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Introduction

The aim of this report is to analyse the health informatics aspects of managing Mild Cognitive Impairment (MCI) in a patient's journey, focusing on data capturing, data sharing, human factors, and digital transformation interventions. This study follows the fictional case of Mary, a 65-year-old retired schoolteacher exhibiting early cognitive decline symptoms with an ancestral history of Alzheimer's disease.

A lightweight modelling approach was adopted, using swimlane diagrams to map Mary's interactions across healthcare services, capture the flow of data between different electronic systems, and highlight patient experience touchpoints. The model was built according to NHS and NICE clinical care guidelines for MCI management. By tracing data movements across electronic health record (EHR) systems, laboratory systems, imaging platforms, referral systems, and patient portals, the analysis identifies critical challenges in data capture and integration, referral process delays, human interaction with technology, and measurement gaps.

The objective is not only to document Mary's healthcare journey but also to critically assess opportunities for digital health interventions that could improve her care experience and others who might be experiencing similar conditions. One specific digital solution - Intelligent Referral Prioritization System will be explored in greater detail to evaluate its feasibility, stakeholders, training requirements, expected benefits, challenges, and success metrics.

Background

Mild Cognitive Impairment and its Impact

Mild Cognitive Impairment (MCI) is characterised by a measurable decline in memory and cognitive functions greater than expected for a person's age but not severe enough to significantly impair daily living activities ([National Institute on Aging, 2024](#)). Common symptoms include short-term memory lapses, difficulty finding words, disorientation, and occasional challenges in planning and organizing tasks. Although MCI does not always progress to dementia, it is recognised as a major risk factor: approximately 10–15% of individuals with MCI develop Alzheimer's disease each year ([Alzheimer's Association, 2024](#)).

The global rise in aging populations has elevated MCI to a significant public health concern. Early detection and intervention are crucial because timely support can slow progression and preserve quality of life. NICE guidelines emphasise structured assessment pathways for suspected MCI, including cognitive screening, blood tests to rule out other causes, neuroimaging, and multidisciplinary care planning ([NICE, 2018](#)).

Mary's Profile

Mary is a 65-year-old retired elementary school teacher who has a family history of Alzheimer's disease on her maternal side. Her medical history includes hypertension and a minor stroke at the age of 61, increasing her vascular risk factors for cognitive decline. She engages in mild daily activity such as walking and participating in community events but maintains a diet high in sugar and sodium, further compounding her vascular risk profile.

Mary began experiencing noticeable memory lapses, speech difficulties, disorientation in new environments, and heightened anxiety regarding her cognitive performance. During a primary care consultation, these symptoms prompted her general practitioner (GP) to initiate a formal MCI investigation, following NHS and NICE protocols.

Diagnosis and Treatment Pathway

The diagnostic process typically begins in primary care, where tools such as the General Practitioner Assessment of Cognition (GPCOG) are employed to screen for cognitive deficits. Blood tests are ordered to exclude reversible causes such as vitamin deficiencies or thyroid dysfunction, with laboratory information systems (LIS) capturing and transmitting results electronically.

Patients with concerning cognitive profiles are referred to specialist Memory Clinics, where more detailed cognitive assessments, such as the Addenbrooke's Cognitive Examination III (ACE-III), are conducted. Neuroimaging (typically MRI scans) is used to assess structural brain changes, with imaging stored in Radiology Information Systems (RIS) and Picture Archiving and Communication Systems (PACS).

Once a diagnosis is established, management typically includes multidisciplinary input from occupational therapists, dietitians, speech and language therapists, and community mental health teams. Information about the patient is shared across various systems, including the NHS Spine for record synchronization, integrated care coordination platforms for appointment and care planning, and patient portals to allow direct access to diagnoses and follow-up plans.

