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REDESIGNING A BASIC LABORATORY INFORMATION SYSTEM FOR THE GLOBAL SOUTH

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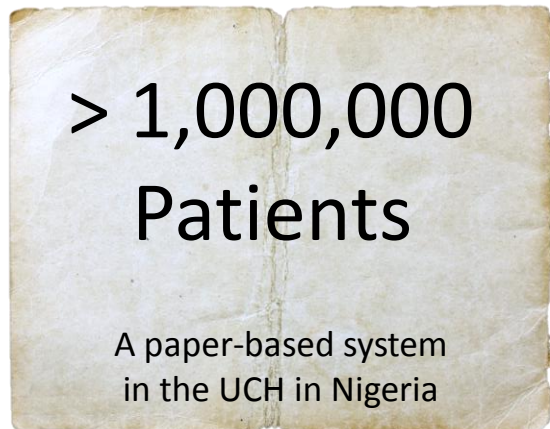
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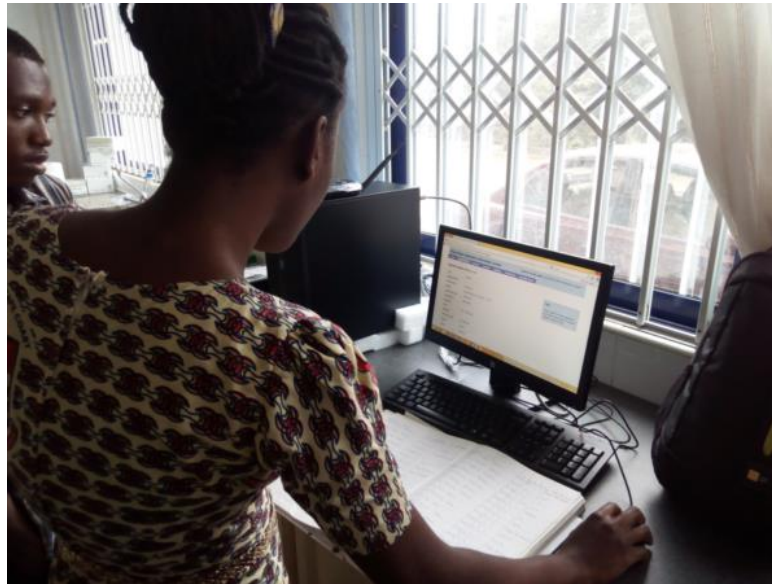
Introduction | Past Environment

