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Designing a Branching Decision Serious Game for Acute Hospital Pandemic Surge Management: The Command & Control (Quiz Version)

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Designing a Branching Decision Serious Game for Acute Hospital Pandemic Surge Management:

The Command & Control (Quiz Version)

Mr. Za'aba Bin Abdul Rahim
Dr Robert de Souza

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EXECUTIVE SUMMARY

Healthcare systems face significant operational strain during pandemic outbreaks, particularly in the early phase when uncertainty, resource constraints, and demand surges intersect. Effective hospital response requires coordinated decision-making across multiple operational domains, including procurement, manpower, and infrastructure. However, opportunities to train such decision-making in a controlled and repeatable environment remain limited.

This white paper presents the design and implementation of the **Command & Control Serious Game (Quiz Version)**, a web-based branching decision simulation developed using Unity. The game simulates the first 7 weeks of an acute hospital's response to a pandemic surge, where players assume the role of an operations decision-maker. Through structured multiple-choice scenarios, players make daily decisions across key departments, with each choice producing almost immediate or delayed consequences.

The simulation is designed as a **single-player, text-based system** with branching logic, where no option is strictly incorrect; instead, decisions vary in effectiveness and impact. The platform captures gameplay data through a cloud-based architecture, enabling post-game analysis and supporting future research into behavioural decision-making.

This paper focuses on the **game design, gameplay structure, and technical implementation** of the system, positioning it as a scalable simulation platform for operational training and analytical exploration.

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1. Background and Problem Context

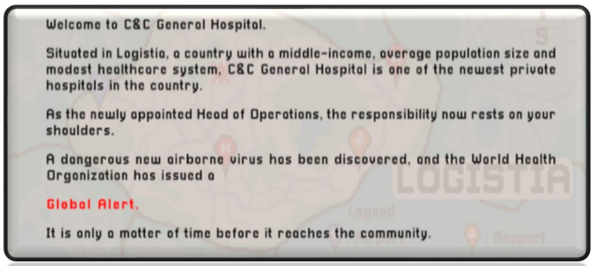
Pandemic outbreaks place acute hospitals under rapidly evolving operational pressure. In the early stages of an outbreak, decision-makers must balance limited resources against increasing patient demand while managing uncertainty in supply chains, workforce availability, and infrastructure capacity (Laycock et al., 2024; Petanidis et al., 2025).

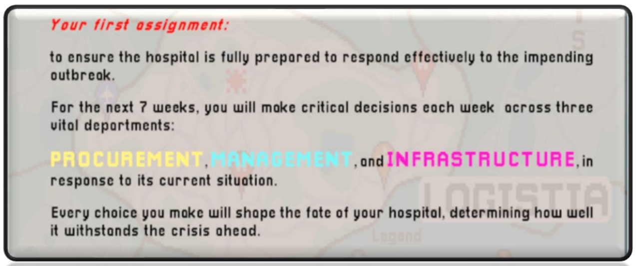
Traditional training approaches in healthcare education and management often focus on clinical competencies or static case studies (Koukourikos et al., 2021; Salem & Khan, 2023). These approaches provide limited exposure to:

- dynamic decision-making under uncertainty
- interdependencies between operational domains
- delayed consequences of early decisions
- trade-offs in resource allocation

As a result, there is a need for simulation environments that allow individuals to explore **complex operational scenarios in a controlled setting**, where decisions can be tested without real-world consequences (Aronsson et al, 2021; Laycock et al, 2024; Schram et al., 2025).

The Command & Control Serious Game was developed to address this need through a structured, scenario-based simulation that models hospital operations during the initial phase of a pandemic surge (The Logistics Institute-Asia Pacific, NUS, 2026).





2. System Overview

The Command & Control Serious Game (Quiz Version) is a **single-player, web-based simulation** that presents a sequence of operational decision scenarios over a seven-week period.

