Antenatal Care in Australia: Process Mapping to Visualise Resources and Care

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Abstract— Antenatal Care (ANC) in Australia is of a high standard internationally and is an important care model for mothers. ANC is able to help prevent preterm birth complications. Process mapping enables the visualization of the journal of care, however different functionality is available from different process mapping tools. This paper presents and critically analyses Lean VSM and PaJMa modelling for the ANC pathway in Australia.

Clinical Relevance— This work can help inform discrepancies in perceived care and received care and can be used as a tool to help guide organizations in the decision-making for health services deployments for ANC services.

I. INTRODUCTION

Approximately 79% of newborn deaths in the world occur because of preterm birth or complications during pregnancy [11]. Antenatal Care (ANC), also known as prenatal care, is defined by the World Health Organization (WHO) as care provided by skilled healthcare professionals to pregnant women and adolescent girls to ensure the best health conditions for both mother and baby during pregnancy [10]. A prevalent form of care used in developed countries, ANC helps prepare women for the birthing process. Through the introduction of different healthcare personnel, ANC allows pregnant women and adolescent girls to be informed about their baby's health, however, the different healthcare resources and care models can be confusing to patients.

ANC includes ultrasounds, blood tests and a variety of screening tests during the pregnancy process that help inform on the fetus' health and any potential life threatening or life altering conditions for the mother or fetus. The overall goal of ANC is to identify and provide care to patients with an increased risk of pregnancy complications in order to reduce maternal morbidity and mortality [10].

Antenatal care is a truly interdisciplinary care model that requires teamwork across many different professions, however with the variety of professions and services involved it can be a challenge to understand the role that they all perform in the care of the patient and the value these professions provide.

Standard process modelling techniques to visualize the patient journey used currently in healthcare are derived from the manufacturing domain. Modelling techniques such as, Lean Value Steam Mapping (Lean VSM or Lean), IDEF-0, UML and IRIS exist within the healthcare domain; however, these modelling techniques have inherent flaws that limit their usability for the consumer [12]. Those modelling techniques

do not incorporate elements specific to patient needs, such as cultural needs and clinical practice guidelines/policies.

In an era where technology is a driving force, many healthcare organizations are in a race to transform their method of healthcare delivery for the consumer through the reduction of wait times and hospital stay while still providing an excellent quality of care [4]. A solution to meeting these goals is the implementation of information technology (IT) systems. However, it has been suggested that the required information for these IT systems is generally obtained from the lens of technical developers and does not receive input from the front-line staff who are the end-users of these systems [6].

In 2009, a new approach to process mapping was introduced called The Patient Journey Modelling Architecture (PaJMa) [6]. The PaJMa modelling technique was created to map the journey of a patient to identify and visualize the different processes in a patient's journey. Initially created for Neonatal Intensive Care Unit (NICU) needs, this model visualizes not just the information that is being gathered and the processes performed on this information, but also how these processes impact the patient. The model can be separated into different segments, including journey specifics, healthcare roles, processes, information creation and movements, the technology used, patient needs, clinical guidelines, and time metrics [6]. The PaJMa method included information that was previously left out in the decision-making process that is relevant for the healthcare and patient journey context.

This paper demonstrates the additional functionality when using PaJMa modelling over Lean VSM to visualize ANC in Australia. A key benefit of PaJMa is that information created and used by different roles are colour coded enabling a clear visual representation of the roles different healthcare professionals perform which can provide more clarity on the use of resources and care models.

II. RELATED WORK

While the concept of process mapping is not novel, it has not been performed previously in the ANC domain. Percival et al, have performed a similar study in adult rehabilitation and forensics with 17 healthcare professionals [12]. Approximately 41% preferred the PaJMA model over the others as it helped with understanding workflow, information flow, cultural flow and personal processes providing representation of the health professionals' work [12].

In this paper, Lean VSM was chosen as a comparison to PaJMA based on the information reviewed by McGregor et al., (2012) and Percival et al., (2016) [7,12]. The researchers

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compared the mapping techniques based on process definition, roles, information, guidelines and protocols, patient needs and metrics [7,12]. The comparison showed that Lean VSM and PaJMA were the most versatile mapping techniques used in healthcare and therefore were chosen to be an ideal baseline choice for comparison.

The initial step in mapping is gathering and analyzing information for the roles of different healthcare professionals [12]. To obtain the necessary information literature searches were preformed from the public domain using Google Scholar and PubMed. From these domains there were various texts that were referenced, the key information was extracted. The Government of Australia website was used as a basis to extract publicly accessible information, this website provided basic information for expectant mothers and clarified a lot of the involvement of different medical providers.

