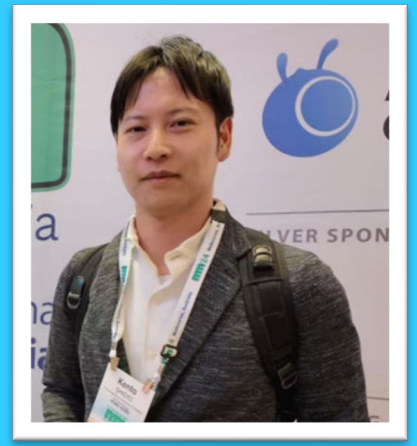
Guardians 2026 - Technical Talk

Clinical Telegaming for Dementia Care

A framework for collecting telemetry data to complement clinician assessment



Presenter: Kento SHIGYO

Kento Shigyo [†], Adam Craig, Michal Balazia, Carl Taswell

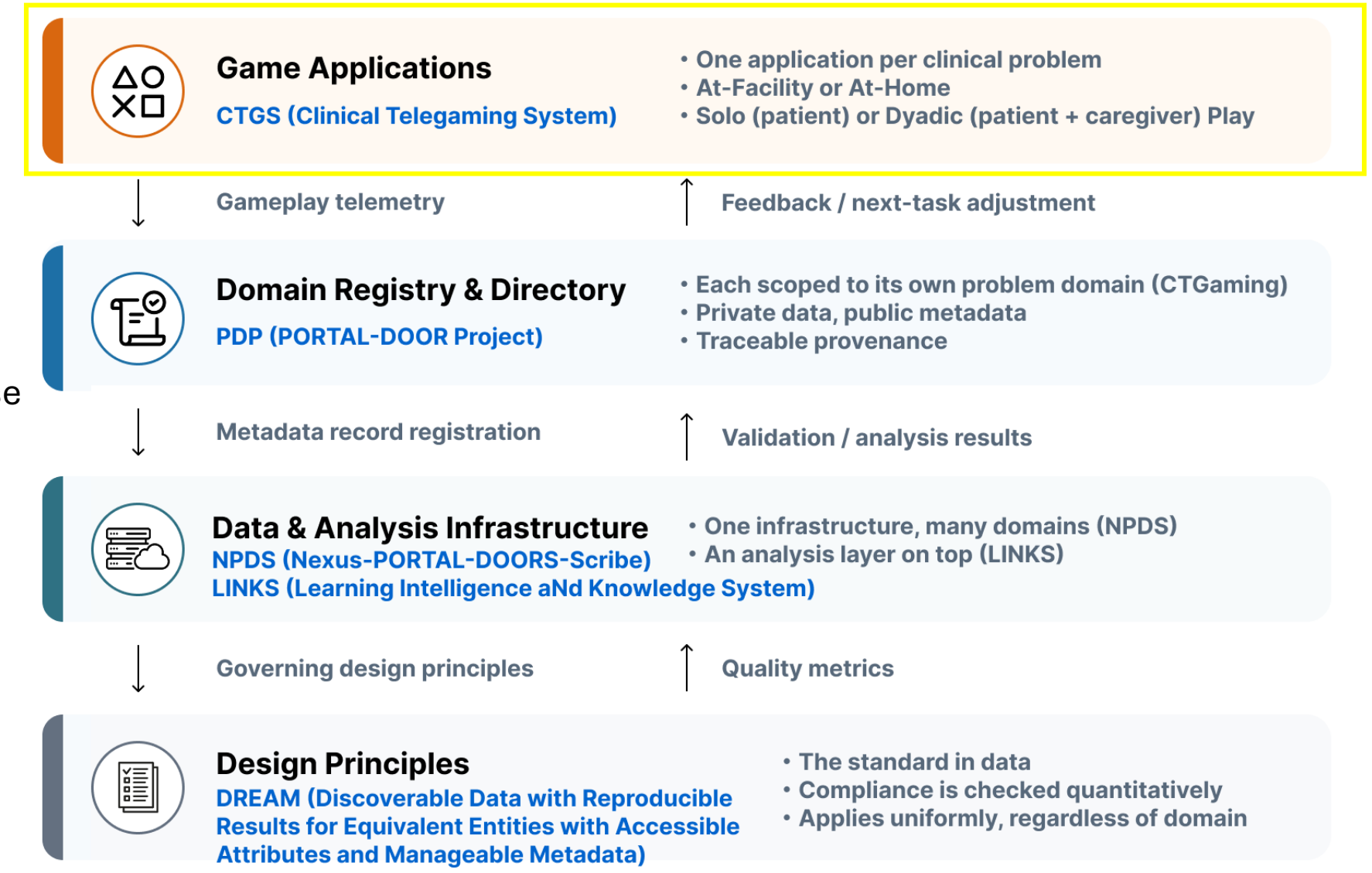
[†]The Hong Kong University of Science and Technology, Brain Health Alliance