2.1 Key Characteristics

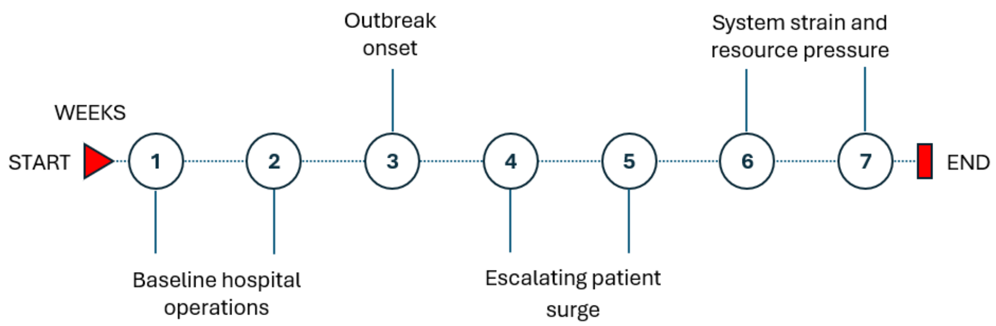
Feature	Description
Game Type	Branching decision simulation
Mode	Single-player
Interface	Text-based with MCQ options
Platform	Web browser
Engine	Unity
Duration	7 in-game weeks
Departments	Procurement, Manpower, Infrastructure

Players assume the role of a **hospital command decision-maker**, responsible for maintaining operational stability as the outbreak unfolds.

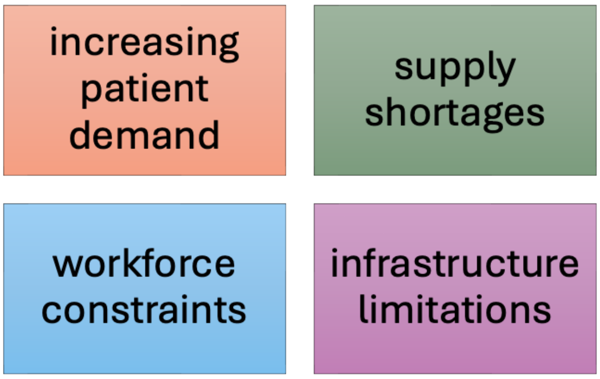
3. Scenario Design

The simulation is structured around a **seven-week timeline**, representing the critical early phase of a pandemic outbreak.

3.1 Game Timeline Structure



The scenario is designed to progressively introduce:



This temporal structure ensures that player decisions must account for both **immediate needs and future consequences**.

3.2 Gameplay Overview (Video Game Trailer)

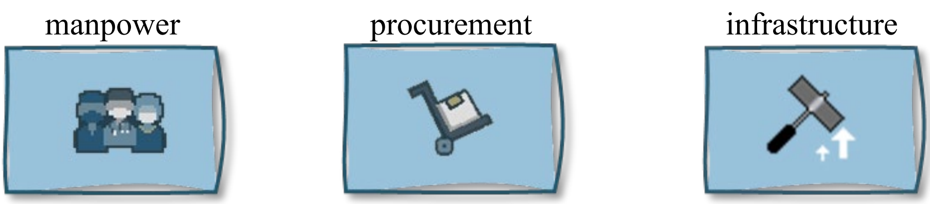
To provide a visual overview of the gameplay flow, user interface, and decision structure, a short video trailer of the Command & Control Serious Game (Quiz Version) is available on YouTube: https://youtu.be/A91ABE4941E

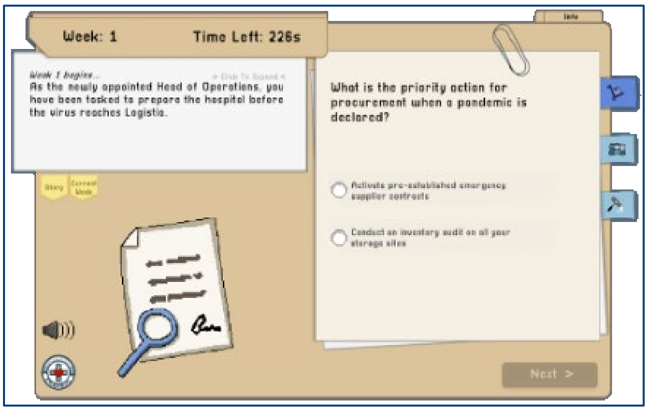
The video illustrates the structure of daily decision-making, the presentation of multiple-choice scenarios, and the progression of the simulation across the seven-week outbreak timeline. It complements the system description by providing a direct view of how players interact with the simulation environment.

4. Game Design and Mechanics

4.1 Decision Framework

Each in-game week presents **three decision points**, corresponding to:





Each decision is delivered as a **multiple-choice question (MCQ)** with either **two or three selectable options, depending on the situation**.

4.2 Non-Binary Decision Model

A key design principle of the game is the absence of explicitly "correct" or "incorrect" answers.

Instead:

- all options are viable
- each option carries **different operational implications**
- options are associated with **varying score values**

This design avoids simplistic right/wrong framing and encourages players to engage with **trade-offs and strategic prioritisation**.