Kirkham et al., (2007) and Rolfe et al., (2017) gave insight to the roles of healthcare providers in northern territories and the differences in services provided in rural Australia [5,8] Wong et al., (2016) provided insight into the role of a family physician in the ANC process while Homer et al., (2016) differentiate the roles of a midwife in the ANC documentation [3,9]. Table 1 summarizes the information from these articles. While the information presented is very useful, in this text format it is still very unclear what the different health care roles in ANC are and how they are helpful for the patient. Using process mapping we show the integration of different healthcare professionals in this journey.

III. Process Mapping

The ANC processes in Australia were mapped using two different healthcare modelling techniques. PaJMa and Lean VSM modelling for the ANC process in Australia were created using the information obtained through literature review for modelling purposes. This research used publicly available ANC process information without patient data or ANC provider role participation so ethics approval was not required. A summary of the roles and responsibilities found during the literature review process is provided in table I.

TABLE I.   ANC Roles Identified from Literature [3,5-9]

Country	ANC Health Care team roles identified from literature	Information Creation
Australia	Midwife General Practitioner (GP) Counselling Imaging Obstetrician (OB) Telehealth Specialist outreach services Laboratory Medicine Pharmacy	Clinical data Imaging Data Medical/ Family History

In Australia, antenatal care is mainly covered publicly by the government through the Medicare program [1]. Testing such as ultrasounds and other laboratory tests are subsidized under this program. However, many people also have private insurance to help cover these costs. In Australia, the ANC process begins around the 10-week mark of pregnancy; during this time, information such as previous health conditions, preference of care types, number of pregnancies, as well as a place of birth and postnatal care support is discussed with the family physician [2]. Furthermore, laboratory testing and ultrasound testing is scheduled or performed, and any other referrals needed for any pre-existing conditions is also discussed. From this meeting, the subsequent meetings are performed at the 16–19-week mark, 20–27-week mark, 28–34-week mark, 35–38 week mark and then as needed from the 38th week onwards [2,5,9]. During these ANC meetings, fetal growth assessments are performed, fetal movements and discomforts are discussed, and labor and delivery questions are answered. In general, the care pathway starts with an appointment with a GP or family doctor. From this point, the involvement of the midwives and OB's become present. Through the process, the patient may have various ultrasounds and laboratory testing that aims to find any abnormalities present. From 10 weeks till birth, the patients have various appointments checking in on the neonate's health and the pregnant mom to ensure there are no complications. Figure 1 shows the PaJMa process mapping approach taken for this case study, and Figure 2 shows the Lean Value Stream process approach. Figure 3 shows the initial admission for a closer look at the PaJMa process. Figure 4 shows the initial admission for a closer look with Lean VSM.