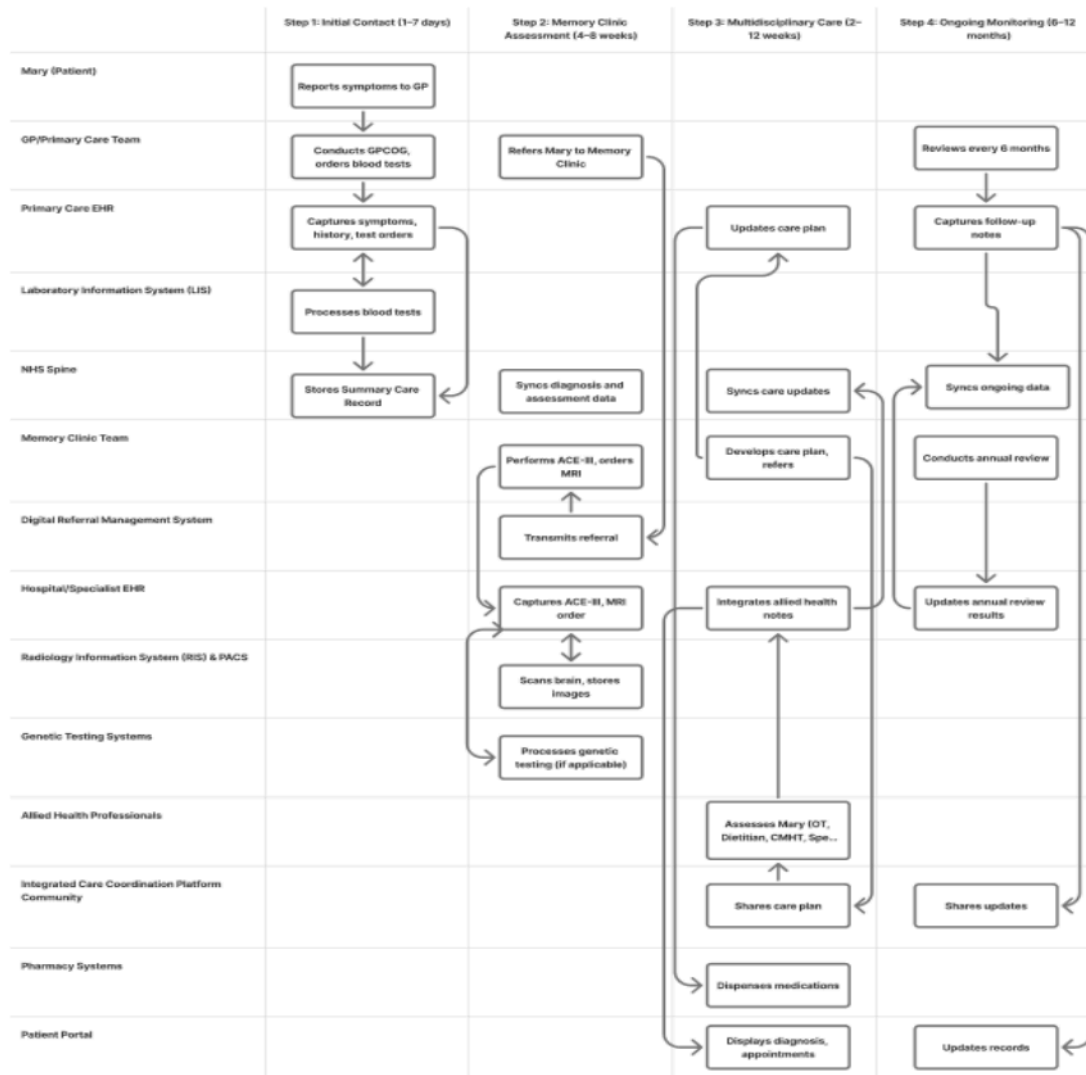
Importance of Health Informatics in MCI Management

Effective management of MCI relies heavily on accurate data capture, secure and efficient data sharing, and patient-centered digital tools. However, complex care pathways involving multiple healthcare providers and digital systems can introduce risks related to data silos, delays in communication, and barriers in patient engagement - especially for vulnerable populations such as those with cognitive impairments.

This report will explore these issues within Mary's case and propose a digital solution to address one specific challenge identified along her healthcare journey.

Patient Pathway

Mary's healthcare journey for Mild Cognitive Impairment (MCI) involves interactions with multiple healthcare professionals, diagnostic services, and electronic systems. Her care pathway can be divided into four key stages: initial contact with primary care, specialist memory clinic assessment, multidisciplinary support, and ongoing management and monitoring. Each stage features specific actors, data exchanges, and technological systems supporting communication and coordination of care.



(Using the diagram that our group made in early stages and based on this our swimlane was made.)