October 9, 2026
At Newcastle University

Summary

Clinical Telegaming

- A Four-layer Architecture
- Illustrated with a game application for dementia caused by Alzheimer's disease



Dementia

An acquired brain syndrome of progressive cognitive decline

- **Decline across ≥2 cognitive domains**
  - Memory, attention, language, judgment, and more
- **Severe enough to disrupt independence** in daily activities
- **Caused by an underlying disease** of the brain nervous system
  - Most commonly Alzheimer's disease (60-70%)
  - Also cerebrovascular disease, Parkinson’s disease, Multiple Sclerosis, Pick’s disease, Lewy’s disease,

ICD-11 (The International Statistical Classification of Diseases and Related Health Problems version 11)

Alzheimer's Disease (AD)

What?

- A progressive brain disease
- Brain cells gradually die, causing the brain to atrophy
- Lead to cognitive define in memory, thinking and others



https://time.com/6245670/lecanemab-medicare-costs-alzheimers-drug/

Mechanism?

- Progressive accumulation of amyloid-β plaques in the brain
- Hypothesized (not yet proven) to be a major driver

Treatment?

- Since 2023, increasingly treated with Disease-Modifying Therapies (DMTs) to slow the underlying disease process itself
- Anti-amyloid antibodies that clear amyloid-β from the brain
  - Lecanemab (2023, biweekly infusion),
  - Donanemab (2024, monthly infusion)



https://pennmemorycenter.org/kisunla-donanemab/

Problems of DMTs for AD-caused dementia



Patients' Side

1. Medications and tests are costly
   - $ 40,000 ~ $80,000 (estimated, vary)
   - £60,000～£80,000 (not covered by NHS, private-pay only)
2. Side effects
   1. Brain swelling or bleeding (ARIA)
   2. Occasionally fatal
3. Sparse monitoring between visits
   - Misses how a patient's daily functioning actually unfolds at home
   - More frequent visits aren't realistic (added cost, time, and burden for patients with limited access)



Clinicians' Side

- Treatment-continuation decisions stay coarse-grained
  - Wasted spending
  - Unwarranted exposure to side effects

Approach: Design Game-based At-Home monitoring system



Patients' Side

- The game brings monitoring to where they already spend their time, at home
- Played solo or with a caregiver
- Also aims to improve well-being and quality of life through shared play with caregivers



Clinicians' Side

- Gameplay telemetry replaces the incomplete picture with continuous data between patient's clinic visits
- Digital biomarkers derived from it (e.g., recall accuracy, decision-making time)
- Support decisions on treatment-continuation

