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User-Centered UI Design for Reducing Digital Skill Gaps in Cloud Healthcare Platforms

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Abstract: Healthcare systems across the globe are beginning to embrace and integrate cloud technologies into their operations and processes; and as a result, healthcare organizations are creating and utilizing electronic health records, telemedicine, and managing large amounts of medical data electronically. Along with these advancements in technology, many healthcare workers do not have sufficient knowledge of the technical aspects of working with complex digital systems. In most cases, researchers have attributed these challenges to the fact that healthcare professionals do not have the training or digital literacy necessary to utilize these advanced systems effectively; but often, the role of usability in the functionality of a system is overlooked. The purpose of this paper is to explore the potential benefits of user-centered interface design in reducing perceived digital skill gaps in healthcare professionals when utilizing cloud-based information systems. The proposed platform is a conceptual platform called CloudHealth Bridge, which will connect healthcare professionals and IT professionals through role-based dashboards, visual workflow mapping, and integrated learning modules. This proposal will define usability-focused design principles and present the technical aspects of cloud-based systems in clinically meaningful workflows and intuitive interface elements. This proposal illustrates how usability-focused design principles used with contextual training can be used to support the process of digital transformation in healthcare environments. Based on the findings of this research, it is concluded that usability-focused interface design can positively impact system adoption and reduce the cognitive barriers faced by healthcare professionals when utilizing cloud-based information systems.

Keywords: *Cloud Computing, Healthcare Informatics, Digital Skill Gap, User Interface Design, Telehealth Systems.*

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I. INTRODUCTION

The global health care industry is undergoing a great amount of change through the use of new technologies such as Cloud Computing, Artificial Intelligence, and Telehealth technologies, driving their digital transformation forward [9]. New technologies are allowing health care providers to collect and store huge quantities of health care data; to monitor patients from a distance; to increase the efficiency of all aspects of their operational infrastructure across the health care system [3].

Cloud Computing has become one of the cornerstones of the current infrastructure of health care [13]. Health care organisations are relying on Cloud Computing as a means to manage electronic health records, perform data analysis, and to provide Telemedicine Services [2]. Organisations can take advantage of Cloud Computing as a scalable and distributed computing resource [15]. However, with the growing complexity of the digital healthcare environment organizations encounter significant challenges associated with the development of digital health care tools that are compatible with the use of those tools by non-technical users, such as health care professionals [7].

The health care workforce includes a significant percentage of health care professionals (clinicians and administrators) who lack the digital skills to be able to successfully navigate through the complexities associated with using advanced digital health information systems [26]. The result of this gap in digital skills is that it increases the time it takes for health care professionals to adopt and utilise various digital tools, thus requiring organisations to provide additional training to their employees, and to decrease organisational efficiencies of health care information systems [17].

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Over the years, much of the research done in the field of workforce development has concentrated on training programs, as a means of addressing the barriers to digital adoption within the healthcare sector [21]. While training programs are still of great importance, reducing the barriers to technology adoption must also be accomplished by improving the usability of technology used within the healthcare environment [5].

Poor user interface design, cumbersome navigation structures, and the use of complicated terminology have been shown to greatly increase the cognitive burden for healthcare providers and to contribute to healthcare providers' belief that digital systems are difficult to use [1].

To address these factors, this paper proposes a conceptual cloud-based healthcare platform called CloudHealth Bridge. The purpose of CloudHealth Bridge is to reduce the workforce's digital skill gap through user-centered interface design [5]. CloudHealth Bridge will meet this objective by providing role-specific dashboards, providing healthcare professionals with tools to visualize their workflows, and developing modules that will translate complex concepts associated with cloud computing into environments that healthcare professionals are familiar with [16]. By reducing the complexity of interactions between healthcare professionals and cloud-based infrastructures, the proposed CloudHealth Bridge system will enhance usability and support successful digital transformation within healthcare environments [12].

II. RELATED WORK

Digital transformation is affecting every aspect of global health systems, especially over the last ten years [9]. A lot of researchers are looking at how digital technologies (like cloud computing, artificial intelligence and big data) can be used to help deliver healthcare services and improve the operational efficiency of those services [12].

Most researchers are concluding that the increasing use of digital technology in health systems means that the workforce will need digital skills in order to be able to provide support to their organisations [26]. This creates a demand for employees with digital skills, and most current employees do not have the technical skills necessary to use new digital technologies [16].

Cloud computing provides a critical enabler technology in the provision of electronic patient clinical information for healthcare organisations [2]. Cloud services provide scalable storage of records and also enable real time collaboration between providers and also support telehealth services [8]. However, many healthcare organisations are utilising cloud computing services and the implementations of those services is often delayed due to concerns over usability, data security, and employee readiness [28].