Step 1: Initial Contact with GP

Mary first presents to her General Practitioner (GP) with complaints of memory lapses, disorientation, and difficulties in conversation. The GP administers the General Practitioner Assessment of Cognition (GPCOG) test, orders blood investigations (e.g., thyroid function, vitamin B12 levels), and records clinical observations into the Primary Care Electronic Health Record (EHR) system (e.g., EMIS Web or SystemOne).

Blood test orders are electronically transmitted to the Laboratory Information System (LIS), which processes samples and returns results to the GP via secure NHS infrastructure. Summary information, including current medications, allergies, and test requests, is updated in the NHS Spine to ensure centralised access across care settings.

Potential data issues at this stage include incomplete capture of detailed family history and variable data synchronization speeds between the GP's EHR and the NHS Spine.

Step 2: Memory Clinic Assessment

Based on cognitive screening results, Mary is referred to a specialist memory clinic. The Digital Referral Management System transmits the referral details, including clinical notes and investigation results, via the NHS Spine to the Memory Clinic EHR.

At the Memory Clinic, Mary undergoes comprehensive cognitive assessment using tools such as the Addenbrooke's Cognitive Examination III (ACE-III). To support diagnosis, an MRI scan is requested. The Hospital/Specialist EHR communicates the imaging request to the Radiology Information System (RIS), and the scan images are stored in the Picture Archiving and Communication System (PACS). The radiology report and images are linked back to the Hospital EHR for clinician review.

If deemed appropriate due to family history, optional genetic testing (e.g., for the APOE ε4 gene variant) is offered, with results integrated into the patient's Hospital EHR.

Challenges identified in this stage include potential delays due to off-site imaging services, paper-based blood test orders creating data islands, and interoperability issues between RIS/PACS and the EHR.

Step 3: Multidisciplinary Care and Support

Following a diagnosis of Mild Cognitive Impairment, Mary's management plan is coordinated by a multidisciplinary team involving occupational therapists, dietitians, speech and language therapists, and the community mental health team (CMHT).

The Memory Clinic develops a personalised care plan, with scheduling and updates shared through the Integrated Care Coordination Platform. Allied health professionals document

assessments and interventions into their respective Allied Health Professional Systems, with key updates fed back into the Hospital/Specialist EHR. Community pharmacy systems dispense medications prescribed by primary or specialist care.

Mary and her caregivers gain access to elements of her diagnosis, appointments, and care plans via the Patient Portal, which synchronises data from the Hospital EHR.

At this stage, risks include communication delays between Allied Health Professionals and the primary care provider, potential fragmentation of patient information across specialist systems, and the patient's or caregiver's difficulty navigating digital tools.

Step 4: Ongoing Management and Monitoring

Ongoing monitoring is essential to assess progression and adapt Mary's care plan. Her GP conducts six-monthly reviews, while the Memory Clinic performs annual assessments. Updates from both services are captured in their respective EHRs and synchronised via the NHS Spine to ensure continuity of information across providers.

Mary continues to access her care updates via the Patient Portal, while prescription renewals and monitoring of comorbidities (e.g., hypertension) are managed through primary care services.

Potential challenges in this phase include slow update cycles between services, risk of missed appointments due to Mary's memory issues, and limited personalization of care communications to address cognitive impairments.

Summary of Actors and Systems Involved

Actor	Role	System/Platform
Mary	Patient	Patient Portal
GP	Primary care diagnosis and monitoring	Primary Care EHR, NHS Spine
Practice Healthcare Assistant	Support with screening tests	Primary Care EHR
Memory Clinic Team	Specialised cognitive assessment and diagnosis	Memory Clinic EHR
Laboratory Technicians	Process blood samples	Laboratory Information System (LIS)

Radiologist	Conduct MRI scans	RIS/PACS
Occupational Therapist, Dietitian, Speech Therapist	Allied health support	Allied Health Systems, Integrated Care Coordination Platform
Community Mental Health Team	Psychological support	Specialist EHR
Pharmacist	Dispense medications	Community Pharmacy Systems

