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AI For Business – MIS716

Assignment 3

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Executive Summary

This report aims to provide a comprehensive overview on how to manage risks and implement 3 AI solutions. The solutions proposed has been designed to improve patient flow within the mental health division. Managing patient flow within a mental health division poses additional challenges that is not seen in any other areas due to the complexities in providing diagnosis and identifying the best treatment plan for the patients.

The proposed solution to improve patient flow within the mental health clinic is an integrated solution with 3 different tools and models, and the solution aims to predominantly reduce administrative workloads of the healthcare support staff, psychiatric professionals and admissions officers. One part of the proposed solution will also see some benefits to patients in terms of improving access to managing appointment bookings.

Below are the 3 solutions and its key benefits that will be integrated into the existing technology infrastructure:

- 1) Virtual Assistant and Chatbot – Implemented to reduce administrative workload of healthcare support staff around managing appointment bookings, scheduling calendars of psychiatrists and sending reminders to patient. This solution will also benefit patients to allow them to easily schedule or reschedule appointments. This will indirectly improve patient flow as more healthcare support staff can be redeployed to support the wards and more patients can be admitted.
- 2) AI ANN Model – This model will be designed and integrated to provide an estimate of patient length of stay once admitted using patient historical data. This will also enable admissions officers to forward plan for busy periods and ensure wards are staffed adequately.
- 3) AI NLP Assisted Transcribing and Dictation – This tool uses natural language processing to listen to audio recordings of therapeutic sessions between the Psychiatrist and patient and will then convert the discussions into medical notes and coding into the patient EHR system. This tool will free up time of the psychiatrist to manually synthesise and enter this data to the system, thus enabling them to see more patients and improving patient flow.

Project Overview

Metta Wise Health (MWHealth) is a hospital within a large chain of health care services providers throughout Melbourne. The client is experiencing significant problems due to administrative workloads that is blocking patient flow in their specialists' clinics such as diabetics, cardiovascular and mental health.

This report will propose a solution designed specifically to reduce the administrative workload within the mental health clinic to improve patient flow. The stakeholders the solutions will benefit are the patients, Admissions Officers, Healthcare Support Officers, and Psychiatric Professionals.

Managing patient flow within a mental health division is a challenging task as the complexities around diagnosis and treatments varies significantly between each patient. When dealing with mental health issues, two patients can exhibit identical symptoms and diagnosis, but may require completely different

treatment plans. Poor patient flow not only impact the patients, but will also impact the staff of MWHealth, as they may end up being overstretched with too many patients to attend to.

Poor patient flow is caused due to a combination of factors such as the increased complexity and volume in medical data collected, poor capacity management and resource allocation, and increased rate of readmission, which is often caused by misdiagnosis, incorrect treatment or not having enough systems in place for post release care plans and treatment adherence (Dawoodbhoy, et al., 2021).

Value Proposition

The solution that we are proposing is an integrated hybrid solution that will be embedded within the Electronic Health Records (EHR) system, Admissions and Appointment management system, and patient consultation note transcribing system.

By using machine learning techniques, MWHealth will be equipped to estimate length of stay of admitted patients to allow for better ward capacity planning and resourcing to improve patient flow and identify peak periods.

Using a virtual assistant to automate administrative tasks such as appointment scheduling and reminders, clinician availability, this will drastically reduce the workload of health care support officers who can then be redeployed to support patient care within the wards enabling more patients to be admitted into the wards.

By implementing an AI NLP assisted transcribing tool, this will improve patient flow as the psychiatric professionals will have additional time to see more patients, and this solution will also benefit MWHealth in the long run as there will be improved quality in the data recorded in the EHR system.

When the data is coded consistently with minimal errors MWHealth can then start to implement other AI solutions in the longer term, such as models predicting if a patient needs to be admitted or not, as another factor affecting patient flow in a mental health unit is one where patients that are low risk are misdiagnosed and admitted to be treated in the hospital, when this bed could have been used for a high risk patient. Due to complexities around mental health care, misdiagnosis is one the biggest barriers to patient flow (Al-Huthail, 2008)

Approach

As part of the scoping process to understand the business needs and find a solution that is fit for purpose, we used a combination of tools and frameworks such as generating user stories, an integrated risk management framework (RAI), Business, Human and Technology (BHT) framework and an opportunity grid to assess the complexity and prioritisation of the solutions proposed.

BHT Framework

BHT framework is a tool that can be utilised to understand the business perspective, human experience with AI and technology fit when implementing an AI solution.

BHT - Business

We've assessed the business perspective within the BHT framework in terms of needs of the business, the AI solution itself, changes the business needs to consider, stakeholders the solution will impact, the value the solution will bring and contexts that needs further consideration. Image 1: Business Perspective – BHT Framework is a summary of the considerations we have placed around business perspective.

Three main needs were identified, and these were, reduce administrative workload around managing appointments and calendar availability using a virtual assistant, better estimate length of stay of each patient to better manage ward capacity and patient flow using machine learning techniques and using Natural Language Processing (NLP), reduce manual data entry of psychiatric session notes to free up time of psychiatric professionals to see more patients.

These solutions will bring about changes around how the patient and health care support professionals manage appointment booking and reminders, with our proposed solution, patients will be interacting with a chatbot to book in their appointments, and from here the chatbot will trigger a few rules based actions to schedule the appointment in the calendars of the psychiatric professionals and send out reminders to the patient closer to the appointment date. This will also bring about changes with the job descriptions of the health care support staff, where administrative tasks will be removed, and priority will be to provide support care to health care professionals within the mental health ward.

MWHealth will also have a new tool that can help them manage ward capacity and pre-empt for surges in demand thus ensuring resources are allocated adequately. This tool can be used by the admissions officers to support their decision-making process, and not replace it completely as these estimates in length of stay should be used with caution due to complexities surrounding mental health cases. There will also be changes in the Psychiatric professional's job roles, where data entry into the EHR system will no longer be required.