4.3 Branching Logic and Delayed Effects

The simulation incorporates **branching decision logic**, where choices influence:

- subsequent scenarios
- future decision contexts
- cross-department outcomes

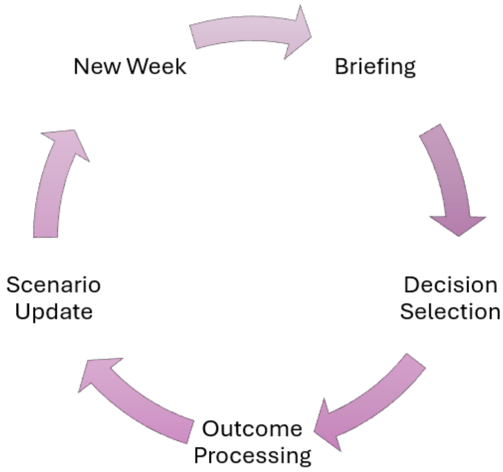
For example:

- a procurement decision affecting PPE availability may influence manpower safety in later weeks
- infrastructure expansion may increase demand on procurement resources

This introduces **interdependency across departments** and reinforces the systemic nature of hospital operations.

4.4 Gameplay Flow

The game operates through a structured, iterative gameplay loop. Each cycle begins with a scenario briefing that presents the operational conditions for the current week. This is followed by a decision-making phase, during which players select from a set of predefined options. The selected actions are then processed by the game system, resulting in updates to the scenario state based on underlying game logic. The cycle concludes with the transition to a new week, introduced through a briefing that reflects the updated scenario conditions.



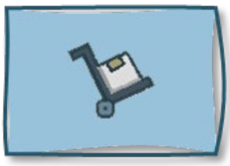
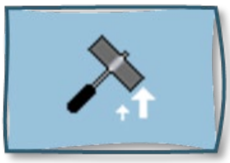
Players receive:

1. a situational update
2. three departmental decisions
3. system feedback (implicit through subsequent scenarios)

This loop repeats across all seven weeks.

5. Departmental System Design

The simulation models three core operational domains.

Department	Procurement	Manpower	Infrastructure
			
Focus Areas	Procurement decisions influence resource availability and downstream operational capacity. • medical supplies (e.g., PPE) • equipment acquisition • supplier lead times	Manpower decisions affect the hospital's ability to sustain operations under pressure. • staff allocation • fatigue management • workforce shortages	Infrastructure decisions determine the system's ability to absorb patient surges. • bed capacity • ward conversion • isolation and ICU expansion

5.1 Interdependency Across Departments

The three domains are not independent. Instead, they form a **linked operational system**, where decisions in one domain can influence outcomes in others over time.

6. Content Architecture

6.1 JSON-Based Design

All game content is stored in **JSON format**, including:

- question prompts
- decision options
- scoring values
- branching conditions
- explanatory feedback

This enables:

- modular content updates
- rapid scenario modification
- scalability across different use cases

6.2 Decision Object Structure (Conceptual)

Each decision node includes:

- scenario description
- three options
- associated score values
- triggers for future events
- explanation text

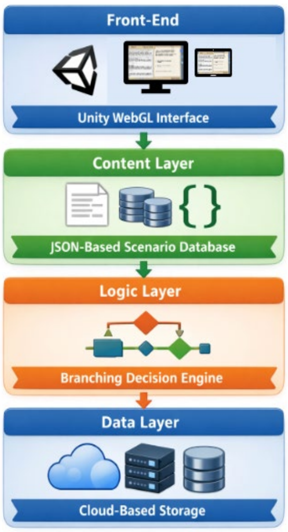
This structure allows the simulation to function as a **data-driven system** rather than a fixed sequence of events.

7. Technical Architecture

The system is implemented using Unity and deployed as a **web-accessible application**.

7.1 System Components

- Front-end: Unity WebGL interface
- Content Layer: JSON-based scenario database
- Logic Layer: branching decision engine
- Data Layer: cloud-based storage



7.2 Data Capture

During gameplay, the system records:

- player decision selections
- sequence of choices
- timestamps
- branching paths
- final scores