Data-flows between Actors

Data Type	Source	Destination(s)
Symptoms Data	Patient/GP	GP EHR → NHS Spine
Appointment Info	GP/Clinic Systems	GP/Clinic EHRs
Test Requests (Blood/MRI)	GP/Clinic	Lab / Radiology Systems
Test Results	Labs / Imaging	Clinic EHRs → GP EHR → NHS Spine
Cognitive Assessments	GP/Clinic	EHRs → NHS Spine
Diagnosis & Risk Flags	Clinic	GP EHR → NHS Spine
Care Plans	GP / Memory Clinic	Primary Care Team → NHS Spine → Allied Health / Pharmacy
Allied Health Notes	Allied Healthcare Systems	GP / Memory Clinic (manually or via integration)
Medication Updates	GP / Memory Clinic	Pharmacy Systems → Patient Portal
Follow-Up Notes	GP	NHS Spine → Memory Clinic / Care Team

These data flows are critical to ensuring continuity of care but are vulnerable to fragmentation and delays, as discussed in later sections. **(using the image of the data flow that was in the group presentation)**

Insights, Challenges, and Suggested Solutions

Analysis of Mary's healthcare journey revealed multiple insights into the strengths and weaknesses of current health informatics infrastructure. Also, with the help of comments provided by Helen on our group presentation, I was able to find multiple issues many of which were health informatics related and some were not. I'm only discussing the health informatics related solutions in this essay. Basically the challenges and solutions that might help provide valuable opportunities for digital enhancement of Mary's care pathway and others.

Data Capture and Integration Challenges - A prominent issue in Mary's care pathway was data silos and integration issues. Cognitive assessment tools, such as the GPCOG and ACE-III, often exist as standalone forms rather than structured data within the Electronic Health Records (EHRs), which made it difficult for clinicians to access and analyse these results quickly. Additionally, imaging data from the Picture Archiving and Communication Systems (PACS) and genetic test results (e.g., for APOE ε4) are not always seamlessly transmitted to referring clinicians. This lack of integration complicates the process of decision-making, as data is fragmented across multiple systems. Paper-based processes, such as blood test requests, create further data islands, delaying the timely integration of crucial patient information.

The **Referral Process Delays** also emerged as a critical bottleneck in Mary's pathway. The wait time for Memory Clinic assessments often extends from 4 to 8 weeks, creating significant challenges for timely diagnosis and intervention. Referral prioritization is largely manual, with family history data not systematically used to identify high-risk patients. Moreover, current digital referral systems do not integrate risk stratification tools, meaning high-risk MCI patients, like Mary, are not flagged for expedited assessments. The absence of status updates during this waiting period means that neither the patient nor the GP is informed about the progress, adding to the uncertainty and anxiety experienced by patients.

In addition to these technical challenges, **Human Factors** play a significant role in Mary's care. As Mary's cognitive difficulties increase, navigating complex digital systems becomes more difficult. Current appointment reminders, which are predominantly email-based, do not account for Mary's memory impairment. Family caregivers also lack dedicated digital tools to assist with care coordination. Furthermore, clinicians face alert fatigue due to the disconnected systems that often require manual data entry and cross-checking. This inefficiency increases the cognitive burden on both patients and care teams.

Additionally, **Measurement Gaps** were identified in Mary's care. There is no standardised digital method for tracking progression metrics between assessments, such as cognitive scores over time. Furthermore, patient-reported outcomes, including anxiety levels, are not systematically captured, which limits the care team's ability to address mental health concerns proactively. Moreover, family observations, a critical aspect of monitoring Mary's day-to-day condition, are not regularly incorporated into her care plan.

These informatics challenges not only contribute to delays in diagnostic clarity and treatment initiation but also create care coordination burdens for both Mary and the healthcare providers. The delays, lack of integration, and failure to track important metrics increase patient anxiety during waiting periods, hinder early intervention opportunities, and ultimately impact patient outcomes.

Some of the solutions to the challenges just discussed are mentioned below and later one of the solutions is discussed in detail:

An Intelligent Referral Prioritization System could incorporate algorithmic risk scoring that factors in family history, vascular risks, and genetic data (APOE ε4) when available. Automated triage flags for high-risk MCI patients would streamline the referral process and reduce diagnostic delays. By integrating with existing systems like the Digital Referral Management System and NHS Spine, this tool could offer real-time prioritization based on clinically validated risk profiles.

