mention of trauma</td>
</tr>
<tr>
<td>783.43</td>
<td>Short stature</td>
<td>Short stature</td>
</tr>
<tr>
<td>786.05</td>
<td>Shortness of breath</td>
<td>Shortness of breath</td>
</tr>
<tr>
<td>782.0</td>
<td>Skin sensation disturb</td>
<td>Disturbance of skin sensation</td>
</tr>
<tr>
<td>780.57</td>
<td>Sleep apnea NOS</td>
<td>Unspecified sleep apnea</td>
</tr>
</tbody>
</table>

**Case status**
- [ ] Outbreak
- [x] Single case
- [ ] Survey
- [ ] Unknown

**Case outcome**
- [ ] Died
- [ ] Discharged
- [x] Hospitalized

**Signs and Symptoms**
- [ ] Aetiologic agent

And compliant with the International Classification of Diseases (ICD-9)
Can also be used with anonymous patients
<table>
<thead>
<tr>
<th>Doctor ID</th>
<th>Full Name</th>
<th>Email Address</th>
<th>Business Phone</th>
<th>Mobile Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>D013</td>
<td>Anabel Romero</td>
<td><a href="mailto:anabel@example.com">anabel@example.com</a></td>
<td>+27-21-5429321</td>
<td>+27-82-4245178</td>
</tr>
<tr>
<td>D001</td>
<td>Antonio Díaz</td>
<td><a href="mailto:antonio@example.com">antonio@example.com</a></td>
<td>+27-21-6512024</td>
<td>+27-82-5954193</td>
</tr>
<tr>
<td>D002</td>
<td>Armando Castro</td>
<td><a href="mailto:armando@example.com">armando@example.com</a></td>
<td>+27-21-6196808</td>
<td>+27-82-6276842</td>
</tr>
<tr>
<td>D011</td>
<td>Efua Tshabala</td>
<td><a href="mailto:efua@example.com">efua@example.com</a></td>
<td>+27-21-4667796</td>
<td>+27-82-4503448</td>
</tr>
<tr>
<td>D015</td>
<td>Flavia Silva</td>
<td><a href="mailto:flavia@example.com">flavia@example.com</a></td>
<td>+27-21-4604522</td>
<td>+27-82-6494721</td>
</tr>
<tr>
<td>D003</td>
<td>Gobind Bargal</td>
<td><a href="mailto:gobind@example.com">gobind@example.com</a></td>
<td>+27-21-6467713</td>
<td>+27-82-6543885</td>
</tr>
<tr>
<td>D004</td>
<td>Ishvara Dwivedi</td>
<td><a href="mailto:ishvara@example.com">ishvara@example.com</a></td>
<td>+27-21-4050354</td>
<td>+27-82-4259073</td>
</tr>
<tr>
<td>D018</td>
<td>Jarita Dang</td>
<td><a href="mailto:jarita@example.com">jarita@example.com</a></td>
<td>+27-21-6222809</td>
<td>+27-82-4575134</td>
</tr>
<tr>
<td>D016</td>
<td>Joy James</td>
<td><a href="mailto:joy@example.com">joy@example.com</a></td>
<td>+27-21-4067392</td>
<td>+27-82-6699524</td>
</tr>
<tr>
<td>D009</td>
<td>Kunal Osman</td>
<td><a href="mailto:kunal@example.com">kunal@example.com</a></td>
<td>+27-21-4332611</td>
<td>+27-82-6678193</td>
</tr>
<tr>
<td>D010</td>
<td>Marcelino Domínguez</td>
<td><a href="mailto:marcelino@example.com">marcelino@example.com</a></td>
<td>+27-21-5033447</td>
<td>+27-82-6735871</td>
</tr>
<tr>
<td>D005</td>
<td>Pablo Méndez</td>
<td><a href="mailto:pablo@example.com">pablo@example.com</a></td>
<td>+27-21-4501617</td>
<td>+27-82-4319976</td>
</tr>
<tr>
<td>D006</td>
<td>Paki Sibiya</td>
<td><a href="mailto:paki@example.com">paki@example.com</a></td>
<td>+27-21-5894776</td>
<td>+27-82-5556742</td>
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<tr>
<td>D019</td>
<td>Rosamaria Riffe</td>
<td><a href="mailto:rosamaria@example.com">rosamaria@example.com</a></td>
<td>+27-21-6972108</td>
<td>+27-82-6098389</td>
</tr>
<tr>
<td>D007</td>
<td>Shasty Inamdar</td>
<td><a href="mailto:shasty@example.com">shasty@example.com</a></td>
<td>+27-21-5941550</td>
<td>+27-82-4992456</td>
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<tr>
<td>D014</td>
<td>Thandiwe Mahlangu</td>
<td><a href="mailto:thandiwe@example.com">thandiwe@example.com</a></td>
<td>+27-21-6899933</td>
<td>+27-82-5023193</td>
</tr>
<tr>
<td>D008</td>
<td>Thembisa Skeyiya</td>
<td><a href="mailto:themba@example.com">themba@example.com</a></td>
<td>+27-21-5220306</td>
<td>+27-82-4424438</td>
</tr>
<tr>
<td>D012</td>
<td>Ushas Parab</td>
<td><a href="mailto:ushas@example.com">ushas@example.com</a></td>
<td>+27-21-5503845</td>
<td>+27-82-5687958</td>
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<tr>
<td>D020</td>
<td>Valentina Núñez</td>
<td><a href="mailto:valentina@example.com">valentina@example.com</a></td>
<td>+27-21-6532166</td>
<td>+27-82-6248444</td>
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<tr>
<td>D021</td>
<td>Vliet Snyman</td>
<td><a href="mailto:VlietSny@example.com">VlietSny@example.com</a></td>
<td>+27-21-5944449</td>
<td>+27-82-6444721</td>
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<tr>
<td>D017</td>
<td>Zola Malahiela</td>
<td><a href="mailto:zola@example.com">zola@example.com</a></td>
<td>+27-21-5670380</td>
<td>+27-82-5619943</td>
</tr>
</tbody>
</table>
Analysis Requests

