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DESIGN OF SCREENING FOR CONGENITAL HYPOTHYROID REGISTRATION AND REPORTING APPLICATION CASE STUDY: M. DJAMIL HOSPITAL

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ABSTRACT

The Congenital Hypothyroid Screening Laboratory of M. Djamil Hospital has problems in recording and reporting Congenital Hypothyroid Screening manually which causes the risk of delays in the administrative process, specimen damage, errors in specimen recording and unintentional data changes. A mixed method study has been conducted with the Analysis, Design, Development, Implementation and Evaluation model approach on the Congenital Hypothyroid Screening registration and reporting system that is currently running with a computerized system. The study began with a qualitative study that formulated a software needs analysis and continued with quantitative research to determine the impact of computerization on the speed of registration and reporting. The average registration and reporting process using the application is 1 minute 40 seconds, which is 6.9 times faster than the manual process, which is 11 minutes 35 seconds. Congenital Hypothyroid Screening data monitoring can be carried out directly by the City/District and Provincial Health Offices; and reduces the risk of data changes. The use of the Congenital Hypothyroid Screening registration and reporting application has restored the role of health facilities in preparing Congenital Hypothyroid Screening specimen data and at the same time freed the Congenital Hypothyroid Screening laboratory from the task of recording specimen data and returning to its role as a Congenital Hypothyroid Screening examiner.

Keywords*: Hypothyroidism, Screening, Report, Record, Application.*

INTRODUCTION

Stunting can cause various negative impacts on a child's development and growth, causing the child to become malnourished, shorter than their peers, and disrupting brain development, which has an impact on the child's intelligence (Ramadanti & Yanti, 2023). There is a relationship between several maternal and infant factors with the occurrence of stunting (Yasril & Sari, 2022). Maternal factors associated with stunting include chronic energy deficiency, maternal body mass index, and premature birth (Elfima, et al., 2024). Growth hormone deficiency is also correlated with the cause of stunted growth (Pramudji, et al., 2021). Children with thyroid disorders have several birth defects and growth hormone deficiency (Wardani & Sulistyono, 2024).

Congenital Hypothyroidism (CH) also affects brain development due to the need for thyroid hormones during pregnancy and the postnatal period (Bernal, 2022) (Uchida & Suzuki, 2021) (Katherine, et al., 2019). Those most associated with hypothyroidism include psychomotor retardation, memory deficits, visuoperceptual skills and constructional dexterity (Heinrich, 2003) (Bortolotto, et al., 2021).

One of the efforts to overcome HC is the CHS (Congenital Hypothyroidism Screening) (Pantiawati, et al., 2024). A screening test that performed when a baby is a few days old to sort out babies who have CH from babies who do not (Yasmin, et al., 2022).

The global prevalence of CH is 1/2000 to 1/4000 live births (Chen, et al., 2013). Research in Portugal reported that CHS had been implemented since 1981 and in 2021 the cumulative incidence of CH was 1/2827 with CHS coverage of 99.5% (Costeira, et al., 2024). CHS coverage in Indonesia is still very low, in 2022 it was recorded that only 2.3% of the total number of babies born were screened. Several challenges occurred in the implementation of CHS. Indonesia has only twelve designated national referral laboratories, a condition that limits the number of samples that can be analyzed each week and further complicates the process with long processing and reporting times (Pulungan, et al., 2024).

The M. Djamil Hospital CHS Laboratory has not been able to facilitate CHS services optimally because CHS recording and reporting which is still manual creates the risk of delays in the administrative process, specimen damage, errors in recording specimens and unintentional data changes.

The purpose of this study is to design a computer-based tool to simplify the CHS registration and reporting process so that time can be shortened. A mixed-method study was conducted using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model approach to the existing CHS recording and reporting system to design a computerized CHS recording and reporting system.

RESEARCH METHODS

This research was conducted at The M. Djamil Hospital CHS Laboratory from February 2024 to April 2024 with a mixed method design, preceded by a qualitative study that formulated an analysis of software needs and followed by a quantitative study to determine the impact of computerization implementation on the speed of CHS registration and reporting. An embedded experimental design with a sequential approach is often chosen when researchers need qualitative data to develop an instrument which is then implemented in a quantitative study (Creswell & Clark, 2007).