IV. Discussion

PaJMa and Lean modelling are the two most capable healthcare modelling techniques. McGregor et al., 2012 and Percival et al., 2016 have previously summarized both models' critical aspects based on process definition, roles information, guidelines, protocols, patient needs, and metrics [7,12]. That group concluded that while the Lean and PaJMa models have high functionality, only the PaJMa model can visually represent guidelines and protocols within the process models and support patient needs [7,12]. From the ANC mapping example, it is visually evident that this statement is highly accurate as the PaJMa model represented in Figure 1, provides more detail of the patient's journey versus the Lean Model represented in Figure 2. In this paper, nine different healthcare roles were a part of the ANC team. In the PaJMa model, these roles are clearly defined with different colours. For example, while analyzing Figure 1, it is evident the general practitioner was colour-coded blue, and the resultant information creation was given the same colour to show the relation visually. In the Lean model, there is also a representation of the different healthcare roles. However, when multiple interdisciplinary roles are introduced to the model, it was challenging to see these associations. In analyzing the process layer, both models were versatile in the representation of the different core processes.
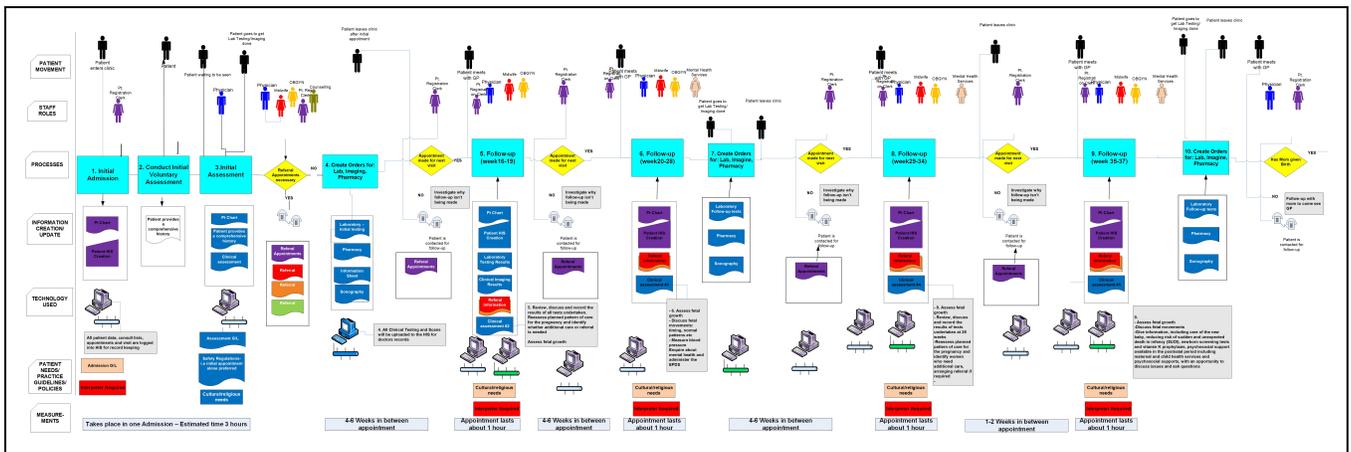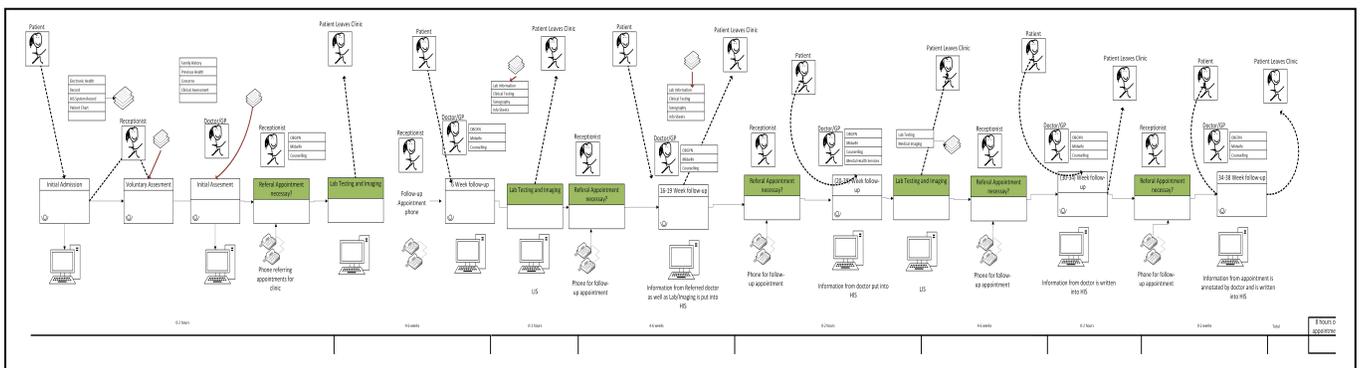
Figure 1. PaJMa approach for ANC in Australia

Figure 2. Lean Value Stream Map of ANC Process in Australia
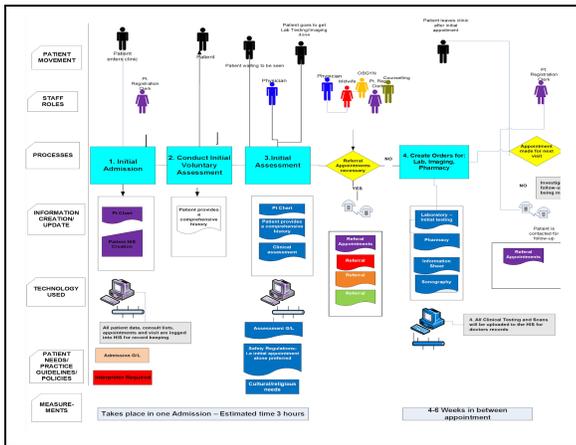