Barriers to adopting electronic health record systems have been explored at various levels in the literature and can include issues surrounding insufficient training, lack of technical support, and poorly designed interfaces [1]. Many health care providers report that they experience frustration when using digital systems that interfere with their current clinical workflow [29].

Prior research has concentrated on technology adoption strategies and workforce training, with little consideration given to how user interface design can reduce perceived gaps in digital skills [21]. This study contributes to the body of knowledge by exploring ways that an intuitive system interface may support the digital transformation of healthcare settings [13].

➢ *Problem Statement*

Even though more money is being put into digital changes in healthcare, doctors still have problems using cloud based medical care systems [21]. Cloud based medical care systems are complex and can include many items like cloud storage, application programming interfaces (APIs), and database systems that are located in several places [15].

For doctors that do not have a background or know-how in technology, understanding these technologies can make it hard for them to do their jobs [26]. Because of this, most doctors depend on IT specialists to help them with the digital systems they need to do their jobs [17]. This adds time to the operation's work flow and lowers the efficiency of the digital health initiative [18].

The main reason for this problem is that most healthcare applications have been designed for technical users and not for clinicians that will be using them to provide care [5]. This has created a mismatch between the design of healthcare applications and the skill set of those who will be using it and creating a higher cognitive load on the clinician and creating a belief that digital healthcare applications require a higher degree of technical skills [1].

The digital healthcare application will be designed to reduce the cognitive load of the clinician while helping to improve the clinician's digital literacy with cloud computing technologies [20].

➢ *Proposed System: CloudHealth Bridge*

The proposed system, CloudHealth Bridge, is a cloud-based healthcare platform designed to reduce the digital skill gap through improved user interface design and integrated learning tools [13].

The platform connects healthcare professionals and IT experts through a unified environment that simplifies interactions with cloud infrastructure [22]. Instead of exposing users to complex technical configurations, the system presents cloud operations through intuitive clinical workflows [5].

- *The System Includes the Following Core Components:*

✓ Role-based dashboards for healthcare professionals and IT specialists [20]

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- ✓ Visual workflow mapping between clinical processes and cloud infrastructure [6]
- ✓ Integrated learning modules explaining cloud concepts using healthcare analogies [17]
- ✓ Infrastructure monitoring tools for system administrators [15]
- ✓ Collaborative communication tools for resolving technical issues [18]

By integrating these components into a single platform, CloudHealth Bridge creates an environment where healthcare professionals can interact with digital systems more confidently while gradually improving their digital skills [26].

➢ *System Architecture*

The architecture of CloudHealth Bridge follows a multi-layer cloud healthcare model consisting of three primary layers:

- *User Layer*

This layer includes healthcare professionals and IT experts who interact with the system through role-based dashboards.

- *Application Layer*

This layer contains the main functional modules of the platform, including the healthcare dashboard, learning hub, workflow mapper, and collaboration tools.

- *Cloud Infrastructure Layer*

The cloud layer consists of distributed services responsible for storing medical data, processing clinical workflows, and supporting system scalability.

Cloud services used in the architecture include authentication systems, cloud storage, serverless computing services, and distributed databases.