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



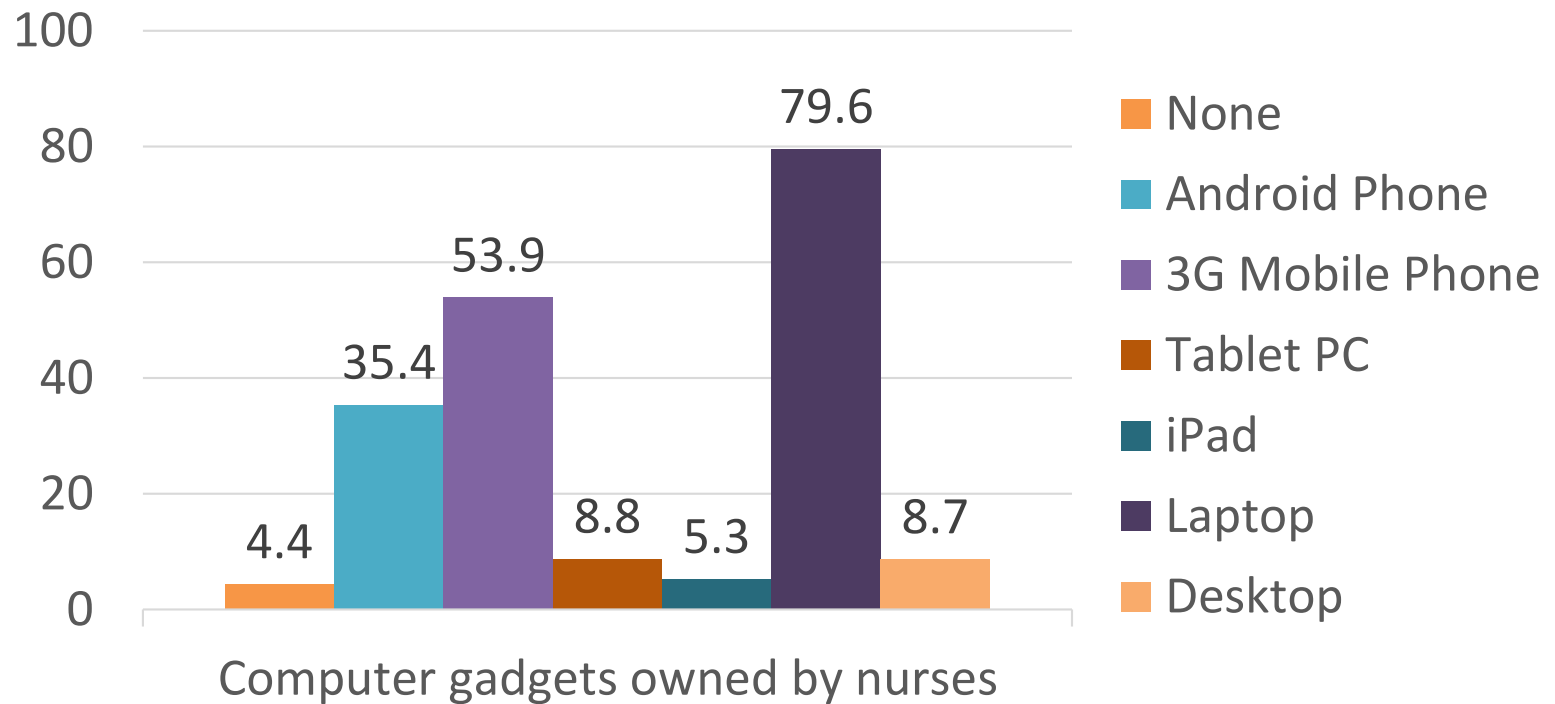
Introduction | What Happens Now

- 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



Introduction | The Gap Today

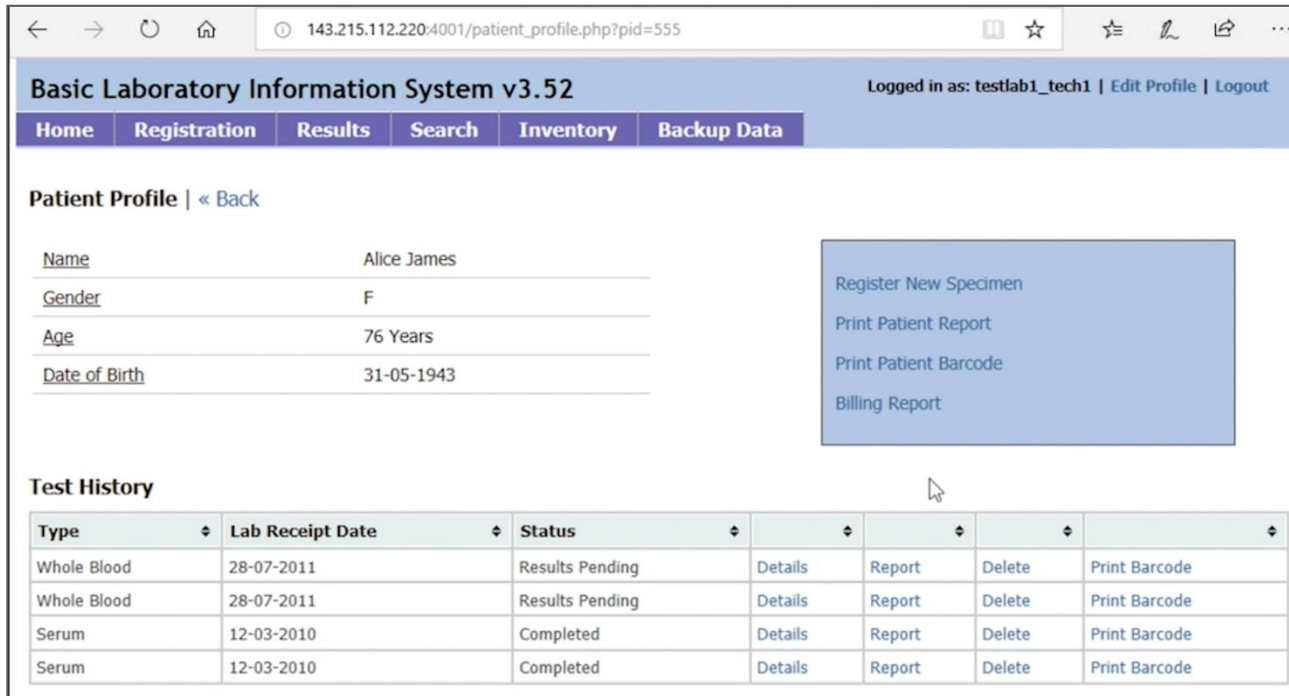
- Users in the global south **aspire to embrace mobile devices in clinical settings.**
- Most of the **available open source lab information system(LIS)** are web applications.
- Can these be **accessed easily** using a web browser across all devices?
- **No.** Devices vary in screen sizes and input 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.