Request new analyses

- Automatic labelling
- Custom IDs for samples, requests, worksheets, patients, ref. samples, etc.
**Analysis Services**

- Different Analysis Specifications for each Analysis
- Different results type for each analysis: text, numeric, choice, attachment, etc.

<table>
<thead>
<tr>
<th>Service</th>
<th>Category</th>
<th>Keyword</th>
<th>Instrument</th>
<th>Unit</th>
<th>Price</th>
<th>Calculation</th>
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</thead>
<tbody>
<tr>
<td><strong>Bacteriology - Identification</strong></td>
<td></td>
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<tr>
<td>E. coli - Serotyping</td>
<td>Bacteriology</td>
<td>Serology</td>
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<tr>
<td>H. influenzae - Biotyping</td>
<td>Bacteriology</td>
<td>Serology</td>
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<td>H. influenzae - Serotyping</td>
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<td>Leptospira - IgM</td>
<td>Bacteriology</td>
<td>Serology</td>
<td>iMark Microplate Absorbence Reader</td>
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<td>N. meningitidis - Serotyping</td>
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<td><strong>Entomology - Resistance Testing</strong></td>
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<td><strong>Entomology - Species Identification</strong></td>
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<td>Parasitology - Identification</td>
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</tr>
</tbody>
</table>

[Deactivate] [Duplicate]
Calculations

Edit AST - Disk Diffusion (v1)

Description

Calculation

Calculation Interim Fields
Define interim fields such as vessel mass, dilution factors, should your calculation require them. The field title specified here will be used as column headers and field descriptors where the interim fields are displayed.

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Field Title</th>
<th>Default value</th>
<th>Unit</th>
<th>Hidden Field</th>
<th>delete</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWER_LIMIT</td>
<td>LOWER LIMIT</td>
<td>0</td>
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<tr>
<td>UPPER_LIMIT</td>
<td>UPPER LIMIT</td>
<td>100</td>
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<tr>
<td>DIAMETER</td>
<td>Diameter</td>
<td>0</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

More

Calculation Formula
The formula you type here will be dynamically calculated when an analysis using this calculation is displayed.

To enter a Calculation, use standard maths operators, + - * / (), and all keywords available, both from other Analysis Services and the Interim Fields specified here, as variables. Enclose them in square brackets [ ].