This research was carried out using the ADDIE model approach combined with Agile Model Driven Development (AMDD) and systems theory (Rusmajaya, 2021) (Ambler, 2004) (Sadowski, 1999). ADDIE-based system development consists of 5 phases: Analysis, Design, Development, Implementation and Evaluation (Melenda, 2015). The ADDIE model encourages the process of problem discovery, formulating alternative solutions, implementing solutions and evaluating (Shakeel, et al., 2023).

The analysis process was carried out qualitatively to determine the needs for the CHS registration and reporting application. Need analysis involves referrers, examiners and monitors in Focus Group Discussion (FGD) events. The specimen's referrer in this study is the health facility that sends CHS specimens to the CHS laboratory. The examiner in this study was the CHS laboratory which examined CHS specimens. The monitors in this research were the health services: District Health Service and

Provincial Health Service. The analysis process was carried out at the CHS Laboratory of. M. Djamil hospital in February 2024. The results of the FGD in the form of qualitative data were analyzed using the content analysis method.

Qualitative research is a research procedure that produces descriptive data in the form of written or spoken words from people or observed behavior (Rahmadi, 2011). Qualitative research tends to focus on participants or research subjects to obtain meaning from research subjects or participants regarding the issues or problems being studied which do not fully come from the literature (Fahmi, et al., 2022).

Informants in this research were selected using purposive sampling by determining certain characteristics of the research subjects to be studied (Rahmadi, 2011). The characteristics underlying the selection of informants in this qualitative study are directly involved in CHS registration and reporting. The number of informants involved was 6 people consisting of the CHS Manager of the Riau Islands Provincial Health Service, the CHS Manager of the Solok City Health Service, the CHS Manager of the Solok City Health Center, the CHS M. Djamil Hospital Laboratory Administration Officer, the CHS M. Djamil Hospital Laboratory Analyst and the CHS M. Djamil hospital's doctor.

Software design in this research is a process of designing and building tools as an alternative solution to the problem of slow CHS registration and reporting processes. The series of design processes includes the design, development and implementation process in the ADDIE model. Software design in this research is a process of designing and building tools as an alternative solution to the problem of slow CHS registration and reporting processes. The series of design processes includes the design, development and implementation process in the ADDIE model. The result of this process will be ready-to-use CHS registration and reporting application product.

At the design stage, application design begins with the modeling stage which produces activity diagrams, system specification design, business process design and database design. The development stage aims to develop the designs that have been determined at the design stage. Software implementation is the process of integrating applications into an organization's workflow. Once all modules are approved, the code is deployed to the server so that it can be accessed via the internet network.

The evaluation process of this research was carried out with a quantitative study which was intended to determine the length of time for the registration and reporting process of CHS. Samples were randomly selected in the amount of 80 specimens in 1 CHS examination. Quantitative data analysis was conducted by comparing the average time of the specimen numbering process, recording results, validating results and issuing CHS result sheets before and after using the CHS registration and reporting application using the SPSS t-test to determine the effectiveness of using the CHS application on CHS recording and reporting time.

RESULT AND DISCUSSION

Initial Workflow

The absence of a good practical workflow remains a challenge in implementing CHS (Pulungan, et al., 2024) The CHS data flow begins with the specimen data registration process by the Health Facility, followed by registration lab IDs by the CHS Laboratory, recording CHS examination results by the CHS Laboratory and validating the results by CHS laboratory doctors. The validated CHS examination

results are then sent to the district health office within the referring health facility area.

Human resources are a very important aspect in the implementation of (Ahri, et al., 2024). Health care facility personnel play more than one role, for example, both clinical and administrative roles are a challenge for CHS (Pulungan, et al., 2024). Repeated registration of specimens complicates the condition.

The registration of specimen identity data in the patient identity data register book is manually carried out by health facilities when collecting blood specimens from newborn babies which will be examined by CHS before being sent to the CHS laboratory. The identity of the specimen is re-registered when the specimen is received by the CHS laboratory in the CHS examination registration book.