When scoping the development of the AI tools to implement, consideration was given to the data source and content, AI techniques and application and we also adopted the user stories techniques to better understand who our stakeholders were in this project, and how these tools can improve their overall experience. Image 2: AI Tools Scoping Process provides a detailed breakdown of considerations included.

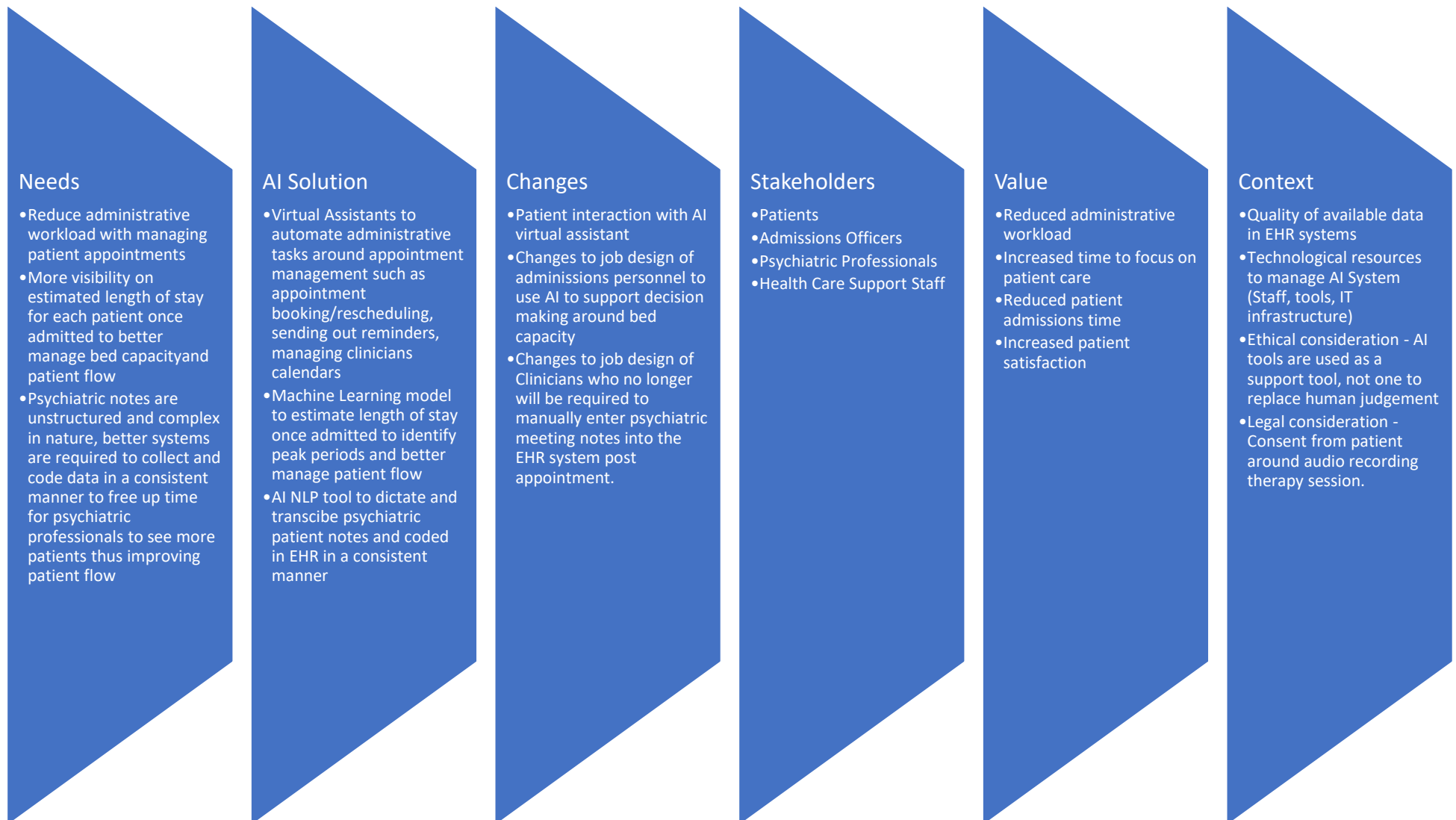


Image 1: Business Perspective – BHT Framework

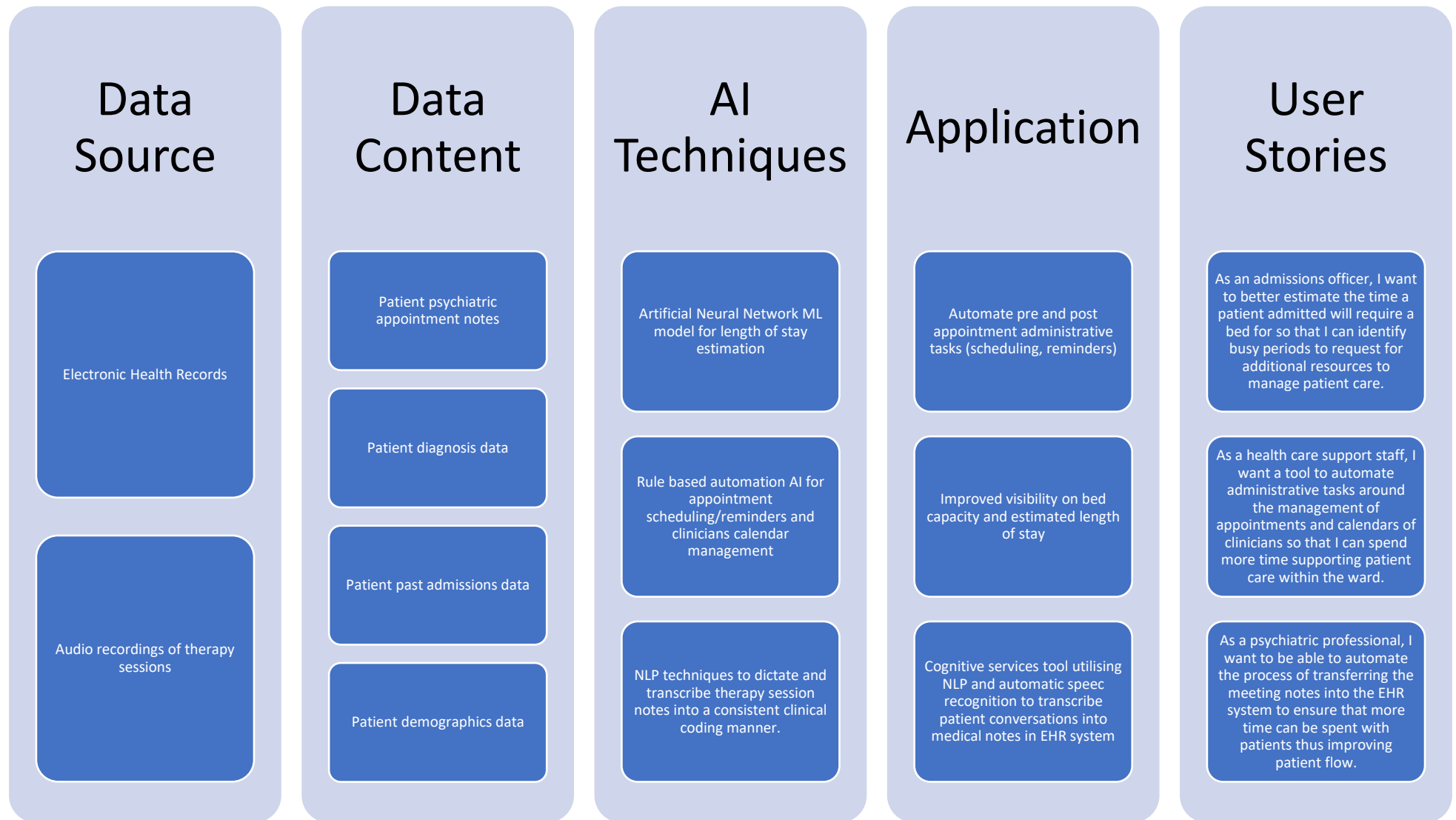


Image 2: AI Tools Scoping Process

BHT - Human

To consider the human experience with the proposed AI solution, we assessed this from the perspectives of the Patient, Admissions Officers, Health Care Support Staff and Psychiatric Professionals. Within these stakeholders' perspectives, we utilised the framework of knowing, engaging, and enabling to further understand how these solutions will be perceived and adopted by the stakeholders impacted. We also considered some risks that may present when implementing these solutions pertaining the stakeholder. Please refer to image 3 to 6 for a detailed summary for each stakeholder.

BHT - Technology

The final element within the BHT framework to discuss is the technological effort, fit and deployment approach to implement the proposed solutions.

During our initial research, we found that misdiagnosis and risk of treatment discontinuation, past substance abuse was found to be contributing factors to patient readmission into the mental health ward, which influences patient flow (Zhang, et al., 2011). We were looking at implementing a tool to accurately predict diagnosis, suggest a treatment plan and an app to support patients post being discharged on how to stay on top of their treatment plan. However utilising tools such as the opportunity grid, we found this would be one that provides high value but one that is of high complexity as well due to the nature in diagnosing mental health cases and providing a personalised care plan. We do recommend that MWHealth includes this thought in the longer-term strategic business planning to implement in the future.

For the solutions that we are proposing, image 7 to 9 is a breakdown of considerations around technological effort, fit and approach that was included as part of the scoping of this project for all 3 of the proposed solutions.