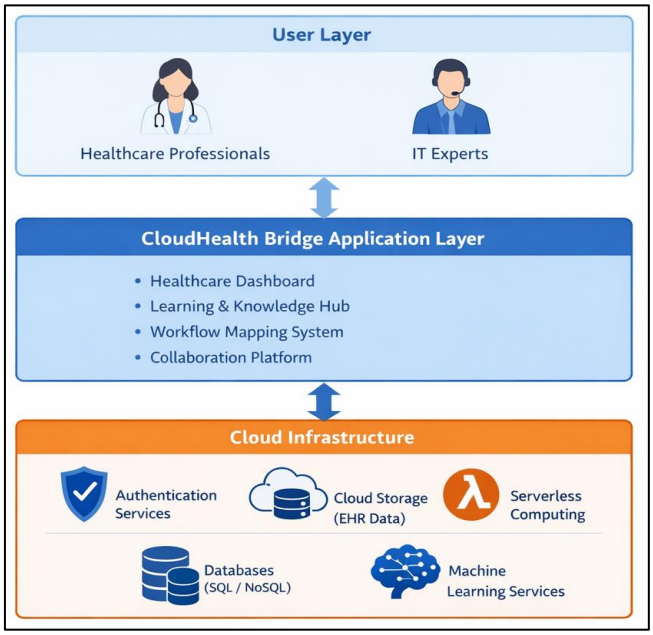

Fig 1 Architecture of the CloudHealth Birdge Platform

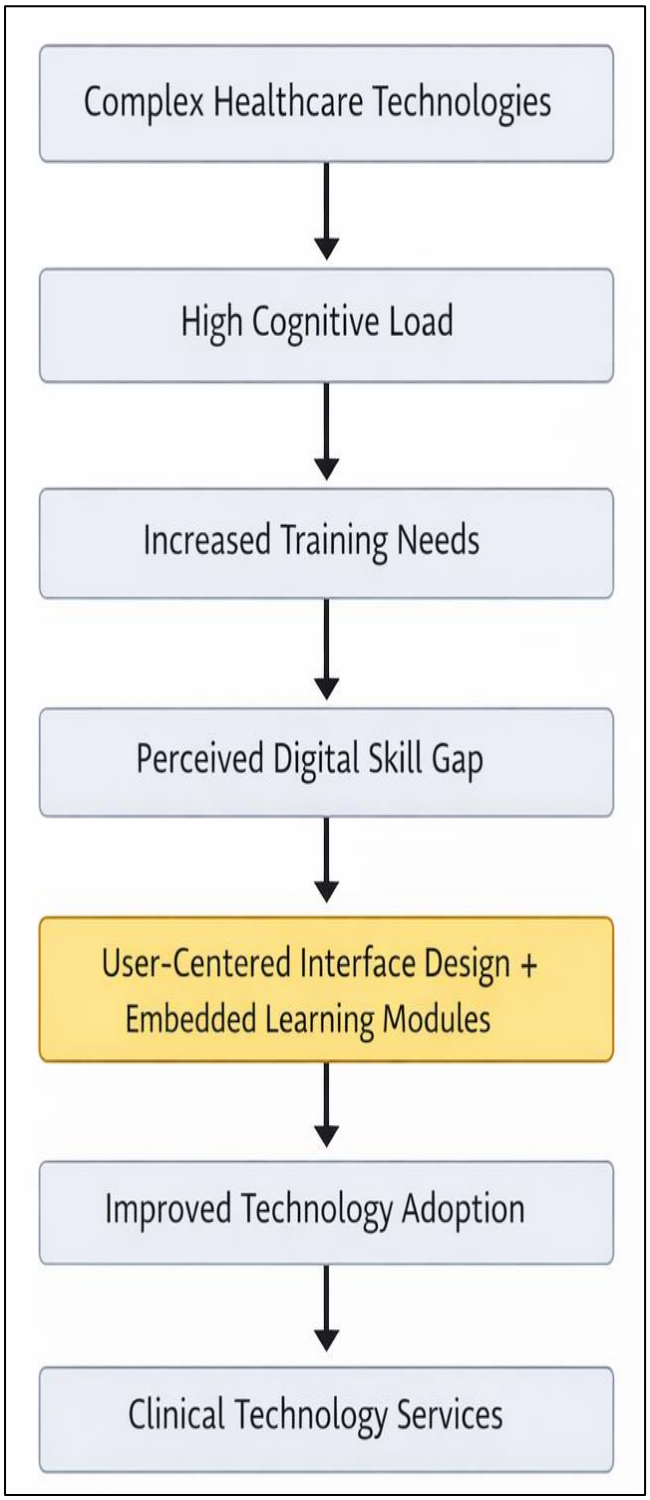

Fig 2 Conceptual Framework Illustrating Healthcare Digital Skill Gaps.

III. IMPLEMENTATION AND INTERFACE DESIGN

The role-based access interface of the CloudHealth Bridge platform is illustrated in Fig. 3, showing how users select their roles and access customized dashboards.