E.g., the calculation for Total Hardness, the total of Calcium (ppm) and Magnesium (ppm) ions in water, is entered as [Ca] + [Mg], where Ca and Mg are the keywords for those two Analysis Services.

```
[DIA> [LOWER LIMIT] and "Resistant" or ([DIA] > [LOWER LIMIT] and [DIA] < [UPPER LIMIT]) and "Intermediate" or ([DIA] >= [UPPER LIMIT] and "Sensitive"
```
Preservations

- Allows to activate or deactivate a sample preservations workflow
- In-lab or out-lab sampling workflow

<table>
<thead>
<tr>
<th>Preservation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient</td>
<td>Room Temperature</td>
</tr>
<tr>
<td>Frozen -20 °C</td>
<td>-20 °C</td>
</tr>
<tr>
<td>Frozen -70 °C</td>
<td>-70 °C</td>
</tr>
<tr>
<td>Incubation</td>
<td></td>
</tr>
<tr>
<td>Incubation with CO2</td>
<td></td>
</tr>
<tr>
<td>Refrigerated</td>
<td></td>
</tr>
</tbody>
</table>

**Edit Frozen -70 °C**

**Title**

**Frozen -70 °C**

**Description**

Used in item listings and search results.

70°C

**Preservation Category**

- Field Preservation
- Lab Preservation

**Retention Period**

Once preserved, the specimen must be disposed of within this time period. If not specified, the specimen type retention period will be used.

Days [182] Hours [0] Minutes [0]

[Save] [Cancel]
Containers

- Specific containers for each Sample Type and analysis
- Integration with the samples preservation workflow
<table>
<thead>
<tr>
<th>Client</th>
<th>ID</th>
<th>Category</th>
<th>Analysis</th>
<th>Date Received</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zola Budd Chest Clinic</td>
<td>ZBC-1001</td>
<td>Bacteriology - Identification</td>
<td>Bacterial Identification</td>
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### Results capture

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<th>Factor</th>
<th>Result</th>
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- Additional remarks field for each analysis
- QC Samples: duplicates, control samples and blank samples
Results capture - Gap

Pre-analysis workflow steps:
1. Sample Separation
2. Nucleic Acid Extraction
3. Amplification (PCR)
## Micro-Biology

### Bacterial Identification

<table>
<thead>
<tr>
<th>Microbiology</th>
<th>Bacterial Identification</th>
<th>LEAF14-001-P1</th>
<th>Clostridium perfringens</th>
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<th>Enterococcus - Penicillin sensitivity</th>
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**Remarks**

**Sensitivity and Susceptibility Testing**

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<th>AST Disk Diffusion</th>
<th>Manual</th>
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Export and Import to and from Instrument

Results Capture

Analyst

Instrument

Export

Select an output form

Data-Collector

FIAS Star

Winescan FT120

Winescan Auto

Import instrument data

Select an input format

Data-Collector

Select instrument data file

import

Export

Log

Analyst

Blank Titrator

Assigned

Add Blank

Add Control

Add Duplicate

Export

Results Capture

Model
Results attachments
### Results verification

You are here: Home › Worksheets › WS13-0052

**Manage Results** Log **State:** Verified

**Warning** Some results exceeded the panic levels that may indicate an imminent life-threatening condition.

![WS13-0052](image)

**Attachments**

**Analyst** Jean Martin  **Instrument** LC MS Triple Quad

<table>
<thead>
<tr>
<th>Position</th>
<th>Analysis</th>
<th>Method</th>
<th>Final Conc</th>
<th>Factor</th>
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- **Life-threatening conditions alert and automatic email notification to labmanager, doctor**
- **Minimum Detection Levels, out-of-range values, % error**
Quality Control

AA 1
Internal Calibration Tests

Reference standard graphs
4 Bika Health Overview · Results reports publication
Other features

Logs · CLIA compliance
Reference Standards
Specifications · Aliquots
Invoices · Exports to financial systems
Price lists
Queries · Quick search
Management reports
Results invalidation workflow

Android Tablet Interface
ERP Interface
Sampling Rounds
Bulk AR Creation
Road map
How deep are your pockets?

Gaob LIMS 3.2 · Health 3.2 · Interlab 2.1

Planned new modules

Inventory and supply chain management
Instrument Server
Sample Storage
Surveys
Work Picklists
Universal Data Bus
Thank you for the opportunity to present Bika Health

Professional Open Source
Bika Community
Web-based · CMS
Functionality and BioInformatics
Roadmap