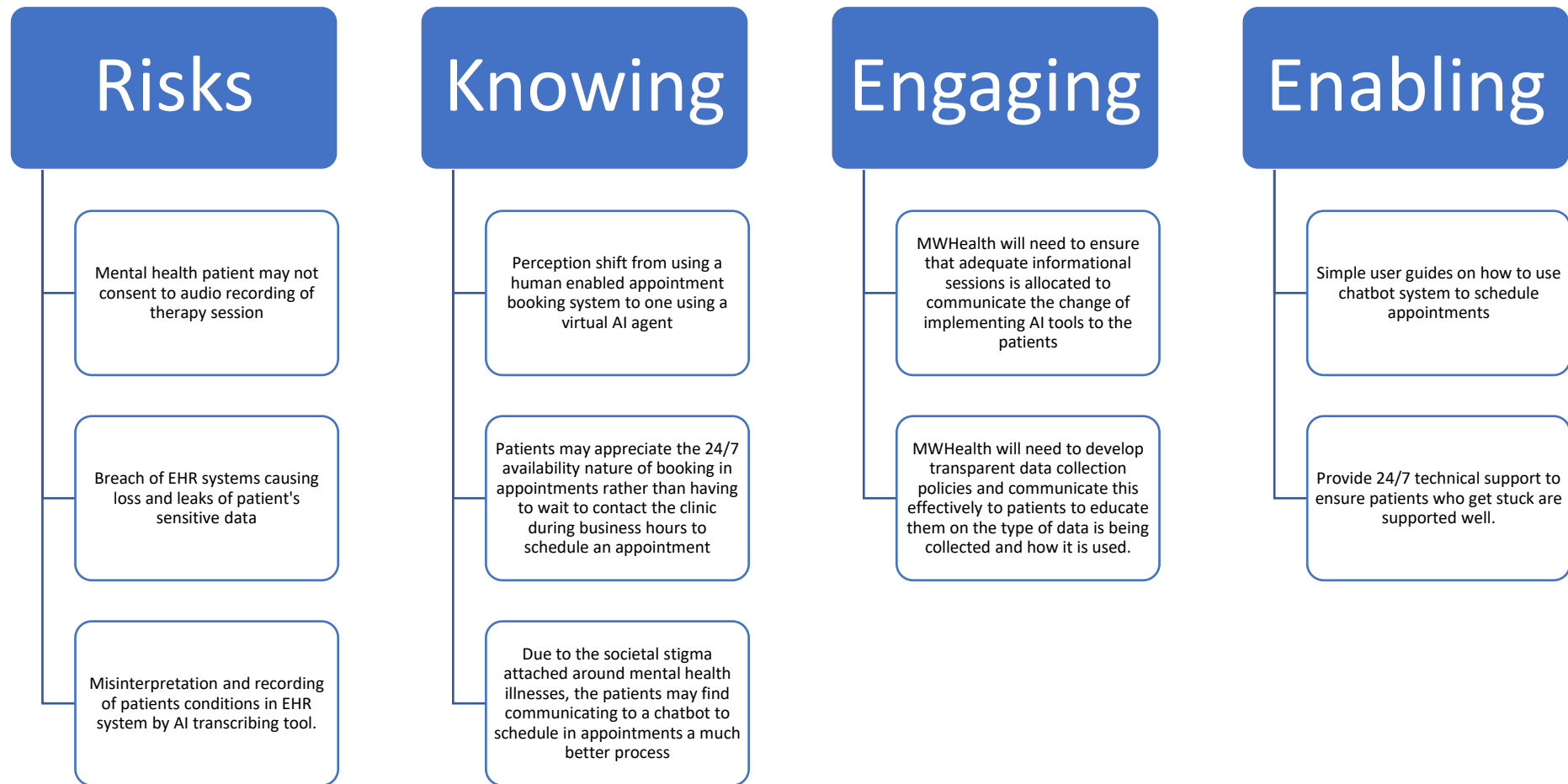


Image 3 – Stakeholder: Mental Health Patient

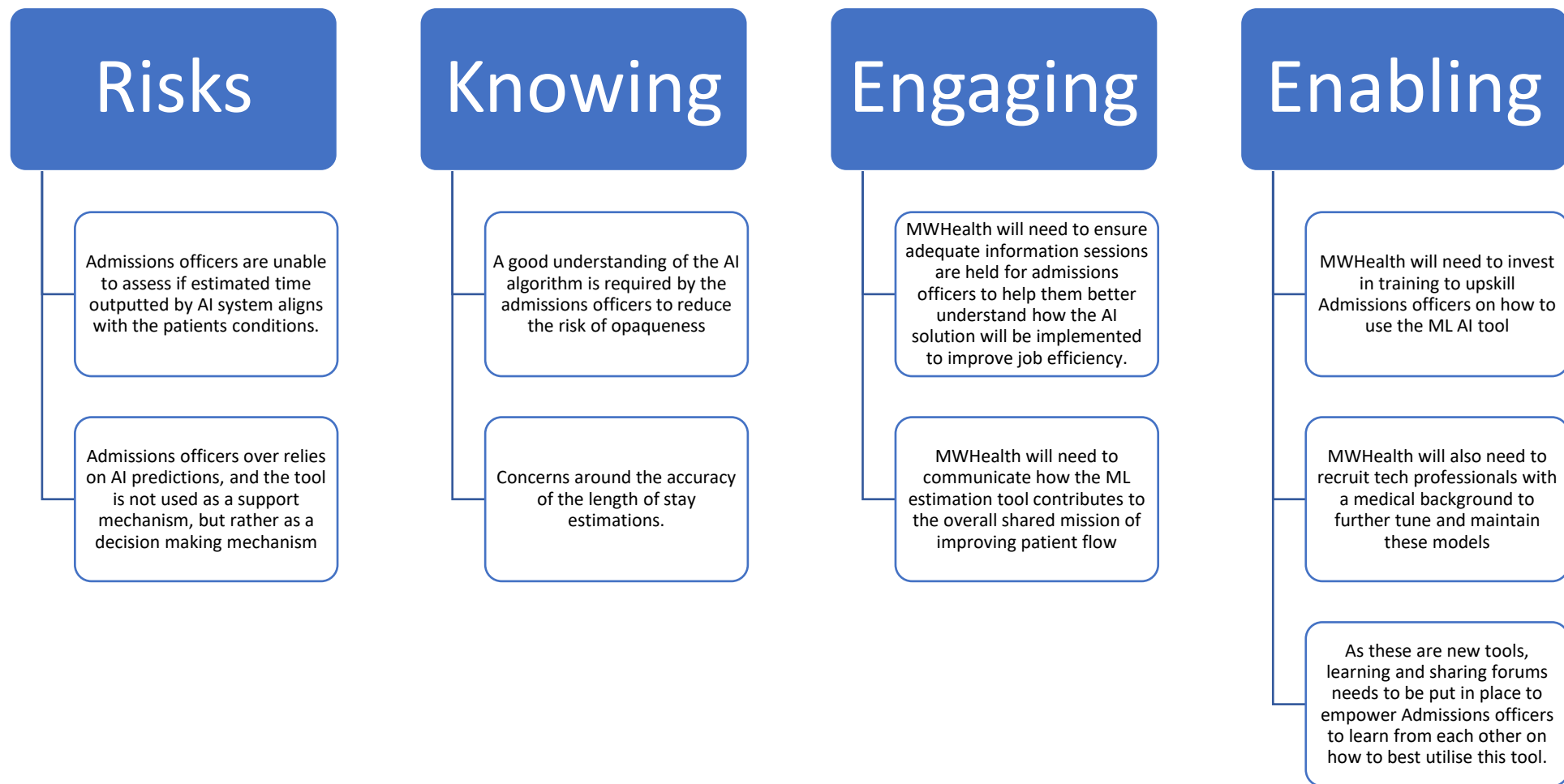


Image 4 – Stakeholder: Admissions Officers

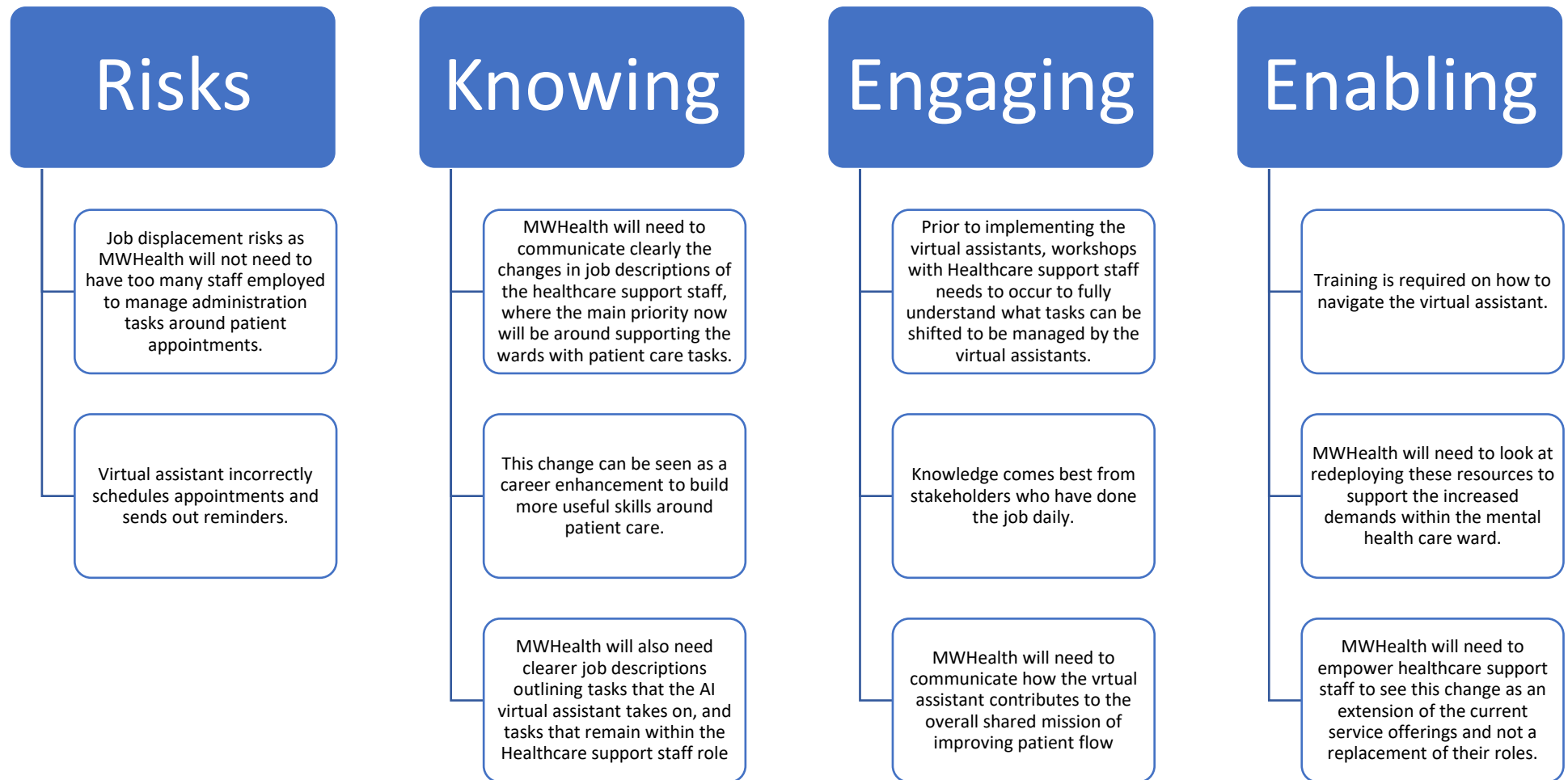


Image 5 – Stakeholder: Healthcare Support Staff

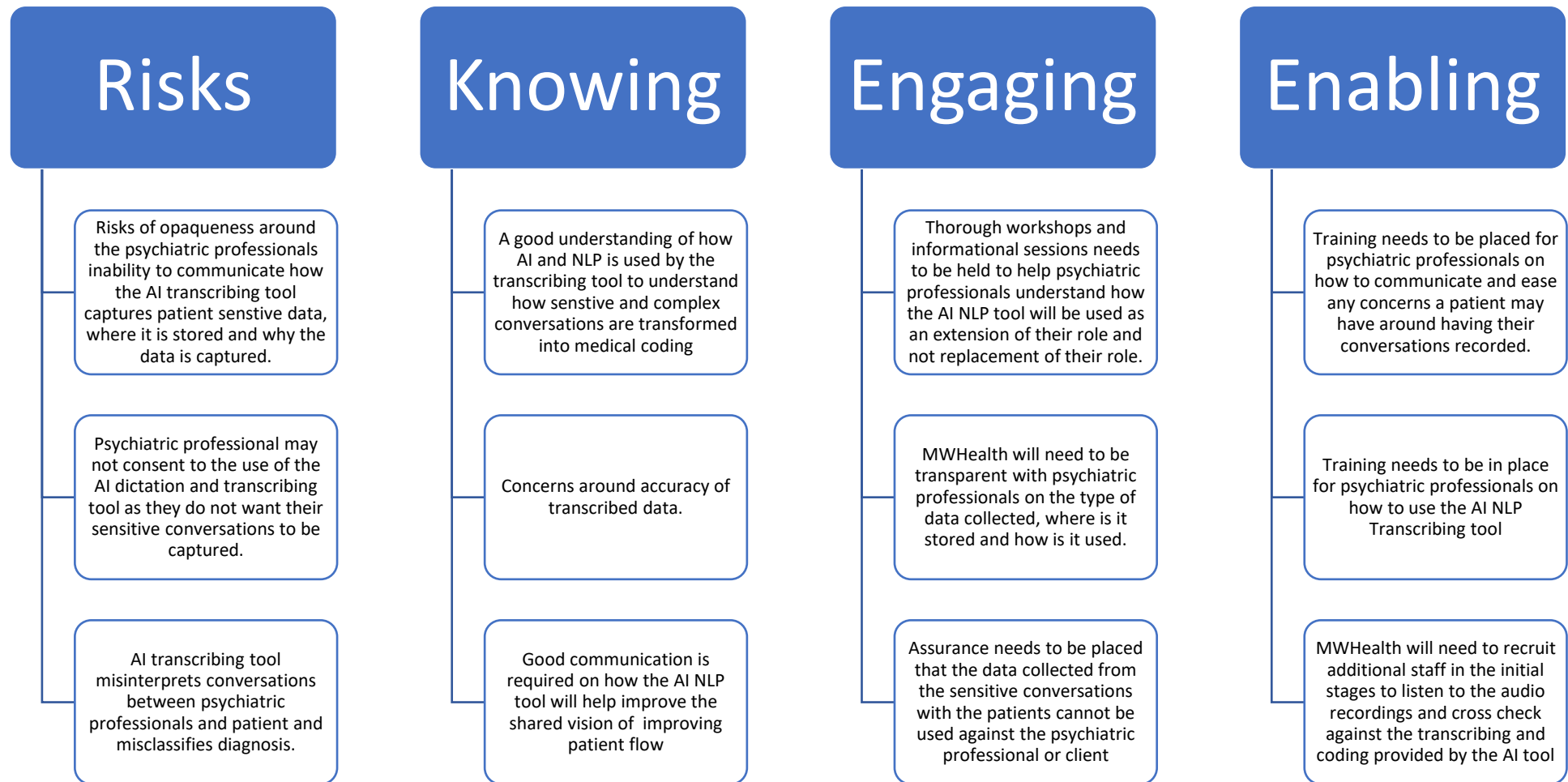


Image 6 – Stakeholder: Psychiatric Professionals

AI Solution (Moderate Effort)	Technology Environment (Fit)	Approach (How)
<ul style="list-style-type: none"> • Analyse existing data to predict patient length of stay to support planning around ward capacity • MWHealth will need to employ some data science resources to build and iteratively tune these neural network models. • Training to be put in place for admissions officers on how to use ML system around capacity planning. 	<ul style="list-style-type: none"> • MWHealth already has an EHR system in place where access to patient past data is available easily for the model development. • Additional development is required to EHR system to allow for real time capture of estimated length of stay against the patient's record. 	