The screenshot displays the C4G BLIS web interface. The browser address bar shows the URL: 143.215.112.220:4001/patient_profile.php?pid=555. The page title is "Basic Laboratory Information System v3.52". The user is logged in as "testlab1_tech1" with options for "Edit Profile" and "Logout". The navigation menu includes "Home", "Registration", "Results", "Search", "Inventory", and "Backup Data".

The "Patient Profile" section shows the following details:

Name	Alice James
Gender	F
Age	76 Years
Date of Birth	31-05-1943

A blue box on the right side of the patient profile contains the following actions:

- Register New Specimen
- Print Patient Report
- Print Patient Barcode
- Billing Report

The "Test History" section contains a table with the following data:

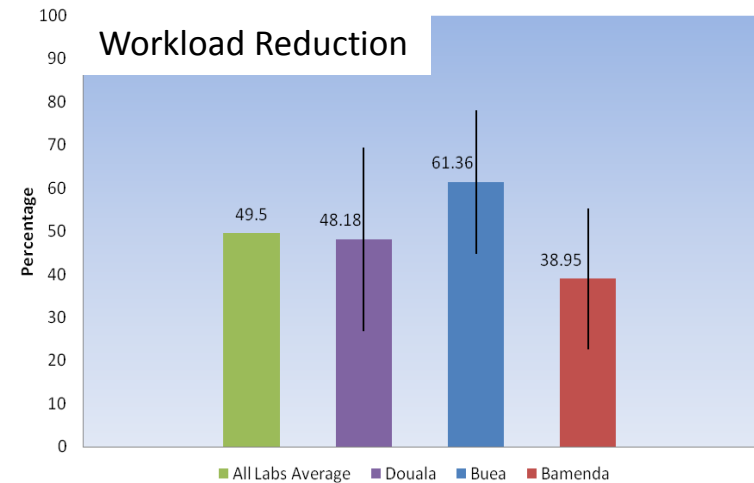
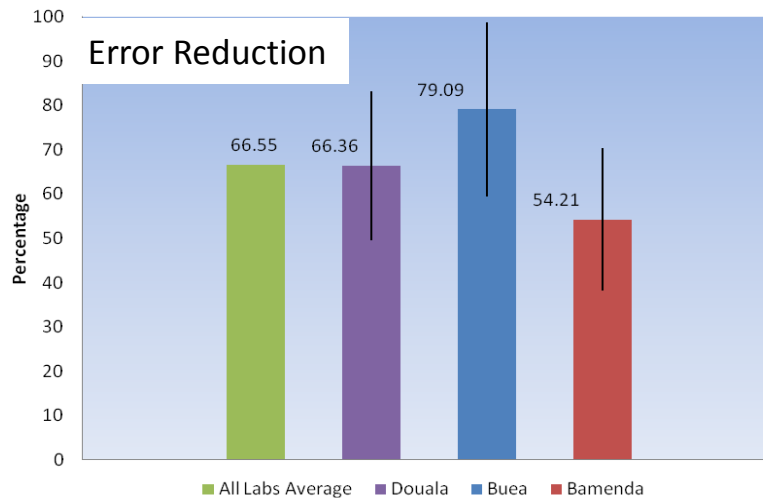
Type	Lab Receipt Date	Status				
Whole Blood	28-07-2011	Results Pending	Details	Report	Delete	Print Barcode
Whole Blood	28-07-2011	Results Pending	Details	Report	Delete	Print Barcode
Serum	12-03-2010	Completed	Details	Report	Delete	Print Barcode
Serum	12-03-2010	Completed	Details	Report	Delete	Print Barcode