The TSH results after the CHS examination are recorded by the CHS laboratory health analyst in the CHS register book. Validation of results and issuance of CHS report sheets for CHS examination results is carried out after recording the results. Validated results are sent to the district health office. CHS data monitoring is

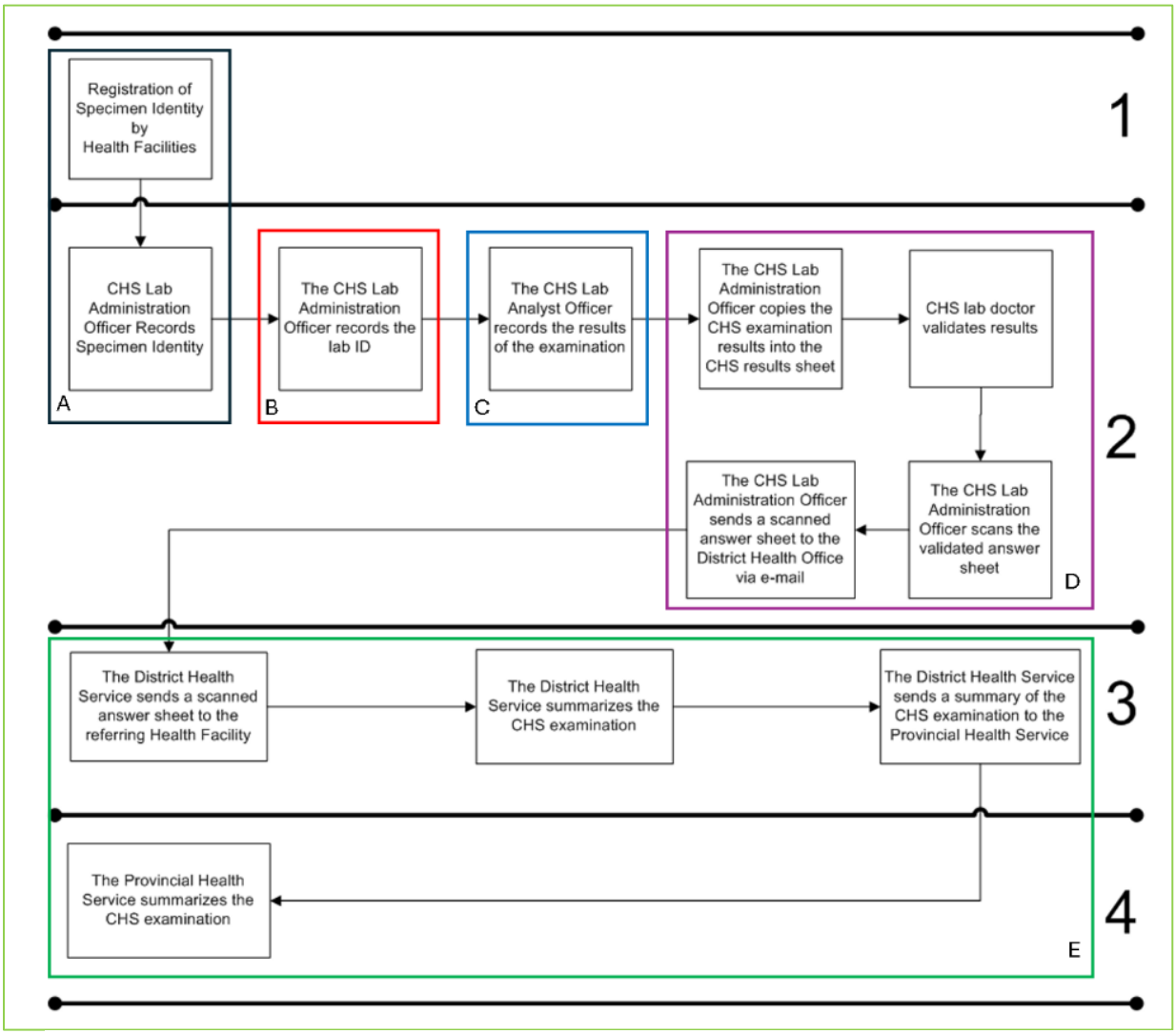


Figure 1. Initial SHK Data Management Workflow

carried out by the district health service and the provincial health service. Positive results are then reported back to the healthcare facility of origin to arrange further tests as needed (Pulungan, et al., 2024).

