REDESIGNING A BASIC LABORATORY INFORMATION SYSTEM FOR THE GLOBAL SOUTH

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Introduction | Past Environment

• In the past, computing resources available to hospitals in the global south were very limited.

> 1,000,000

Patients

A paper-based system in the UCH in Nigeria
Introduction | What Happens Now

- The access to information and communication technologies has grown rapidly across hospitals in Africa in recent times.

Introduction | What Happens Now

• Digital Devices Owned by Nurses

Data Source: Adedeji a. "Factors influencing the use of electronic health records among nurses in a teaching hospital in Nigeria"
Introduction | The Gap Today

• Users in the global south **aspire to embrace mobile devices in clinical settings**.

• Most of the **available open source lab information system (LIS)** are web applications.

• Can these be **accessed easily** using a web browser across all devices?

• **No.** Devices vary in screen sizes and input methods.
Introduction | Is The Gap Critical?

• In fact, it makes medical professionals less efficient and less productive.

• It is estimated that Africa, which has 11% of the world’s population, carries 22% of the global disease burden and more than 1.5 million additional health workers are needed to resolve the human resource shortage.

C4G BLIS | Overview

- C4G BLIS is an open-source web-based system to track patients, specimens and laboratory results.

C4G BLIS | Overview

• Developers: **Georgia Tech**, Centers for Disease Control and Prevention (**CDC**) in the United States, and **Ministries of Health** of several countries in **Africa** since 2010.

• Three key features: 1) **Robustness** 2) **Fully configurable and customizable workflow** 3) **Flexible database**.

• For more information, please refer to [http://blis.cc.gatech.edu](http://blis.cc.gatech.edu)
Past user studies have confirmed that C4G BLIS is very effective in terms of error reduction and workload reduction.
C4G BLIS | Deployment

- 8 Countries and more than 100 hospitals
C4G BLIS | Our Goal

- **Redesign** C4G BLIS to meet the emerging demands of the LIS communities
- **Evaluate** the improvement with **actual users in three African countries**
- **Share the lessons learned** with the standard enactment community.
C4G BLIS | Interface Issues #1

Welcome, testlab1_tech1.

The Basic Laboratory Information System (BLIS) tracks patient specimens and laboratory results.

Tips
You can update your profile and password by clicking on Edit Profile.
C4G BLIS | Improvement #1

Welcome!

Jung Wook Park (Lab Technicians)

The Basic Laboratory Information System (BLIS) tracks patient specimens and laboratory results.

Tips

You can update your profile and password by clicking on your profile in the top-right side of the page.
C4G BLIS | Interface Issues #2
C4G BLIS | Improvement - #2

Registration

Patient Look-up

Search Fields

Patient Name: James

Results

<table>
<thead>
<tr>
<th>PATIENT NUMBER</th>
<th>PATIENT ID</th>
<th>NAME</th>
<th>GENDER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17593</td>
<td>Carlson Limited</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>03443</td>
<td>Abdul Lawson</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>11508</td>
<td>Abel Green</td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>08940</td>
<td>Abra King</td>
<td>Female</td>
</tr>
</tbody>
</table>

Tips

1. Please search a patient by entering his/her name, ID, number or barcode.
2. If you cannot find him/her in the list, you can add him/her by clicking the button below.
C4G BLIS | Mobile Support

- A responsive UI framework, which supports various screen sizes and resolutions.
User Study | Structure

<table>
<thead>
<tr>
<th>User Study</th>
<th>Device</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 1 – Current Interface</td>
<td>Desktop</td>
<td>Smartphone</td>
<td></td>
</tr>
<tr>
<td>(n=30, 17 Weeks)</td>
<td>Desktop</td>
<td>Smartphone</td>
<td></td>
</tr>
<tr>
<td>Study 2 – Proposed Interface</td>
<td>Desktop</td>
<td>Smartphone</td>
<td></td>
</tr>
<tr>
<td>(n=21, 7 Weeks)</td>
<td>Desktop</td>
<td>Smartphone</td>
<td></td>
</tr>
<tr>
<td>Task 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Find an existing patient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>using a given name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Find an existing patient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>using a given patient ID</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Register a new patient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>using a given name and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>additional information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e.g., name, age)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
User Study | Tool

- We used an online data logging system, HotJar.
User Study | Results

- The results show that we significantly improved the usability of C4G. (See Table 2 and Figure 7 in our paper)

<table>
<thead>
<tr>
<th>Device</th>
<th>Improvement (Task Processing Time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop</td>
<td>32%</td>
</tr>
<tr>
<td>Smartphone</td>
<td>34%</td>
</tr>
</tbody>
</table>
Discussion | Computing Environments

• There was one dominant operating environment when C4G BLIS was first deployed in May 2010
  – Windows (93%), 1024x768 screen resolution (43%),
  – Internet Explorer (55%) or Firefox (29%) browsers.

• As of May 2019, the most widely used browser in Africa
  – Chrome for Android (35% in the market share)
  – Chrome (Latest version 74.0) is broadly adopted (17.65%)
A system administrator in Cameroon reported that 75% of the participants preferred working with tablets if the screen was large enough, and 25% of them were approved the use of smartphones to access the laboratory data.
Discussion | Interface Standard and Usability

- **Medical data exchange standards** have been considered as **a central issue** of hospital information systems,
  - Health Level Seven (HL7),
  - Clinical Document Architecture (CDA)
  - Continuity of Care Document (CCD)
  - Systematized Nomenclature of Medicine (SNOMED)

- Several studies found that **adopting** such a standard could simplify communication interfaces and **improve the quality of patient care**.
Discussion | Interface Standard and Usability

• The complex interfaces and the lack of intuitiveness causes usability problems. However, this issue has not been treated as necessary in the data exchange standards.

• Usability has a strong, often direct relationship with clinical productivity, error rate, user fatigue and user satisfaction.
Conclusion

• We were able to improve the usability by > 30% by applying a responsive, simple, open-source website framework to the existing LIS. It should not be a challenging task.

• We encourage international standards organizations dealing with health informatics to pay attention to usability standards for information systems.
Thank you