<ul style="list-style-type: none"> • This solution will be a custom solution that needs to be built in house • Solution will be built on the Amazon AWS platform that has strong machine learning capabilities. • Time frame: Allow 6 months from data quality review, additional development on EHR platform to capture estimates and model building and deployment by data scientist. • Implementation will be done in house and includes all testing, piloting phase and implementation

Image 7 - Technology Assessment: AI ANN Model to Estimate Length of Stay

AI Solution (Low Effort)	Technology Environment (Fit)	Approach (How)
<ul style="list-style-type: none"> • Implement rule based virtual assistant and chat bot to assist with appointment booking and clinicial calendar management. • Plenty of vendors offering these services with API capabilities to connect to existing EHR platforms and website • Minimal training is required for Healthcare support staff to operate AI virtual assistant • Develop communication materials for patients to communicate expected changes with appointment management. 	<ul style="list-style-type: none"> • MWHealth has an EHR system where using API capabilities virtual assistant solutions from third party vendors can be easily added on as an extension of the EHR system. • Some technical expertise resources is required when developing the rules and triggers for the appointment booking and calendar management automation. • Some technical expertise resources is required when developing the chat bot rules. • MWHealth will also need to invest technological resources to manage the data access levels to these 3rd party vendor solution as to enable bookings, they do not need access to sensitive data pertaining the patient's diagnosis 	<ul style="list-style-type: none"> • Use a third party vendor as these are standard rule based administrative tasks that require minimal customisation towards the business problem. • Potential vendors: <ul style="list-style-type: none"> • Nuance: https://www.nuance.com/healthcare/patient-engagement/appointment-management.html • EBO AI: https://www.ebo.ai/industries/healthcare/ • IBM Watson: https://www.ibm.com/au-en/products/watson-assistant • Time frame - can be implemented within 3-4 months as this implementation will be outsourced to vendors who are experts in navigating the complexities that come with an AI implementation project