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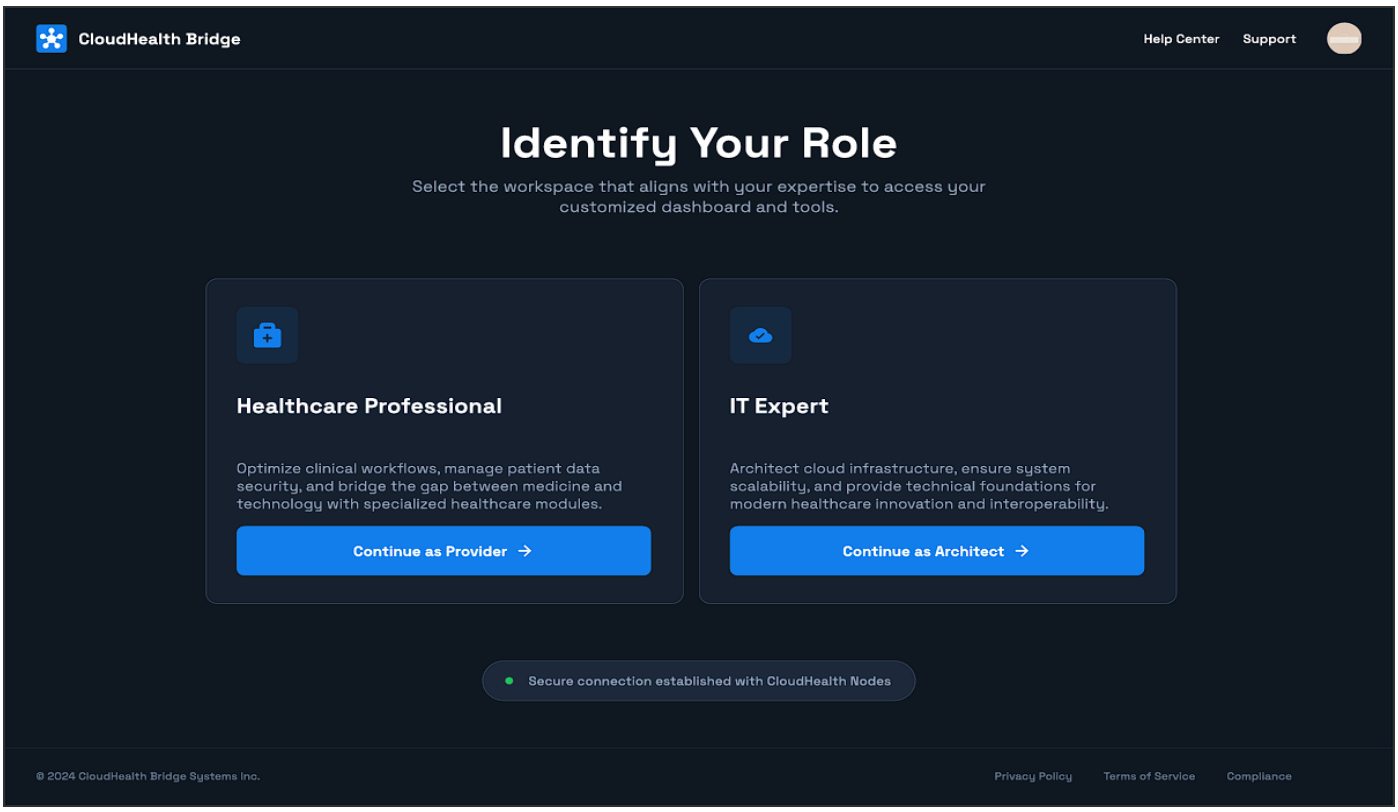

Fig 3 Role-Based Access Interface of the CloudHealth Bridge Platform.

The healthcare professional dashboard is shown in Fig. 4, highlighting patient data visualization and system service access within the platform.