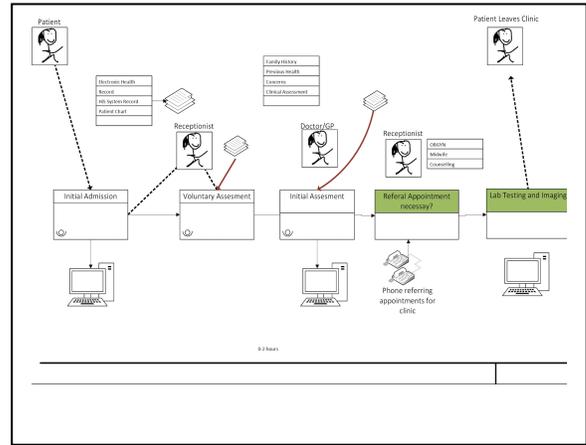
Figure 3. PaJMa approach Initial Portion

Figure 4. Lean Value Stream Initial Portion

The PaJMa model is organized and read from left to right, while the Lean model does allow more versatility in this set-up, for this paper, it followed the same direction and was just as easy to follow along. A significant advantage to the PaJMa model was the information creation section; the Lean Model allowed there to be the inputs of the different type of information creation encountered, the organizational structure with the colour-coding in the PaJMa model allowed there to be superior identification for where and when the knowledge creation and transfer were happening. For example, in the

PaJMa model, there could be a representation of multiple layers of information being created from different referrals. Using the Lean model, this was much more difficult to incorporate as there was no accurate section for this information.

One area where the PaJMa model stands out is its ability to incorporate patient needs and patient guidelines. Figure 3 represents a portion of the PaJMa model where this is present. In the PaJMa model, cultural needs and religious needs are incorporated within the model, while as in the Lean model,

these two critical aspects are left out [7]. This can be very useful when you have needs in certain religions, for example, in the Muslim religion there are different cultural norms behind who can physically touch a woman and in this scenario, it would be pivotal that ANC is provided by a female [13]. In terms of the metrics, both models provide explicit detail for the time processes, a specific function or appointment can take. As shown in Figure 3 and Figure 4 the models are able to visualize the time taken at the bottom. Lastly, both models can incorporate the different types of IT infrastructures used; however, the PaJMa model does a superior job of organizing this and connecting it to the different tasks. For example, the referral will create both paper and electronic records; both are visually mapped in the PaJMa model and taken into consideration. In the Lean model, the creation of information is mapped; however, the multiple structures in which it is created is harder to follow along. Overall, the PaJMa model was able to show and relay information to a higher degree of effectiveness than the Lean model. The PaJMA model showed the information creation and technologies used to a higher degree of effectiveness. It was superior at highlighting the different roles and responsibilities present in the care pathway. While the Lean model showed the same information, the model was not as visually appealing, easy to follow along, and could not showcase clinical and cultural guidelines, a significant consideration for patients now.

A major outcome from the creation and comparison of the two models is how effectively the PaJMa model can be used to provide large amounts of information. As shown in Figure 3, the PaJMa model can pinpoint the multiple areas where data creation occurs effectively yet simply. In the Lean model shown in Figure 4, there is similar information being presented, however, the effectiveness and connections are not apparent. Colour coding within the PaJMa model helps organize this similar to how a mind map is used to connect concepts. The ability to showcase multiple sources of information in an organized and structured approach is a strength the PaJMa model has over others. The applications of this modelling technique could range from showcasing healthcare professionals the gaps in existing care practice to patients being empowered to understand the care pathway. Through the visualization process it is evident that the PaJMa model has great potential to support healthcare transformation and communication.

V. CONCLUSION

This paper presents the selection of a modelling technique that enables differences in resources and care to be evident from the model representation. ANC is a vital care pathway used in supporting pregnant women. In Australia, there are many different ANC pathways. Through the analysis of the available literature, an example of the ANC pathway in Australia is mapped using two popular healthcare mapping techniques to compare the differences visually in both mapping procedures. Both models were contrasted based on process definition, roles information, guidelines, protocols, patient needs and metrics. It was evident that the PaJMa model provided information with a fine organizational structure versus the Lean Model in all categories. The

capability of the PaJMa model to incorporate all aspects of patient care allows it to be a more versatile and robust mapping tool versus the Lean model. While significant contributions in the areas of process mapping have been made, this paper, aims to visualize the care pathway pre-hospital admission which is a unique application. The care pathway at home is very different from the hospital and can better inform patients through visualization on the different services available to them. The limitation of this paper is that the information that has been mapped is very general and does not analyze the difference in care between different regions of the country. Furthermore, the information presented visually seems to be given through the lens of a physician thus it might have a bias towards the work physicians preform versus the other health professionals. For future work, roles and responsibilities from the respective allied health professional colleges can help with modelling to showcase the true roles of the different professions. Finally, modelling using data present in rural and urban settings for ANC can be used to help guide decision-making for health services deployments.

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