Gameplay telemetry: records of actions and performance during play

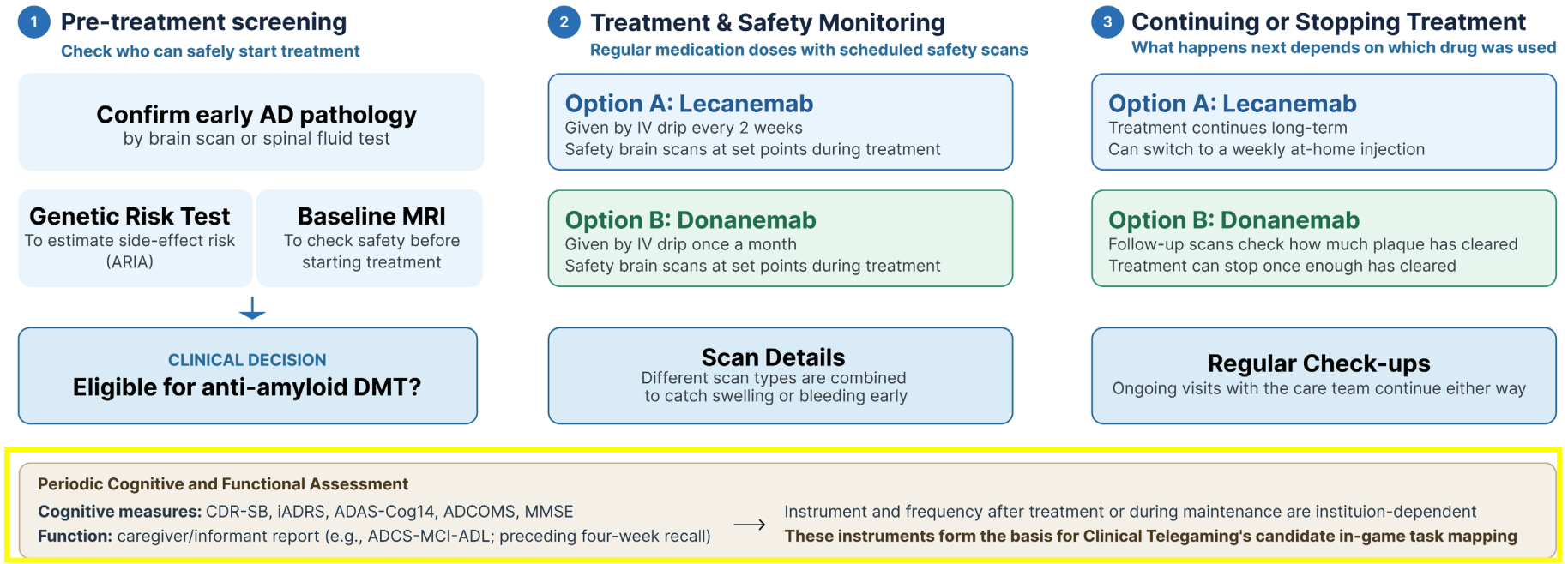
Research Questions

- **Game Design**
  - What game design can effectively engage patients and caregivers in at-home gameplay to continuously monitor cognitive and social functioning
  - in support of clinicians' treatment-continuation decisions for dementia care in anti-amyloid therapies?

Research Methods

- **Game Design**
  - Participatory design workshops with patients, caregivers, and clinicians
  - Iterative prototyping, following established game design frameworks
    - E.g., Outcome → Game Task → Gameplay Design pipeline (MDAO)
  - Longitudinal at-home deployment (~1 year), tracking session adherence and retention

Clinical endpoints for game task requirements



- Approach: Design game task based on cognitive and functional assessment already used during the monitoring phase
- Goal: complement DMTs by enabling more precise monitoring between clinic visits

Lecanemab: CDR-SB

- Overview by
  - question categories
  - Impairment degree

Questions for patients and caregivers respectively

Questions for caregivers

[Clinical Dementia Rating Worksheet]

CDR®
Clinical Dementia Rating Assessment Protocol

CLINICAL DEMENTIA RATING (CDR)