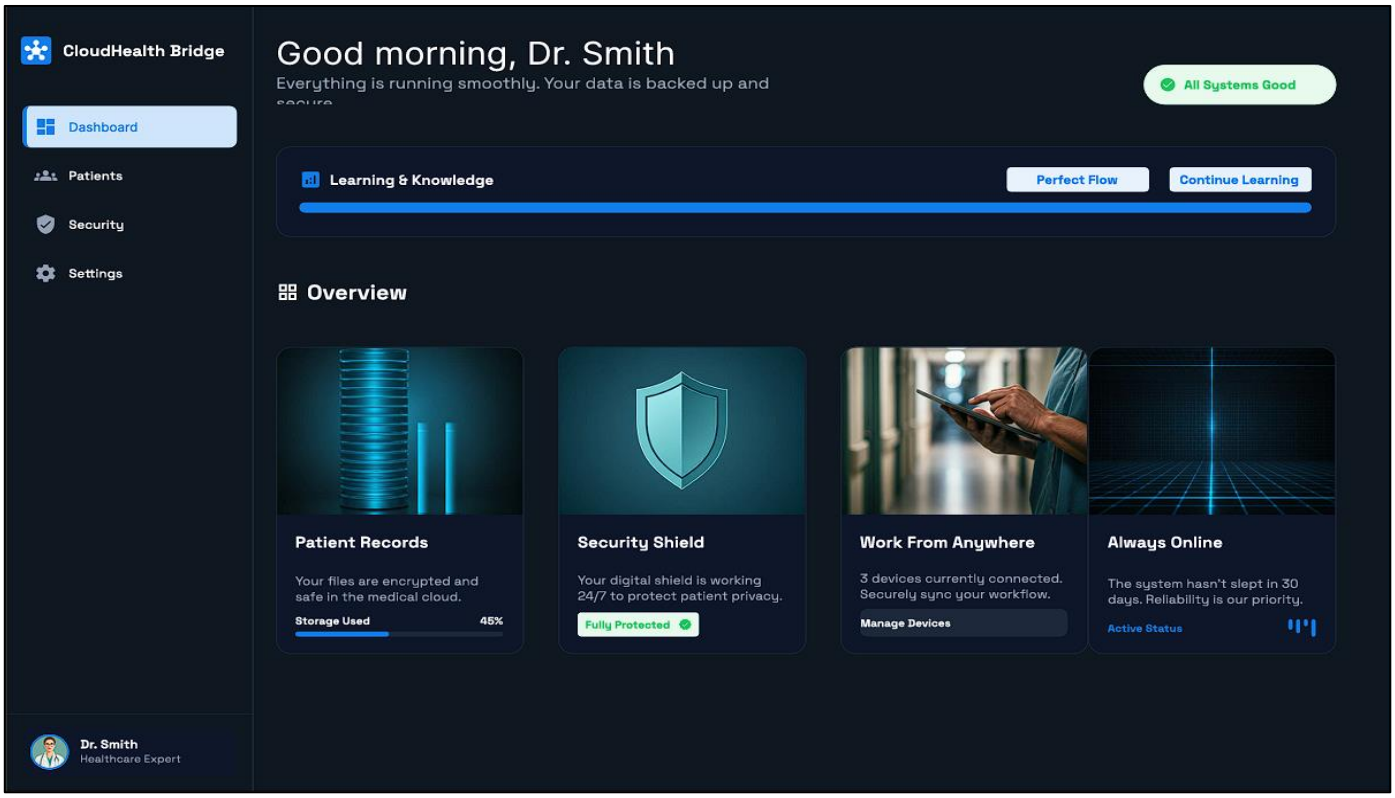

Fig 4 Healthcare Professional Dashboard Showing Patient Data and System Services.

The knowledge bridge learning module for explaining cloud computing concepts is presented in Fig. 5, demonstrating how technical concepts are translated into healthcare-friendly content.

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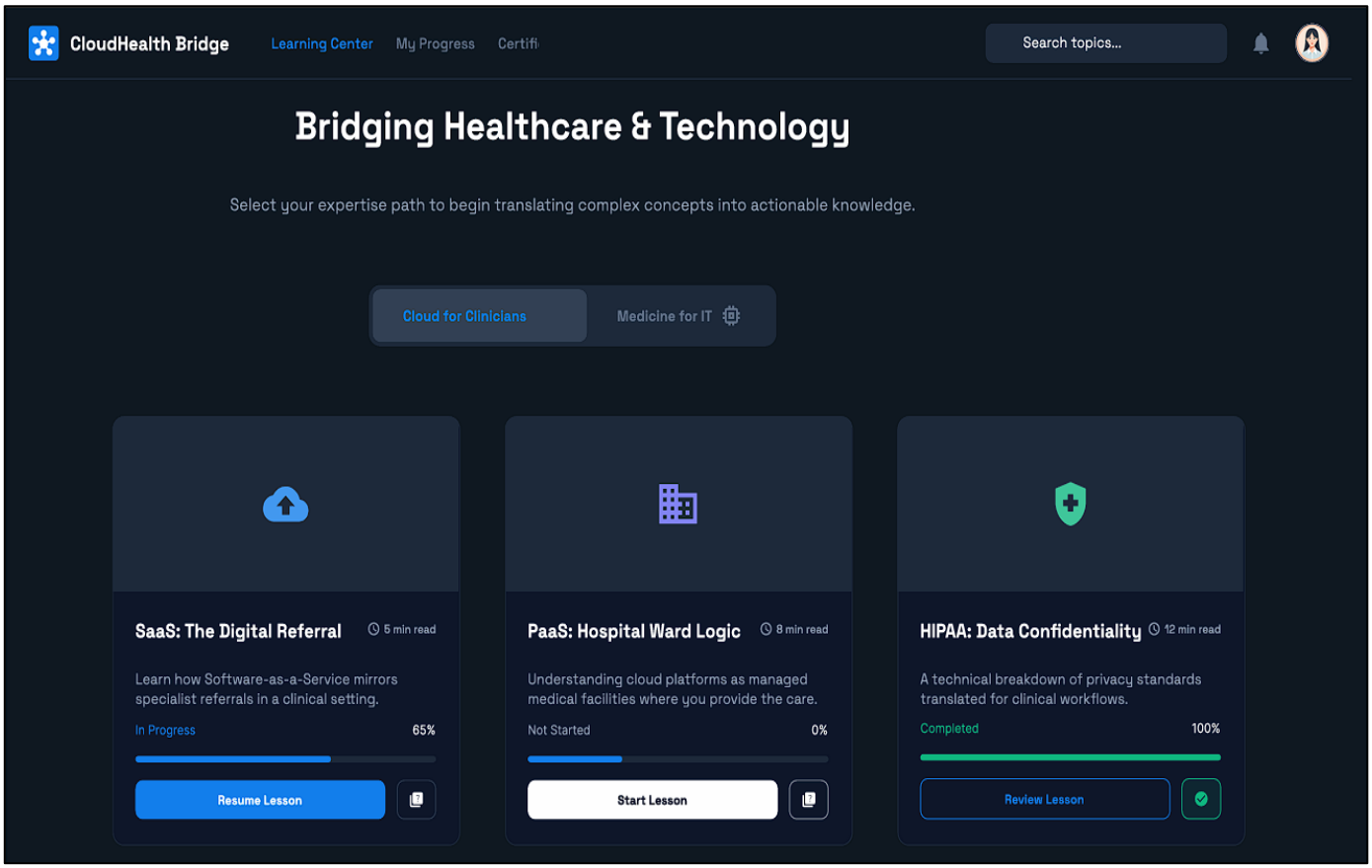

Fig 5 Knowledge Bridge Learning Module Explaining Cloud Computing Concepts Part 1

An extended view of the learning module is shown in Fig. 6, further illustrating interactive elements used to enhance user understanding.