Enhanced Appointment Support could include multimodal reminders (SMS, voice calls) tailored to cognitive needs, caregiver-facing notification options, and progressive escalation for non-response. This would help patients like Mary, who may forget appointments due to memory impairment, and ensure that critical diagnostic and follow-up appointments are not missed.

Integrated Cognitive Monitoring might involve digital versions of standard assessments (GPCOG, ACE-III), between visit cognitive tracking via patient/caregiver portals, and automated analysis of longitudinal trends. This would allow for proactive monitoring of cognitive changes and alert clinicians to early signs of decline or complications between formal assessments.

A Caregiver Digital Support System could offer a secure portal for family observations and concerns, a resource library with training materials, and communication channels with the care team. By involving caregivers more directly through digital tools, the care experience could become more collaborative and responsive to daily patient challenges.

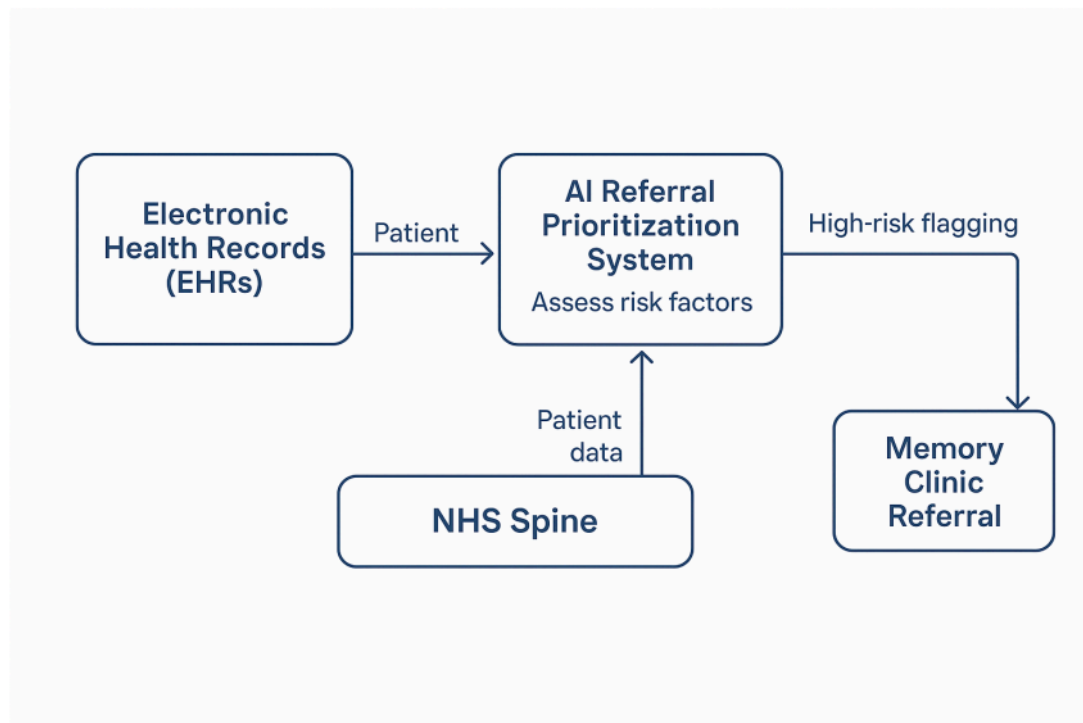
Interoperability Improvements could include AI-assisted data reconciliation across systems, structured data capture for cognitive assessments, and automated reporting to primary care during wait periods. This would reduce information loss, prevent redundant testing, and ensure all clinicians involved in Mary's care are operating with the most current data.

While all solutions show promise, the referral prioritization system addresses the most critical delay in Mary's pathway while leveraging existing NHS digital infrastructure.

Intelligent Referral Prioritization System

The main issue I'm focusing on is the 4-8 week wait for a Memory Clinic assessment, which causes multiple problems. The delay leads to uncertainty about the diagnosis, making both the patient and their caregivers anxious. During this time, the condition could be progressing without proper monitoring, risk factors (like Mary's hypertension) are left unaddressed, and early interventions like cognitive rehabilitation or lifestyle changes get delayed. The current process of triaging referrals is manual, and it doesn't take full advantage of available risk data - such as family history, vascular factors, and genetic markers - that could help prioritise high-risk patients like Mary.