Figure 1 shows the initial CHS data management workflow.

1. Process carried out by health service facilities.
2. The process is carried out by the CHS laboratory.
3. The process is carried out by the District Health Service.
4. The process is carried out by the Provincial Health Service.

A. CHS Specimen Identity Registration Process
   There was a problem of repeating registration
B. CHS specimen numbering process
   No problems occurred
C. The process of recording CHS results
   No problems occurred
D. CHS results validation process
   There was a problem with ineffective digitalization of documents (copying the results to the answer sheet, scanning the results sheet and sending the results sheet)
E. Monitoring process of CHS data recapitulation
   No problems occurred

I. Use Case Diagram

CHS program involves many stakeholders, and covers several areas, including education, screening, follow-up of results, diagnosis, management, and evaluation (Pulungan, et al., 2024). The business processes that occur in managing CHS data are in the form of registration specimen identity, specimen numbering, recording CHS examination results, validating CHS results and monitoring the recapitulation of CHS examination results. The login process makes each user's display simpler because only the application menu

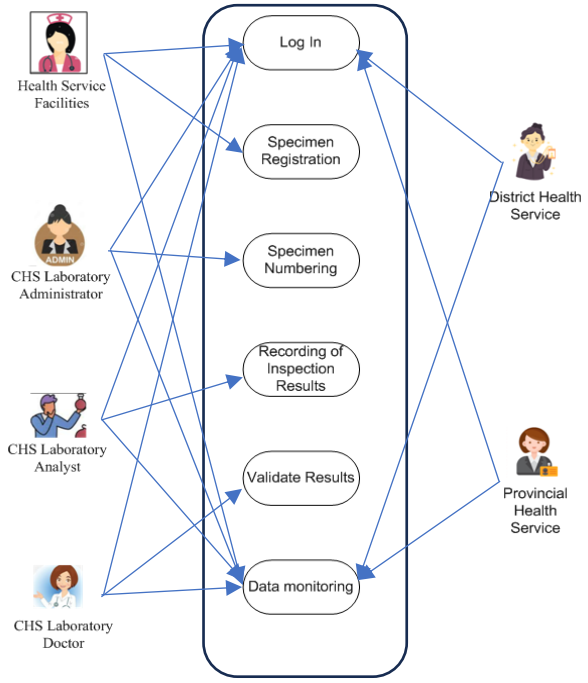
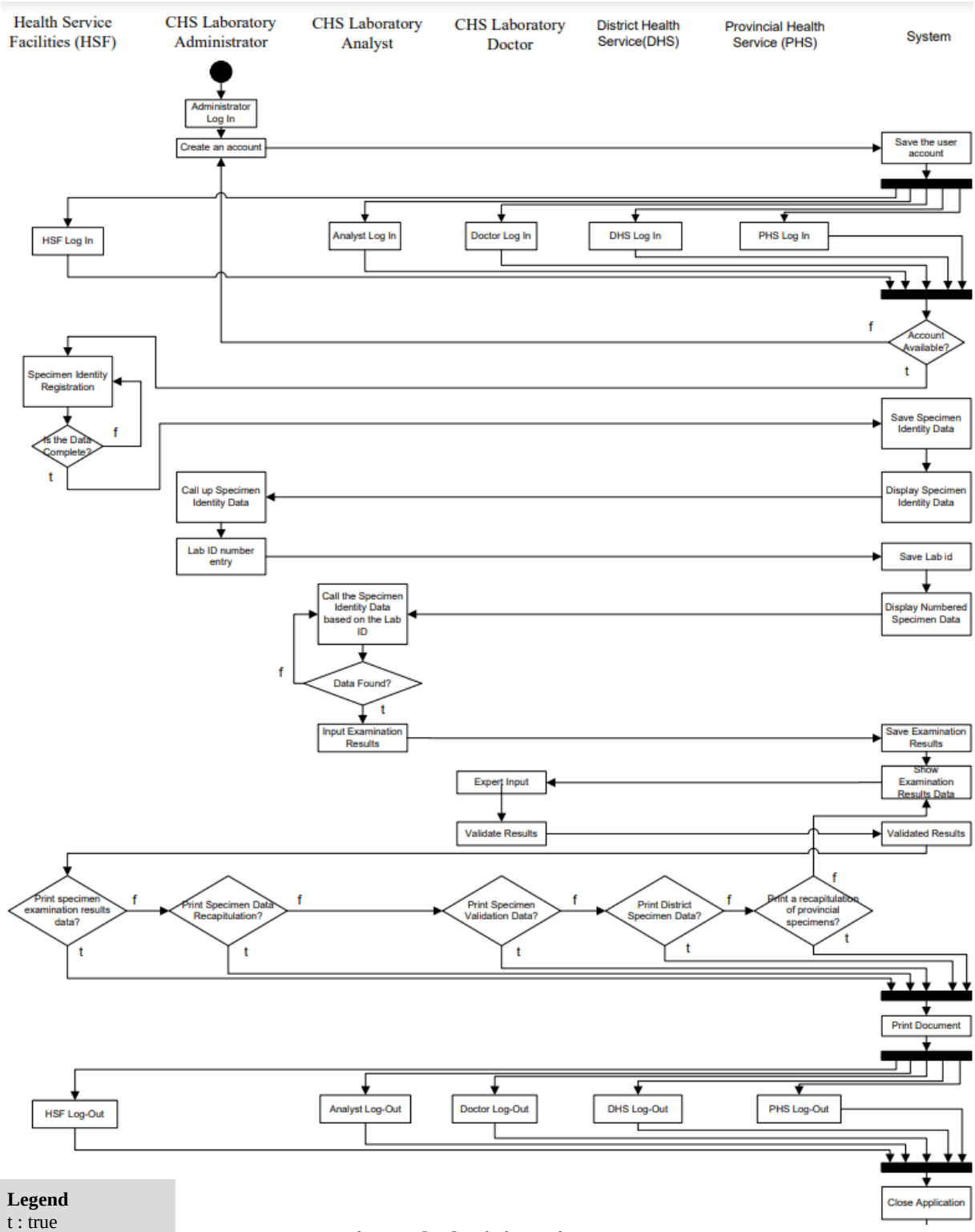


Figure 2. Use Case Diagram

that matches the role will appear. Several variables that have been stored in each user's account identity will also reduce the activity of filling in variables on forms. The use case diagram can be seen in FIGURE 2.



Legend
t : true
f : false

Figure 3. Activity Diagram

II. Activity Diagram

Laboratory administration officers are given access to enter the CHS registration and reporting application and create accounts for other users to gain access to the application. The process of registration specimen identity is the beginning of data formation.

Health facilities carry out the process of registration of specimens that will be sent to the CHS laboratory. The specimen numbering process begins by displaying the data that has been recorded by the health facility and stored in the recording process.
The process of recording CHS results is carried out after laboratory analyst officers carry out a CHS examination of the specimens that have been assigned a number. CHS results are recorded according to the lab ID that was given to each sample in the previous process. CHS results and the name of the responsible doctor are stored in the database through the system. The CHS results validation process is carried out by the doctor in charge after the specimen is examined and the examination results are recorded.

III. User Interface

User participation in software development has a positive impact on user acceptance (Ambler, 2004). Involvement of all parties and responsibility to collaborate, share knowledge and expertise can help in developing software that meets user needs (Saif, et al., 2021). In this study, the user interface design was prepared based on the information obtained during the FGD activities to increase user engagement.
This interface is related to the user log-in process, CHS specimen identity registration process, CHS specimen numbering process, CHS results recording, CHS results validation process and CHS results recapitulation.