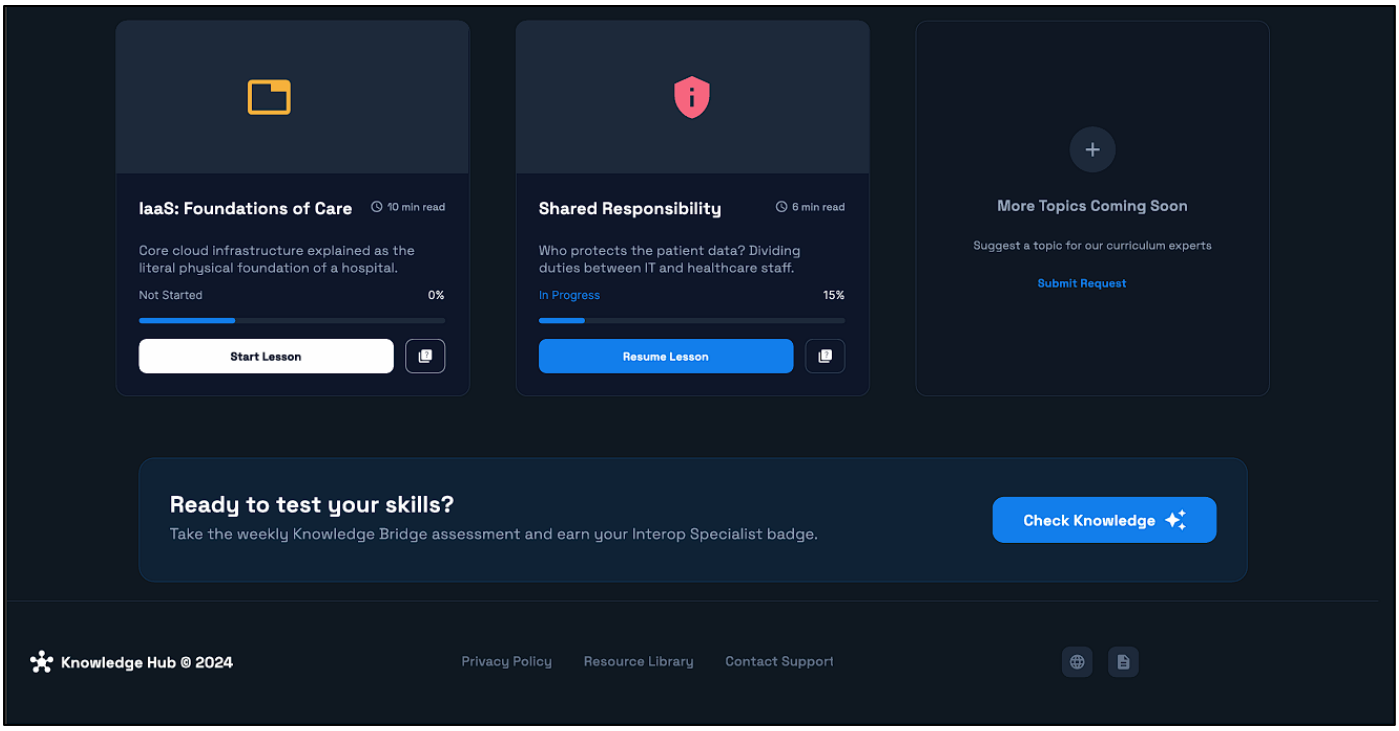

Fig 6 Knowledge Bridge Learning Module Explaining Cloud Computing Concepts Part 2

The clinical workflow mapping interface is illustrated in Fig. 7, showing how healthcare processes are connected with cloud infrastructure services.