My solution is an AI-powered referral prioritization system that would integrate with the existing NHS digital infrastructure. This system would pull structured data from the GP's EHR (like family history, vascular risks, cognitive test scores, and medications - SNOMED CT), then run it through evidence-based algorithms that apply MCI progression models. This would identify patients at high risk and flag them for quicker review.



(This is what the proposed structure looks like for the solution.)

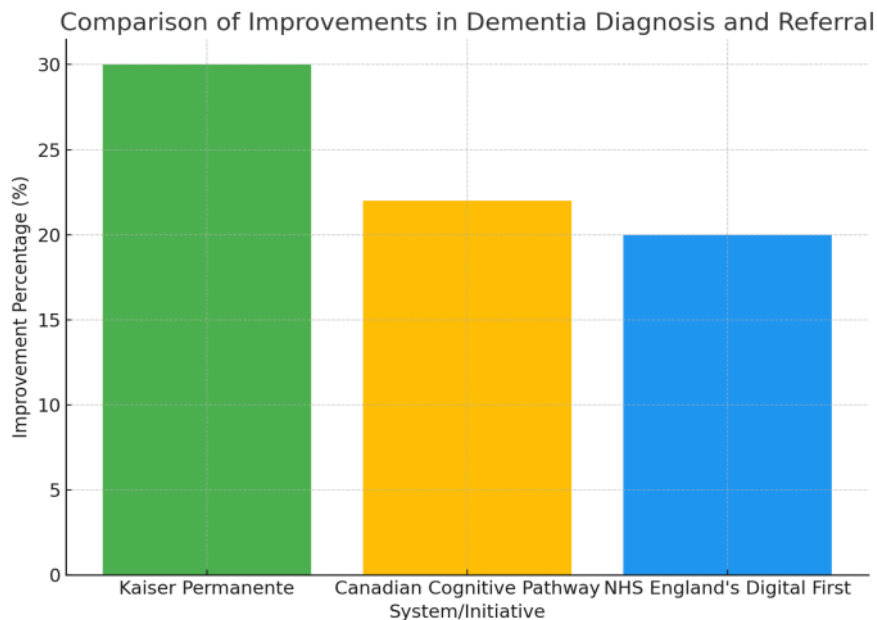
The system would work with the NHS Spine to update patient records, send referral prioritization flags through the Digital Referral System, and even provide updates to patients through the Patient Portal. It would also help doctors by suggesting additional tests (like genetic testing or more imaging) and offering guidance on how to manage cases in the meantime, all with simple, patient-friendly explanations.

In terms of implementation, it would involve some stakeholders: GPs would only need minimal extra work to input data into the system, and the Memory Clinics would need to adjust workflows to handle prioritised cases. Patients would need clear communication about how their referrals are being prioritised, and NHS Digital would oversee the tech integration to ensure everything runs smoothly.

Technically speaking, the system would be a modular add-on to existing NHS referral platforms, using FHIR standards to pull data from EHRs, NHS Identity for secure logins, and approved cloud infrastructure for hosting. Training would be pretty straightforward - GP staff would need a brief session on enhanced referral forms, and Memory Clinic teams would need to adjust their processes to handle these new prioritised cases. Patients may need help navigating the patient portal as well.

For evaluation, we would look at key metrics like how much wait times go down for high-risk patients, how quickly they get diagnosed and treated, patient and caregiver satisfaction, and how well clinicians can use the system.

There is evidence from systems like **Kaiser Permanente's dementia risk stratification**, which reported improvements in diagnosis timelines (numbers are not exact but expect near 30%), and the **Canadian Cognitive Impairment Pathway**, which improved appropriate referrals by 22%. NHS England's **Digital First initiative** also shows how feasible this kind of integration can be. The NHS Digital First initiative has provisions for referral for cases with high priority to the Memory Clinic, but these referrals to Memory Clinics are typically triaged manually by humans (e.g., triage nurses or administrators) without standardised risk scoring. They do not systematically use structured data - SNOMED CT (like family history, vascular risk, or cognitive scores) for prioritization. What I'm trying to propose is a risk stratification algorithm embedded in the referral system that automatically flags high-risk patients using structured EHR data and evidence-based models. This will make the system proactive, personalised, and automated - something current NHS systems don't yet offer in this context.