CLINICAL DEMENTIA RATING (CDR):	0	0.5	1	2	3

	Impairment				
	None 0	Questionable 0.5	Mild 1	Moderate 2	Severe 3
Memory	No memory loss or slight inconsistent forgetfulness	Consistent slight forgetfulness; partial recollection of events; "benign" forgetfulness	Moderate memory loss; more marked for recent events; defect interferes with everyday activities	Severe memory loss; only highly learned material retained; new material rapidly lost	Severe memory loss; only fragments remain
Orientation	Fully oriented	Fully oriented except for slight difficulty with time relationships	Moderate difficulty with time relationships; oriented for place at examination; may have geographic disorientation elsewhere	Severe difficulty with time relationships; usually disoriented to time, often to place	Oriented to person only
Judgment & Problem Solving	Solves everyday problems & handles business & financial affairs well; judgment good in relation to past performance	Slight impairment in solving problems, similarities, and differences	Moderate difficulty in handling problems, similarities, and differences; social judgment usually maintained	Severely impaired in handling problems, similarities, and differences; social judgment usually impaired	Unable to make judgments or solve problems
Community Affairs	Independent function at usual level in job, shopping, volunteer and social groups	Slight impairment in these activities	Unable to function independently at these activities although may still be engaged in some; appears normal at first glance	No possibility of independent function outside home Appears well enough to be taken to functions outside a family home	Appears too ill to be taken to functions outside a family home
Home and Hobbies	Life at home, hobbies, and intellectual interests well maintained	Life at home, hobbies, and intellectual interests slightly impaired	Mild but definite impairment of function at home; more difficult tasks abandoned; more complicated hobbies and interests abandoned	Only simple tasks preserved; very restricted interests, poorly maintained	No significant ability to do things in home
Personal Care	Fully capable of self-care		Needs prompting	Requires assistance in dressing, hygiene, keeping of personal belongings	Requires much help with personal care; frequent incontinence

Score only as decline from previous usual level due to cognitive loss, not impairment due to other factors.

Lecanemab: CDR-SB

- Overview by
  - question categories
  - Impairment degree

This is a semi-structured interview. Please ask all of these questions. Ask any additional questions necessary to determine the subject's Clinical Dementia Rating (CDR). Please note information from the additional questions.

Memory Questions for the person close to the subject:

1. Does he/she have a problem with his/her memory or thinking? ☐ Yes ☐ No

1a. If yes, is this a consistent problem (as opposed to inconsistent)? ☐ Yes ☐ No

2. Can he/she recall recent events? ☐ Usually ☐ Sometimes ☐ Rarely

3. Can he/she remember a short list of items (shopping)? ☐ Usually ☐ Sometimes ☐ Rarely

4. Has there been some decline in memory during the past year? ☐ Yes ☐ No

5. Is his/her memory impaired to such a degree that it would have interfered with his/her activities of daily life a few years ago (or pre-retirement activities)? (in the opinion of family and friends) ☐ Yes ☐ No

6. Does he/she completely forget a major event (e.g., trip, social function, family wedding) within a few weeks of the event? ☐ Usually ☐ Sometimes ☐ Rarely

7. Does he/she forget pertinent details of the major event? ☐ Usually ☐ Sometimes ☐ Rarely

8. Does he/she completely forget important information of the distant past (e.g., birthdate, wedding date, place of employment)? ☐ Usually ☐ Sometimes ☐ Rarely

9. Tell me about some recent event in his/her life that he/she should remember. (For later comparison with the subject's responses, obtain details such as location of the event, time of day, participants, how long the event was, when it ended and how the subject or other participants got there).

Within 1 week: _____

_____

_____

Clinical Dementia Rating Worksheet

Lecanemab: CDR-SB

- Overview by
  - question categories
  - Impairment degree

Judgment and Problem Solving Questions for Subject:

Instructions: If initial response by subject does not merit a grade 0, press the matter to identify the subject's best understanding of the problem. Circle nearest response.