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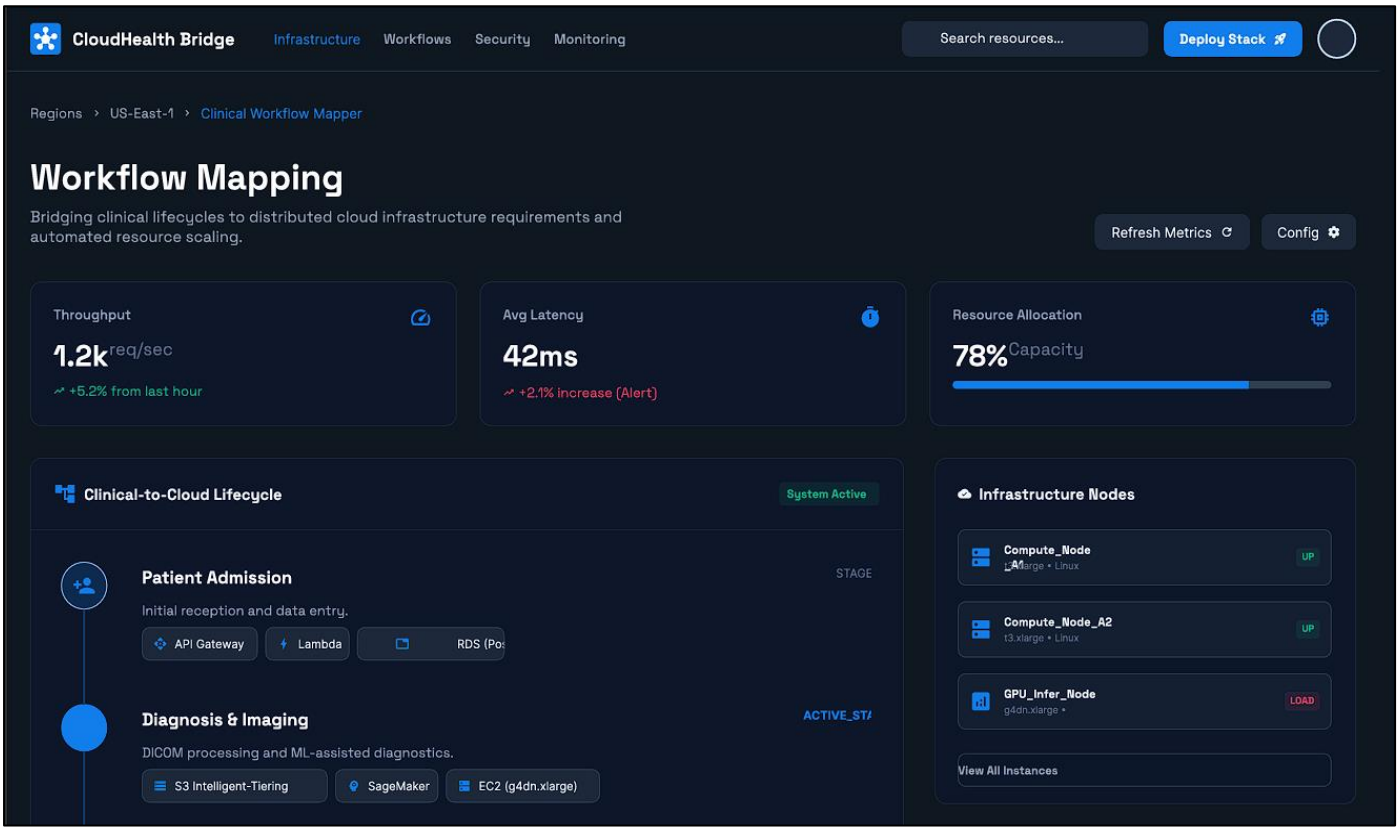

Fig 7 Clinical Workflow Mapping Interface Connecting Healthcare Processes with Cloud Services Part 1.

Another view of the workflow mapping interface is presented in Fig. 8, demonstrating detailed integration between clinical workflows and cloud components.