The login process only requires username and password variables. When the user enters the appropriate username and password, the user can access the application. The CHS specimen identity registration process consists of a CHS specimen identity

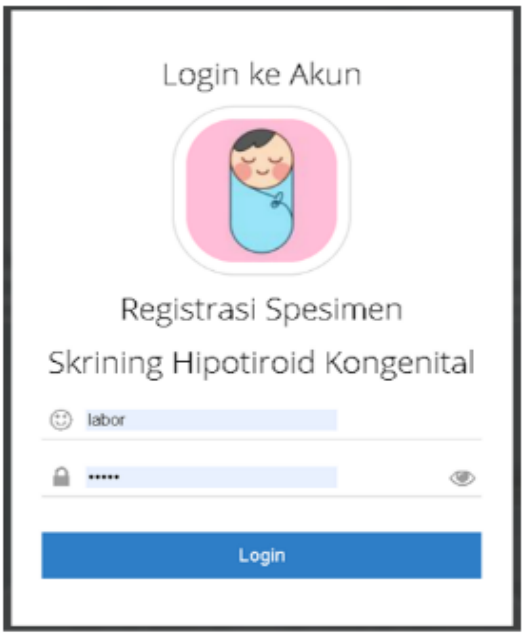


Figure 4. Log-in Interface

form interface. The CHS specimen numbering process consists of two interfaces, including the CHS specimen numbering table and the CHS numbering form. The process of recording CHS inspection results consists of five interfaces, namely the Batch search form, specimen data table and CHS inspection results data entry form. The CHS examination results validation process consists of two interfaces, including the CHS results validation table and the CHS results validation form. The process of monitoring the recapitulation of CHS examination results has five interfaces including high CHS results table, normal CHS results table, data download form, CHS report sheet and CHS results recapitulation. Application log-in interface can be seen in FIGURE 4.

IV. Implementation

The implementation phase requires solid technical expertise especially software development skills and programming, which is an activity a user is never expected to be involved in, due to their lack of technical knowledge (Saif, et al., 2021). The applications that have been tested by participants are then socialized with the CHS Laboratory and socialized to the District Health Office in West Sumatra Province, Jambi Province, Riau Province and Riau Islands Province via the zoom application so that it can be implemented. To ensure smooth use of the Application, a user guidebook has been prepared which has been submitted to the relevant District Health Service to be distributed to all Health Facilities under its coordination. The manual also includes a telephone number that is connected to the WhatsApp application for communication when problems occur in use.

V. Evaluation

A quantitative study to determine the length of time for the registration process and reporting of CHS data was carried out in the Evaluation process. Quantitative data in the form of time variables for the process of registration specimen identity, specimen numbering, recording results and validation manually which have been obtained as initial data compared with time variables for the process of registration specimen identity, specimen numbering, recording results and validation using the CHS registration and reporting application.

The impact of application use on CHS registration and reporting times was tested using a paired t-test. Testing was carried out on data on the total time of the CHS registration and reporting process. Data on the total length of time for CHS registration and reporting manually or using the application. The maximum time for the CHS registration and reporting process using the application is 1 minute 47 seconds, this time is 7 times faster than manual CHS registration and reporting, namely 12 minutes 43 seconds.

The minimum time for CHS registration and reporting using the application is 1 minute 32 seconds, this time is 7 times faster than the manual process of 10 minutes 50 seconds. On average, the CHS

Tabel 1. Difference Between Manual and Application Process Time

Parameter	Manuals	Application	Time Difference
Maximum length of time	12:43	1:47	10:56
Minimum length of time	10:50	1:32	09:18
Average length of time	11:35	1:40	09:55
Standard deviation	00:20	00:03	

registration and reporting process using the application takes 1 minute 40 seconds, this time is 6.9 times faster than the manual process of 11 minutes 35 seconds. The average time for the manual CHS registration and reporting process is 11 minutes 35 seconds with a standard deviation of 0 minutes 20 seconds. The average time for the CHS registration and reporting process using the application is 1 minute 40 seconds with a standard deviation of 0 minutes 3 seconds.