Image 8 - Technology Assessment: Virtual Assistant

AI Solution (Moderate Effort)	Technology Environment (Fit)	Approach (How)
<ul style="list-style-type: none"> •Implement AI NLP assisted transcribing to reduce manual workload around synthesising appointment notes and medical coding in EHR system •Data protection policies for both the patient and psychiatric professional needs to be developed around consent collection, data storage and transparency around how the data is used. •Additional resources is required at initial implementation stage to cross check audio recordings against the AI transcription and coding. •As NLP conversion is a complex field, MWHealth will need to utilise support from vendors who are experts in the field, however by doing so it poses additional risks around overreliance on vendor to manage AI system and also financial risks around the hidden costs with using these vendors. 	<ul style="list-style-type: none"> •Hardware to record conversations with the patients needs to be purchased. (Recording Devices such as on body recorder clips) •Development required to transfer audio recordings into EHR system against client's record for ease of retrieval and checks. •Additional cloud storage resources needs to be purchased to meet demands of increased data collected in the audio recordings. •Need to employ AI NLP System administrator to manage system and support psychiatrists with any technical issues. 	<ul style="list-style-type: none"> •Use third party vendors as to design, build and implement an AI NLP assisted transcribing tool in house is a huge and complex undertaking that requires additional human resources to be employed that may end up costing more to the project. •Potential Vendors: <ul style="list-style-type: none"> •AWS Health Transcribe: https://aws.amazon.com/transcribe/medical/ •DeepScribe AI: https://www.deepscribe.ai/medical-dictation-alternative •Time Frame: Allow an estimated 8 - 12 months for the implementation of this tool - this factors in a redesign of required policies and procedures internally, communicating the change and obtaining consent from patients, the additional development work required to integrate session recordings into existing systems and the AI NLP system implementation on top of existing technology infrastructure.

Image 9 - Technology Assessment: AI NLP Assisted Transcribing and Dictation

Proposed Solution

AI ANN Model to Estimate Length of Stay

Researchers were able to accurately estimate the length of stay and reduce the average length of stay of the patients by up to 2 days using a neural network model (Ippoliti, et al., 2021). By reducing average length of stay, this will free up resources for MWHealth to take in more patients into the wards thus improving patient flow.

Artificial Neural Network (ANN) models are complex models organised in layers and have been designed to mimic how the brain functions to process complex data. Due to the nature of complexity in psychiatric data, we are confident using this algorithm will be the best one for the use case. We propose that the estimated length of stay once provided by the model is integrated back to MWHealth Admissions system for capacity planning and analysis.

As the model we are implementing works off existing patient data which there is access to, using the opportunity grid, we have identified this solution to be one of moderate complexity but provides high value in terms of estimating the length of stay. Staffing such as data scientists and data management professionals will need to be recruited to enable this tool.

Virtual Assistant

We are proposing that MWhealth purchases a virtual assistant tool from one of the vendors we have listed in image 8.

As the AI virtual assistant and chatbot function we are proposing is one that is rule based, we found this area to be the low hanging fruit that MWHealth can kick off the project with. Due to availability of vendors, most of the system configuration and development will be undertaken by the vendors making this a simple tool to implement. Below are a list of tasks that can be shifted to the virtual assistant to manage:

- Scheduling of initial appointments with patients – chatbot
- Assisting patients with rescheduling of appointments - chatbot
- Manage the calendars of psychiatric professionals to ensure optimum appointment scheduling
- Sending out appointment reminders (Email/SMS)

Using the opportunity grid, this solution has been identified as one with high value and low complexity and can be classified as an easy win for MWHealth to improve patient flow.

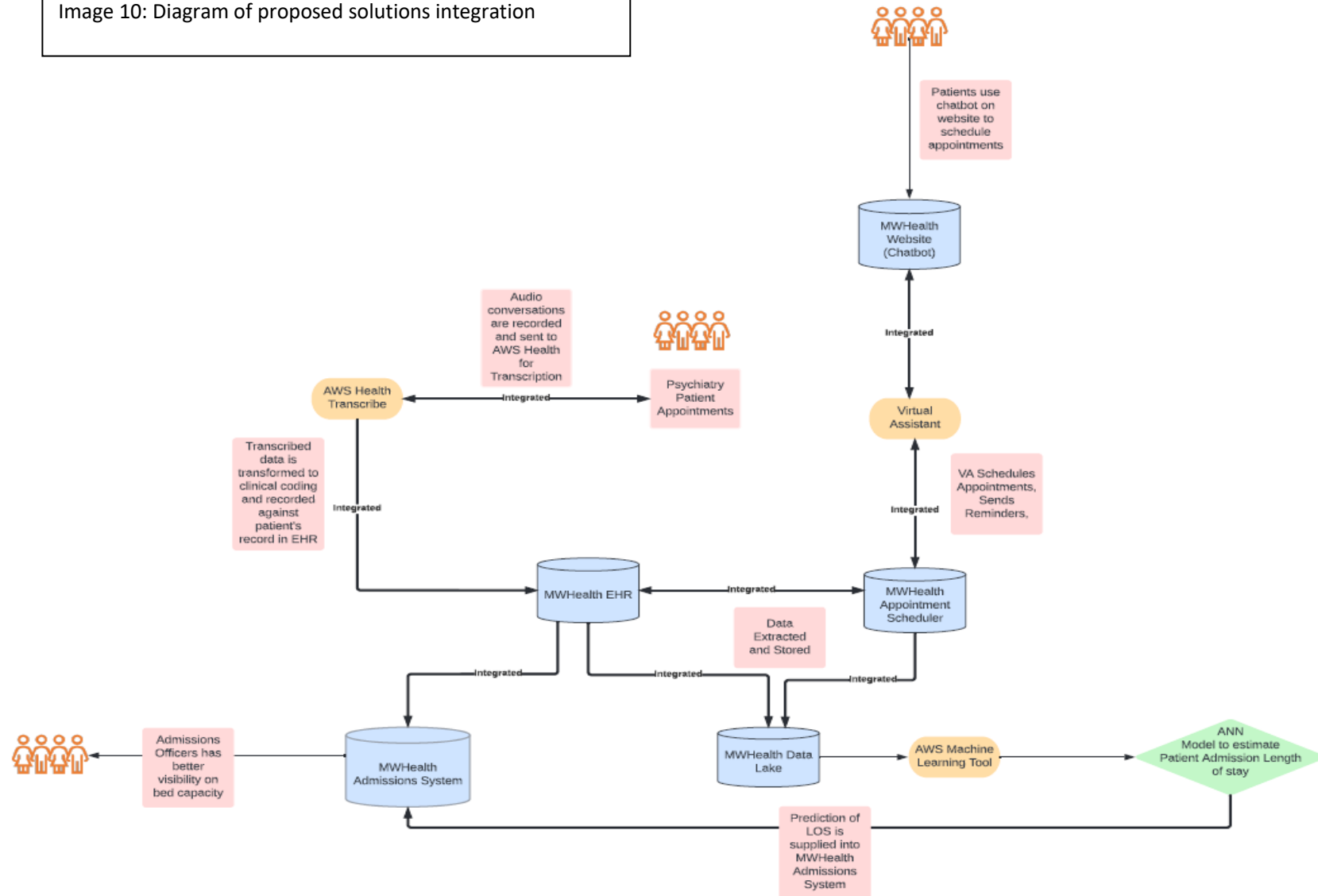
AI NLP Assisted Transcribing and Dictation