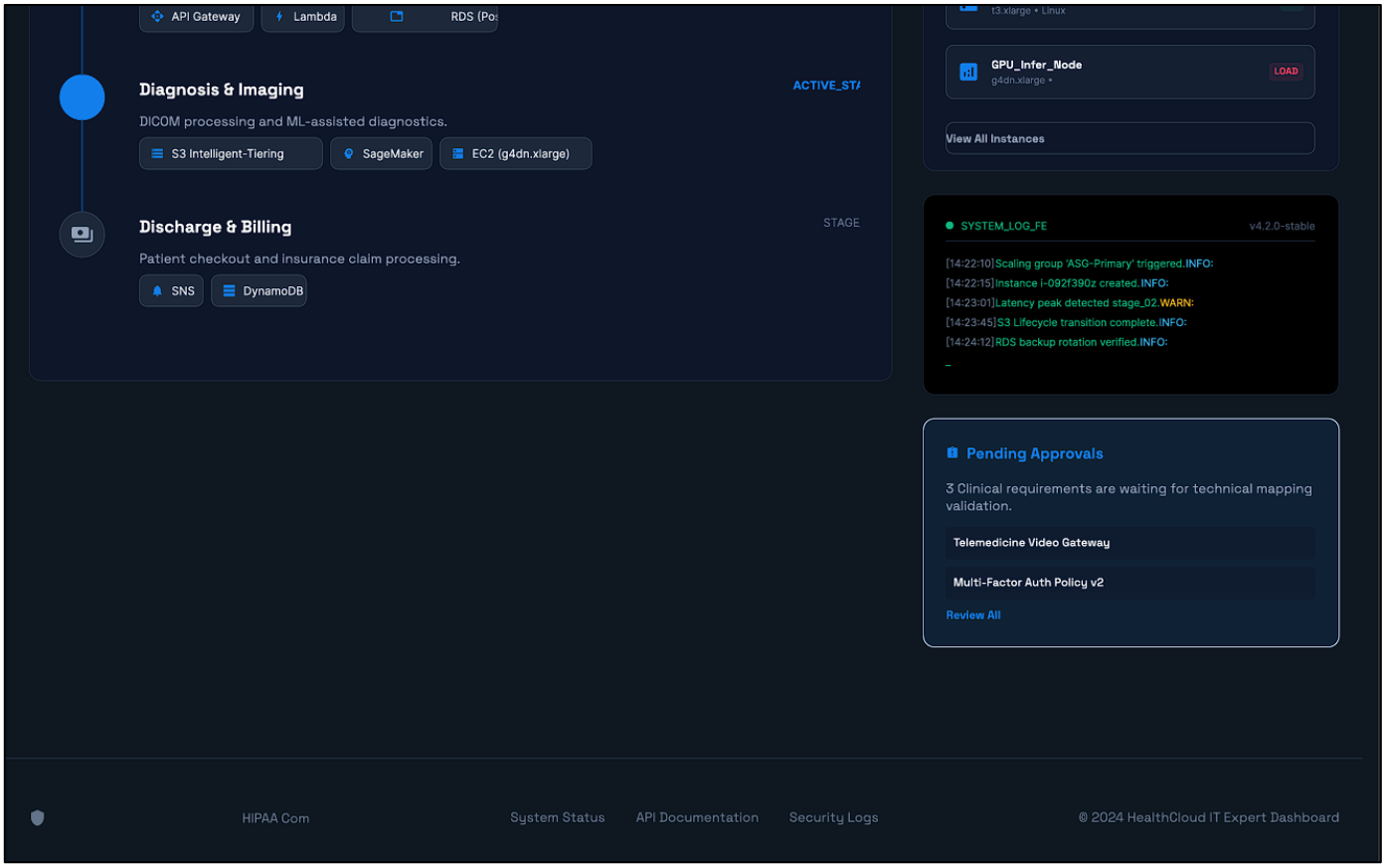

Fig 8 Clinical Workflow Mapping Interface Connecting Healthcare Processes with Cloud Services Part 2.

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To help users navigate through a complex and diverse environment, the interface of the platform has been designed with a focus on the user's needs. In addition to being user-friendly, we have made every attempt to improve the usability of our system.

The Healthcare Dashboard provides a simple way to access key functions of the system, such as viewing a patient's record, checking on the status of your data security, or monitoring the reliability of the overall system. The use of visual elements and the integration of modular components will allow the user to easily view and interact with complex cloud-based services.

In addition to the Healthcare Dashboard, the Knowledge Bridge Learning Hub provides interactive training modules for understanding cloud computing concepts in terms familiar to the healthcare professional. Using analogies to healthcare will allow individuals within the healthcare field to gain a better understanding of technical concepts, even if they have no previous education in IT.

"Featuring a mapping tool that enables the user to visually represent relationships between clinical workflow and cloud infrastructure services. For instance, confirming that patient admissions are connected to authentication and that creating diagnostic images is linked to both cloud storage and machine learning. This enables healthcare workers to easily visualize how digital technology can be used to support a clinic's operations."

- *Expected Impact*

The proposed system aims to reduce digital skill gaps in healthcare environments by simplifying interactions between healthcare professionals and cloud technologies [26].

The integration of intuitive dashboards, workflow visualization tools, and contextual learning modules can reduce the learning curve associated with cloud-based healthcare systems [5].

Additionally, improved collaboration between healthcare professionals and IT specialists can enhance system reliability and reduce operational delays caused by technical issues [22].

IV. CONCLUSION

Healthcare digital transformation requires both technological innovation and workforce readiness [12]. While training programs play an important role in developing digital competencies, system usability also significantly influences technology adoption [21].

This paper proposed CloudHealth Bridge, a conceptual cloud healthcare platform designed to reduce digital skill gaps through user-centered interface design and integrated learning tools [13].

The proposed approach demonstrates how combining intuitive system interfaces with contextual learning environments can support digital transformation in healthcare organizations [5]. Future work will focus on implementing the platform in real healthcare settings and evaluating its effectiveness in improving system adoption and workforce digital readiness [17].

- *Clinical Trial Number*

Not applicable.

- *Ethics and Consent to Participate*

Not applicable.

- *Funding*

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