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>¹

C4G BLIS | Effectiveness

- 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

← → ↻ 🏠 ⓘ 143.215.112.220:4001/home.php 📄 ☆ ⚙️ 🔍 📄 ⌂ ⋮

Basic Laboratory Information System v3.52 Logged in as: testlab1_tech1 | [Edit Profile](#) | [Logout](#)

[Home](#) [Registration](#) [Results](#) [Search](#) [Inventory](#) [Backup Data](#)

Home

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.

[User Guide](#) | [Comments?](#) | C4G BLIS v3.52 - A joint initiative of C4G @ Georgia Tech, the CDC and participating countries | [English](#) | [Français](#) | [Default](#)

C4G BLIS | Improvement #1

The screenshot shows a web browser window with the URL `jungwook.com/c4gblis/`. The page features a navigation menu with links for Home, Registration, Results, Search, Reports, Inventory, and Backup Data. The main content area is titled "Home" and contains two panels: a "Welcome!" message for Jung Wook Park (Lab Technicians) and a "Tips" section. The footer includes version information and language options.

← → ↻ 🏠 `jungwook.com/c4gblis/` 📖 ☆ ⚙️ 🔍 📄 ⋮

C4G BLIS Jung Wook Park
Lab Technician

🏠 Home 📄 Registration 📄 Results 🔍 Search 📄 Reports 📄 Inventory 📄 Backup Data

Home

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 v3.5. A Joint Initiative of C4G at Georgia Tech, the CDC, and Participating Countries. All rights reserved. User Manual · Feedback · English · Francais · Default

C4G BLIS | Interface Issues #2

The screenshot shows a web browser window with the address bar displaying `143.215.112.220:4001/results_entry.php`. The page title is "Basic Laboratory Information System v3.52" and the user is logged in as "testlab1_tech1". The navigation menu includes "Home", "Registration", "Results", "Search", "Inventory", and "Backup Data". The "Results" menu item is highlighted with a mouse cursor. On the left sidebar, there are links for "Single Specimen Results", "Batch Results", "Verify Results", "Worksheet", and "Lab Section-wise Results". The main content area is titled "Single Specimen Results" and contains a search form with the following fields: "Patient Number" (dropdown), "Contains" (dropdown), a text input field, "Lab Section" (dropdown with "ALL" selected), and a "Search" button. At the bottom of the page, there is a footer with the text: "User Guide | Comments? | C4G BLIS v3.52 - A joint initiative of C4G @ Georgia Tech, the CDC and participating countries | English | Francais | Default".

C4G BLIS | Improvement - #2

The screenshot shows a web browser window with the URL `jungwook.com/c4gblis/registration.html`. The user is logged in as a "Lab Technician". The navigation menu includes Home, Registration, Results, Search, Reports, Inventory, and Backup Data. The "Results" menu is open, showing options: Single Specimen Results, Batch Results, Verify Results, Worksheet, and Lab Section-wise Results. The main content area is titled "Registration" and contains a "Patient Look-up" section with search fields for Patient Name, Conditions, and Input, and a Search button. Below this is a "Results" table with columns for Patient Number, Patient ID, Name, Gender, and action buttons (Register Specimen, View, Update, Delete). A "Tips" box on the right provides instructions on how to search for patients.

Registration

This pages allow us to **Lab Section-wise Results** up existing patients based on name, patient ID or number.