The difference in the average value of the CHS registration and reporting process manually and by using the application is 9 minutes 55 seconds faster than using the application with a standard deviation of 0 minutes 17 seconds.

The statistical test results obtained a value of 0.001, so it can be concluded that there is a significant difference between the length of time for the CHS registration and reporting process manually and by using the application.

One of the challenges of implementing the CHS program is low coverage (Pulungan, et al., 2024). The speed of the recording process using the application can increase the screening capacity by 6.9 times. This condition has indirectly expanded the scope of CHS.

VI. Workflow Simplification

The simplification approach to process improvement is applicable where there is a perception of complexity in the process (Kumar & Bhat, 2011). Repeated registration is an ineffective process that occurs in the manual CHS specimen registration process. This condition occurs because it is not possible to synchronize Health Facilities data as a referrer with the CHS laboratory in the manual registration process. Repeated registration extends the recording process at the CHS laboratory. Speeding up specimen registration time can be achieved by digitally synchronizing data.

The risk of CHS data inconsistency occurs when registering manually. Differences in manual writing patterns result in differences in perception. Data written on filter paper by Health Facilities is often not read well, so the CHS laboratory cannot correctly record the specimen data received.

The number of CHS specimens received in 2023 was 32,992 and it was found that 34.3% of the data received by the CHS laboratory could not be read properly. Variables that cannot be read include personal identity number, mother's name, telephone number, referring to health facility, referring to doctor, city of origin of the health facility and mother's residence address. Data inconsistencies can be eliminated by utilizing an integrated digital registration system that makes it easier to read the same data.

Process D with actor 2 in Figure 1 shows an ineffective document digitization process. The process of issuing CHS report sheets, validating and scanning documents to be sent via e-mail takes quite a long time, namely around 8 minutes. Digital reporting results using an information system can speed up document digitization time. The TSH value that has been reported can be easily validated by a laboratory doctor and a CHS reading sheet is issued digitally.

The manual CHS results reporting system is serial. The results sent by the CHS laboratory to the district health office cannot be seen directly by the referring health facility. This time lag can increase the potential for delays in results information which increases the risk of late follow-up for babies with high TSH.

The District Health Service is also burdened with the task of recapitulating District level data to be reported to the Provincial Health Service. The recapitulation process also creates a time lag in monitoring CHS data. The use of digital information systems can overcome the problem of monitoring data that is not real time by

providing simultaneous recapitulation facilities.

Problems with manual recording systems can be overcome by utilizing digital information systems. Digital data synchronization can eliminate repetitive recording activities because data that has been stored in the database can be recalled if needed. Changing the manual recording system to a digital system changes the flow of CHS registration and reporting. Simplification of the CHS data registration and reporting flow can be seen in FIGURE 5.