Similarities:

Example: "How are a pencil and pen alike? (writing instruments)

How are these things alike?" Subject's Response

1. carrot……cauliflower _____
   (0 = vegetables)
   (1 = edible foods, living things, can be cooked, etc.)
   (2 = answers not pertinent; differences; buy them)

2. desk……bookcase _____
   (0 = furniture, office furniture; both hold books)
   (1 = wooden, legs)
   (2 = not pertinent, differences)

Differences:

Example: "What is the difference between sugar and vinegar? (sweet vs. sour)

What is the difference between these things?"

3. lie……mistake _____
   (0 = one deliberate, one unintentional)
   (1 = one bad the other good – or explains only one)
   (2 = anything else, similarities)

4. river……canal (lake……dam) _____
   (0 = natural - artificial)
   (2 = anything else)

Clinical Dementia Rating Worksheet

Lecanemab: CDR-SB

- Overview by
  - question categories
  - Impairment degree

Orientation Questions for Subject:

Record the subject's answer verbatim for each question

1. What is the date today? ☐ Correct ☐ Incorrect

2. What day of the week is it? ☐ Correct ☐ Incorrect

3. What is the month? ☐ Correct ☐ Incorrect

4. What is the year? ☐ Correct ☐ Incorrect

5. What is the name of this place? ☐ Correct ☐ Incorrect

6. What town or city are we in? ☐ Correct ☐ Incorrect

7. What time is it? ☐ Correct ☐ Incorrect

8. Does the subject know who the person close to the subject is (in your judgment)? ☐ Correct ☐ Incorrect

Clinical Dementia Rating Worksheet

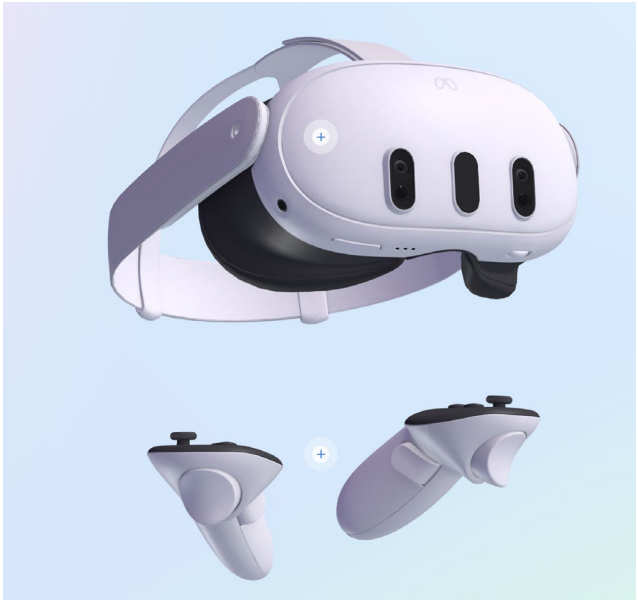
Game story: "A Day at the Market"

- **Morning — Orientation**
  - Patients open their in-game journal/calendar to start the day
  - Confirms today's date and day of the week before heading out
- **Midday — Judgment and Problem Solving**
  - Player visits a market with a shopping list: "Gather the vegetables for tonight's soup"
  - Must sort and collect items belonging to that category, ignoring distractors (tools, furniture, etc.) mixed in among them
- **Evening — Memory**
  - Back home, a caregiver character asks: "What did you pick up at the market today?"
  - Player must recall the specific objects they collected earlier in that same session — the same items from the Judgment task, now used as the delayed-recall target

Clinical Dementia Rating Worksheet

Game Application (VR)

- Studies show VR-based games are feasible and enjoyable for older adults with cognitive impairment, and support sustained engagement
- VR can simulate everyday activities in 3D, closer to real daily life than a clinic interview





https://www.meta.com/jp/en/quest/quest-3/
https://www.meta.com/jp/en/vr-glasses/

Thank you!

- Presenter: Kento Shigyo
- Affiliation
  - Department of Computer Science and Engineering, The Hong Kong University of Science and Technology
  - Brain Health Alliance
- Contact
  - kshigyo@bhavi.us