Patient Look-up

Search Fields: Patient Name (dropdown)
Conditions: Contains (dropdown)
Input: James (text field) [Search button]

Results

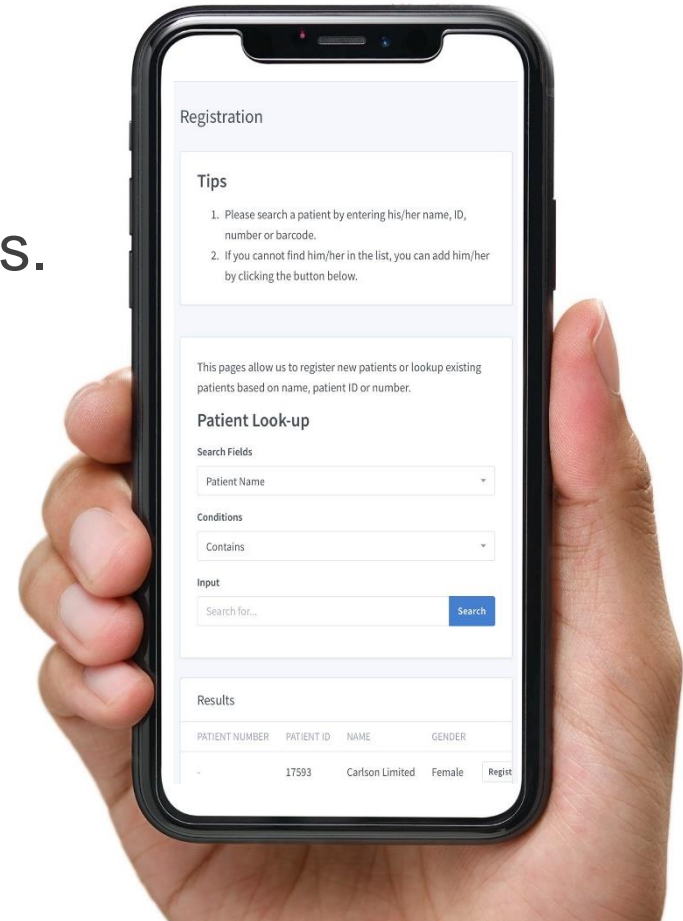
PATIENT NUMBER	PATIENT ID	NAME	GENDER	
-	17593	Carlson Limited	Female	[Register Specimen] [View] [Update] [Delete]
-	03443	Abdul Lawson	Female	[Register Specimen] [View] [Update] [Delete]
-	11508	Abel Green	Male	[Register Specimen] [View] [Update] [Delete]
-	08940	Abra King	Female	[Register Specimen] [View] [Update] [Delete]

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

	User Study			
	Study 1 – Current Interface (n=30, 17 Weeks)		Study 2 – Proposed Interface (n=21, 7 Weeks)	
Device	Desktop	Smartphone	Desktop	Smartphone
Task 1	Find an existing patient using a given name			
Task 2	Find an existing patient using a given patient ID number			
Task 3	Register a new patient using a given name and additional information (e.g., name, age)			

User Study | Tool

- We used an online data logging system, HotJar.

The screenshot displays a web application interface for patient look-up. The main content area is titled "Patient Look-up" and contains a form with fields for "Patient Name", "Contains", and a search button. A heatmap overlay shows a red line indicating the user's path from the search button down to the "View Profile" button. A "Tips" section on the right provides instructions on how to use the page. Below the form is a table with columns for "PATIENT NUMBER", "PATIENT ID", "NAME", and "GENDER". The table contains one row with the name "Adara Nichols" and gender "F". Below the table are buttons for "Register Specimen", "View Profile", "Update Profile", and "Delete Profile". The "View Profile" button is highlighted with a yellow circle. On the right side, there is a "Session Info" and "Notes & Actions" panel. The "Session Info" shows the time "29:34" and the user is logged in as "testlab**_tech**". The "Notes & Actions" panel lists various user actions such as "Clicked: div#headerMenuCollapse>div.co...", "Visited http://35.185.71.143:5001/find_pa...", "Changed: #pq", "Clicked: #psearch_button", "Clicked: table#patientListTable>tbody>tr...", "Visited http://35.185.71.143:5001/patient_...", "Clicked: div#headerMenuCollapse>div.co...", "Visited http://35.185.71.143:5001/find_pa...", "Clicked: #p_attrib", "Clicked: #p_attrib", and "Changed: #p_attrib to """. At the bottom, there is a video player interface with a progress bar and controls.

User Study | Results

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

Device	Improvement (Task Processing Time)
Desktop	32%
Smartphone	34%

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%)

Discussion | Needs in the Near Future

- 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.

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Thank you