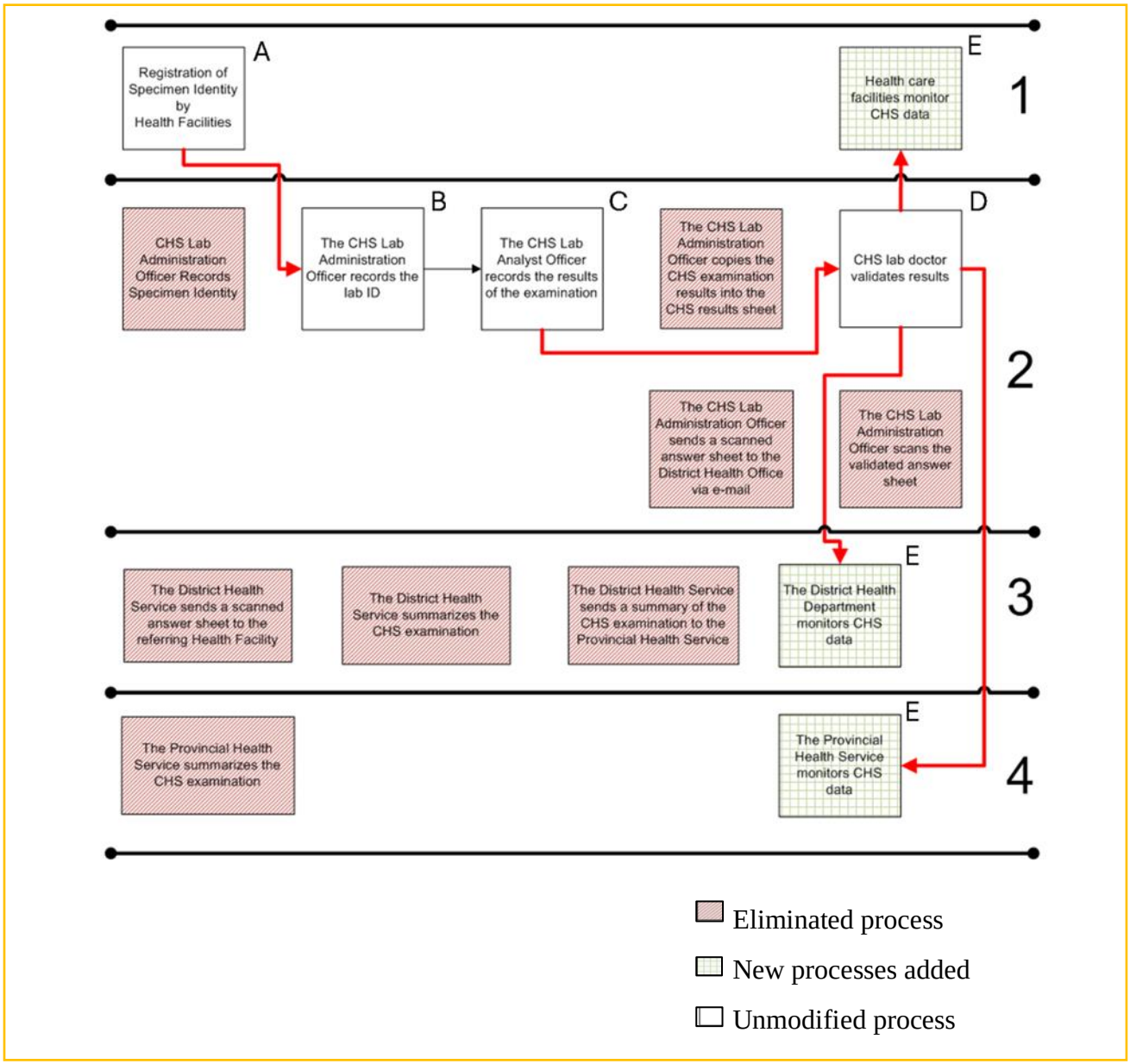


Figure 5. Simplified Workflow

A. CHS Specimen Identity Registration Process
B. The process of recording specimen identity in the CHS laboratory can be simplified
C. CHS specimen numbering process
D. The numbering process is still maintained
E. The process of recording CHS results
F. The process of recording results is maintained
G. D. CHS results validation process
H. The validation process is simplified by eliminating the activities of copying CHS result data, scanning CHS report sheets and sending CHS report sheets via e-mail)
I. Monitoring process of CHS data recapitulation
J. The monitoring process is simplified by making it easy to distribute CHS report sheets automatically and there is no need for manual recapitulation.

The strength of this research is the support from the CHS team which really needs supporting tools so that CHS registration and reporting can be formulated according to needs and the results can speed up the process time. However, time limitations mean that only a few specimens can be examined quantitatively during the evaluation process, which may cause bias. The more specimens studied, the risk of prolonging the CHS laboratory service time because the specimen samples used in the study are actual data.

CONCLUSION

The effect of implementing the registration and reporting system that has been created on the effectiveness of recording time, the effectiveness of reporting time, the risk of unintentional data changes and the ease of monitoring CHS data has had a positive impact in the form of increasing the speed of the CHS registration and reporting process in the CHS laboratory by 7 times faster; CHS data monitoring can be carried out simultaneously by the District and Provincial Health Services; the risk of data changes due to data can be avoided because what has been recorded cannot be changed.

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