Although the area of NLP is a complex area and require specialised skill sets to manage, using the opportunity grid, we've identified this as one that is moderate in complexity if suppliers and vendors are used to implement this solution. Due to there being well known service vendors in the market such as AWS Health Transcribe, this reduces the complexity for MWHealth to manage and implement internally and provides high value in terms of easing the workload of psychiatric professionals enabling them to see more patients.

The use of AWS Health Transcribe can be initially deployed within the mental health unit, and then it is also scalable to be deployed to other units within MWHealth. This tool aligns with the business needs of improving patient flow by freeing up workloads of professionals. Not only will this tool help with reducing workload, but it will also allow for effective and consistent medical coding, where the data can then be used to develop other models that can be used to improve patient flow.

Image 10 demonstrates how all 3 solutions can be integrated into the existing MWHealth infrastructure.

Image 10: Diagram of proposed solutions integration



Recommendations and Conclusions

As part of the implementation process, we recommend prior to implementing the solutions that MWHealth organises as risk and governance steering committee to develop policies and systems internally to ensure that the implementation of the AI solutions is done in a manner where risks are mitigated. The steering committee will need to develop a list of policies and systems as per image 11.

Once the internal policies and systems are in place, MWHealth can begin with the implementation plan. We recommend that implementation is done with the business needs, human perspective and technology fit in mind and image 12 demonstrates key actions that MWHealth can undertake.

In terms of implementation, we would recommend to begin with implementing the virtual assistant as this is one that requires minimal effort due to the supply of packaged solutions in the market that can be easily integrated into the current day to day systems and processes and we estimate 3 to 4 months for completion. The development of the ANN model to estimate length of stay can also be kicked off concurrently alongside the implementation of the virtual assistant. This will require moderate effort as it will be a solution designed in house, using data from the existing EHR and we estimate a total of 6 months to develop the integration, tune and validate the models.

The implementation of the AI dictation and transcribing will be one that requires a considerable amount of effort as hardware equipment needs to be purchased, the solution needs to be tested thoroughly, psychiatric professionals to be trained and consent needs to be collected, so we recommend running this as a stand alone project and we estimate between 8 to 12 months for this implementation.

There are limitations in our research due to the lack of visibility on existing technological infrastructure within MWHealth that needs to be investigated in further detail to understand if the additional technological development is required.

To conclude, we are confident that all 3 solutions when used in integration between the existing systems can drastically reduce administrative workload for the stakeholders and thus improve and increase patient flow. However care is to be given to how these tools are used, and it is to be used as a support tool and not a tool to completely remove the human decision making process.

*Image 11 – Risks and Governance
Committee – Processes and Systems to
be developed internally*



Business	Human	Technology
<ul style="list-style-type: none"> •Resource hire: Data scientists, Data management, Integration specialists,systems engineer, technology support officers •Develop communication strategy to communicate changes for both external and internal stakeholders •Purchase audio recording hardwares •Purchase additional softwares •Develop change management strategy •Budget modelling 	<ul style="list-style-type: none"> •Implementation of virtual assistant communications to patients & healthcare support officers •Run informational workshops for all stakeholders affected by change •Develop training videos/documentation on how to navigate virtual assistant - patient & internal stakeholders •Consent collection for patient and psychiatric professional on use of Audio recording •Develop clear and easily understandable documents on how the AI systems are working to avoid blackbox scenarios and mitigate risks around opaqueness as the AI solution needs to be easily understood by the patients and internal stakeholders to ensure uptake of solution. •Develop training videos/documentation on how to navigate the Length of Stay Model and the AI Transcribing solution for all internal stakeholders. •Training to internal stakeholders on how to communicate correctly to patients on why the AI solutions was implemented, how it works and where the data collected is being used - this will ensure confidence in uptake and transparency. 	<ul style="list-style-type: none"> •Audit of existing data to assess current state quality. •Implement regular data quality checks to ensure data used in model is of best quality as this will affect the estimation. •Clear guidelines on data that is to be used within the AI solutions. •Ensure that current technology infrastructure is up to date and suitable to enable the integration of the proposed solutions. (EHR, Data Lake) •Implement 24/7 IT support system as patients will be using the chatbots and may encounter technical difficulties. •Use off the shelf solutions to implement the virtual assistant and AI transcribing and dictating tool as these are complex to be developed in house. •For the ANN model to estimate length of stay, this can be developed in house as mental health patient flow poses additional challenges nd changes from patient to patient, having this inhouse will allow the flexibility to iteratively develop and fine tune the model.

Image 12 – Recommended Actions for MWHealth

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