(The solution discussed will improve the referral time by nearly 20%)

Some challenges to keep in mind: ensuring the algorithm is fair across different demographics, making sure clinicians still oversee automated decisions, and managing the increased demand for assessments from those identified as high-risk.

On the positive side, this system would provide real benefits not just to Mary but also to other patients who have similar conditions - mainly reducing anxiety by speeding up diagnosis and intervention, offering earlier help with modifiable risks, and giving them more timely access to support. It would also improve their experience by keeping them informed and tracking progress more transparently.

For the healthcare system, there are big wins too. It would help allocate specialist resources more efficiently, reduce unnecessary tests for lower-risk patients, improve data capture for population health, and align with value-based care models. But of course, there are hurdles. Data quality, like ensuring family history is recorded properly, could be an issue. Different EHR systems across the country might need to be integrated, and clinicians may be hesitant to trust algorithmic recommendations completely. Balancing automation with clinical judgment is key, and there could be resource concerns when dealing with prioritised cases.

Ethically, we need to ensure the system doesn't disadvantage elderly patients who might not be as comfortable with technology, and there must always be human oversight of the automated

prioritization. Also, the system should be transparent in how it makes decisions and how genetic data is used.

Looking at international models highlights how other health systems address similar challenges and underscores the importance of improving triage in the UK. For instance, in the **Netherlands**, memory assessments are often conducted directly in primary care settings rather than requiring specialist referrals. This decentralization helps reduce delays and allows for earlier identification and management of cognitive issues, showing that quicker access points can make a significant difference. In **Australia**, digital risk stratification tools have been embedded into dementia care pathways, allowing clinicians to flag high-risk individuals earlier and tailor interventions more precisely - an approach that closely aligns with the proposed intelligent referral system. Finally, in the **United States**, early dementia identification is a priority in value-based care models, where providers are incentivised to detect and manage cognitive decline sooner in order to improve outcomes and reduce long-term costs. Each of these systems demonstrates how integrating digital tools into referral and triage processes can lead to more timely, equitable, and effective care for patients with cognitive concerns.

The solution suggested aligns with NHS Long Term Plan priorities around earlier diagnosis (as seen in cancer care models), digital-first healthcare, personalised care approaches, and prevention-focused models.

Conclusion

Mary's journey through the MCI care pathway highlights critical opportunities for health informatics interventions to enhance both clinical efficiency and patient experience. The proposed intelligent referral prioritization system addresses the most significant delay in her pathway while building upon existing NHS digital infrastructure.

One key takeaway from this analysis is that there is already valuable data available to help identify high-risk MCI patients earlier, but it is not being used effectively at the moment. Digital solutions, like the one I have suggested, can help reduce delays without the need for more specialists or resources. It is also clear that patient-centered design is essential, especially when dealing with patients with cognitive impairments, ensuring that the system is accessible and supportive for them. Rather than replacing existing systems entirely, enhancing what is already in place with modular improvements is a much more practical and feasible approach.

For this to succeed, it would be important to implement the solution step by step, making sure it's continuously evaluated. There needs to be close collaboration with clinicians on the ground, and involving both patients and caregivers in the design process will be key. It is also crucial that the algorithms used in this system are developed ethically.

Overall, this project shows how health informatics can turn theoretical models into tangible improvements for managing chronic conditions. For patients like Mary, innovations like this

could provide earlier reassurance, more timely interventions, and ultimately lead to better long-term outcomes as they navigate challenges like Mild Cognitive Impairment.

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86/100

Disease pathway background research 8.5(10):

Comments

Well done with a really clear statement of aims, which is followed through in all sections.

Pathway modelling, data capture and sharing in the pathway 8 (10) :

Comments This rpathway development contains clear steps and insights throughout, with plenty of attention to both data and the patient experience

Analysis of the pathway9(10):

Comments This is the strongest aspect of this report. The problems are mapped well to practical solutions that fall within the current capabilities of digital technology types. Well done with literature searches and comparisons with other countries

Report Quality 9(10)

Comments High quality report with the subject of study placed withing context of relevant literature, well done.

Final mark (40)

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