Timestamp	Consent	Tota	Total	Da	Day 1 Q1 Responses	Day 1	Day	Day 1 Q2 Responses	Da	Day 1	Day 1 Q3 Responses	D1	D
20/02/2026 11:38:19	Disagree	0:52	48	pl_01	Activate pre-established emergency suppl	2	mp_01	Conduct risk assessment	3	infra_01	Choose the easiest modifications, and put in place immediately	1	p
11/03/2026 11:45:45	Agree	13:06	47	pl_01	Activate pre-established emergency suppl	2	mp_01	Conduct staff briefing	2	infra_01	Establish Hot & Cold Zones immediately as proposed by the infe	2	p
16/03/2026 12:14:39	Agree	6:09	51	pl_01	Conduct an inventory audit on all your sto	3	mp_01	Conduct risk assessment	3	infra_01	Conduct assessment of the current infrastructure layout and con	3	p
16/03/2026 12:44:51	Agree	9:50	53	pl_01	Activate pre-established emergency suppl	2	mp_01	Conduct staff briefing	2	infra_01	Establish Hot & Cold Zones immediately as proposed by the infe	2	p

This data is stored in a cloud database for analysis.

7.3 End-of-Game Feedback

At the end of the simulation, players receive:

- total score
- summary of decisions
- explanation of outcomes

This provides closure to the gameplay experience and supports reflection.

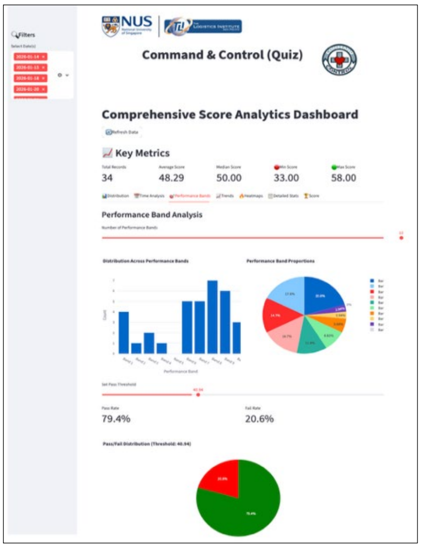
8. Learning Analytics and Behavioural Data from Gameplay

Beyond its simulation function, the platform captures structured gameplay data that can be analysed to examine **decision-making behaviour in outbreak scenarios**.

8.1 Data Types

Data Captured	Description
Decision selections	Choices made per scenario
Branching paths	Sequence of decisions
Timing data	Decision response times
Scores	Performance indicators

8.2 Visualisation and Analysis



A lightweight Python-based tool was developed to visualise gameplay data, enabling:

- score distribution analysis
- decision frequency mapping
- pathway comparison across players

These visualisations support exploration of:

- decision trends
- strategic preferences
- variation in gameplay approaches

8.3 Analytical Potential

The dataset enables analysis of:

- how players prioritise resources
- how early decisions influence later outcomes
- differences in decision strategies across sessions

This positions the platform as both a **simulation tool and a data-generating system**.

9. Implementation and Deployment

The game is deployed as a **browser-accessible application**, allowing users to access the simulation without installation.

Key implementation features:

- lightweight interface
- scalable cloud backend

- modular content updates via JSON
- compatibility across devices

This enables ease of deployment in educational and training contexts.

10. Future Development

Potential enhancements to the game could include:

Multiplayer (role-based)	Expanded departmental coverage	Adaptive scenario difficulty	Integration with real-world datasets	Enhanced analytics dashboards
• enable **role-based collaboration and interdependence**, where players must coordinate, negotiate, and make decisions collectively under time pressure, reflecting real-world hospital dynamics	• extend the simulation to represent a **broader healthcare ecosystem**, allowing players to engage with **complex interdependencies and cascading system effects**	• implement **dynamic scenario adjustments** based on player performance, ensuring **appropriately challenging and personalised learning experiences** across different expertise levels	• incorporate **authentic data inputs** to support **evidence-based decision-making** and enhance the realism of operational constraints	• provide **actionable insights into individual and team decision-making**, supporting **reflection, feedback, and continuous learning improvement**

11. Conclusion

The Command & Control Serious Game (Quiz Version) demonstrates a structured approach to modelling hospital surge management through a **branching decision simulation**. By combining a scenario-driven design, interdependent operational domains, and a data-driven architecture, the system provides a platform for exploring complex decision-making processes during pandemic outbreaks.

The simulation's design emphasises:

Together with its technical implementation and data capture capabilities, the platform represents a scalable approach to simulating healthcare operations under crisis conditions, with potential applications in both training and analytical research.

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The Logistics Institute – Asia Pacific
National University of Singapore
Block E2, #04-13, 5 Engineering Drive 2, Singapore 117579
Tel: (65) 6516 4842 · Fax: (65) 6775 3391
Email: tlihead@nus.edu.sg · URL: www.tliap.nus.edu.sg