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Factors Influencing Decision Support System Acceptance

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ABSTRACT

While clinical DSS have many proven benefits, their uptake by GPs (general practitioners) is limited. The purpose of this research was to develop and explore a UTAUT (Unified Theory of Acceptance and Use of Technology) based model of how and why GPs accept DSS. Insight into the reasons why GPs do not use clinical DSS combined with knowledge of why GPs use DSS will allow the development of strategies to facilitate more widespread adoption with consequent improvements across many areas. Depth interviews were conducted with 37 GPs comprising a mix of education backgrounds, experience and gender. The developed model indicated that four main factors influence DSS acceptance and use including usefulness (incorporating consultation issue, professional development and patient presence), facilitating conditions (incorporating workflow, training and integration), ease of use and trust in the knowledge base.

Keywords: Decision support systems

UTAUT

General practitioners

Technology acceptance

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1. Introduction

Decision support systems (DSS) research has been undertaken for over 35 years with such systems proving useful in supporting semi-structured and unstructured problems [2]. The main aim of DSS is to provide the user with tools that enhance their decision making process, resulting in more informed decisions [2]. However, despite increasing developments in DSS, the usage breadth increase has been modest [4]. DSS are most widely used in corporate functional management fields, such as marketing and logistics, with limited use within non-corporate areas such as medicine [21]. While there has been some research into DSS acceptance in fields such as agriculture [37] and marketing [30], there is little research on the acceptance of DSS within the medical field, despite the potential of clinical DSS to provide improvements in areas such as: the quality of medical care [13]; disease prevention [55]; disease management and drug dosing [59]; management of chronic physical illness [7]; decision variations between practices [51]; and compliance with guidelines [66]. Clinical DSS are knowledge bases which contain the ability to perform inferences on known information based on prior experience or knowledge [16].

Clinical DSS have been developed since the 1990s [41]. However, most of these DSS do not go beyond the trial stage, and are often only adopted by those who created them. Although there are numerous studies that show the benefits of using DSS by general practitioners (GPs) [19, 50], their uptake is very low [20]. It is therefore important to identify the factors that influence GPs’ acceptance of these systems to facilitate their usage and improve decision making. A starting point in exploring the reasons for low usage of clinical DSS lies in the area of user acceptance of information technology.

An inventory of DSS in health was created in 2002 as a part of the National Electronic Decision Support Taskforce (NEDST) report [41, 53]. This inventory identified 35 DSS
that were either in use or in progress at the time. However, this report is now out-dated. Since the NEDST report [41] there has not been an updated report on the status of these DSS or on the possible existence of new DSS.

The NEDST report [41] categorised DSS into four types. Type 1 DSS provide information that then requires further analysis before the user can make a decision. Type 2 DSS provide trend analysis of patients' clinical status and/or clinical alerts. Type 3 DSS use knowledge bases and inference engines to generate recommendations. Finally, type 4 DSS are closely related to type 3, but are equipped with autonomous learning capabilities such as case-based reasoning, neural networks, and discrimination analysis for more advanced decision making support. Applying the categories of DSS and the definition of clinical DSS, NEDST's [41] type 1 and 2 categories do not classify as DSS, with only types 3 and 4 DSS considered to be actual DSS. It was identified in the inventory that only five of the 35 systems were either type 3 or 4. Type 1 and 2 systems are more like MIS systems that can help aid decision making, but are not actually typical DSS. Therefore, for this research, only type 3 or 4 clinical DSS will be considered DSS.

The area of user acceptance of information technology (IT), not just in the areas of DSS or health, has spawned considerable research. A number of models aim to explain the acceptance and intention to use IT [58, 61, 64]. For example, Roger's Innovation Diffusion Theory examines the relationship of the characteristics of an innovation (not specifically IT) with the rate of its adoption at an organisational rather than an individual level; as a result, this is found to be somewhat limited with regard to individual adoption [11]. The focus of this study is individual adoption, and the Unified Theory of Acceptance and Use of Technology (UTAUT) [64], which supports this perspective, is therefore the model upon which this research will be based. The UTAUT is based on eight IT acceptance models, including the widely researched technology acceptance model (TAM). The UTAUT synthesises these eight previous models based on
their unique and significant elements [64]. The UTAUT is comprised of four main determinants of intention and use: Performance Expectancy, Effort Expectancy, Social Influences, and Facilitating Conditions, as well as four moderating variables: gender, age, experience and voluntariness of use. The UTAUT has explained up to 70% of the variance in behavioural intention, compared to 30-40% for competing models [61, 64], and represents a major step in acceptance research [35]. Due to its infancy, the UTAUT has only been incorporated in a few studies to date [8, 22, 34], which found support for most of the constructs as well as the overall model.

Although technology acceptance research has been conducted for many different types of systems [60, 64], its application to DSS is limited. Existing research often uses the TAM [17]. Other studies do not make any reference to a particular acceptance model, but rather examine specific issues [24, 43]. DSS differ from other technologies in their ability to provide advice to the user making the decisions, and therefore the factors influencing the use of DSS need to be established. It has been argued that the current technology acceptance models are not suited for more complex, advanced technologies, but are more appropriate for simpler technologies such as email and word processing [5]. Many studies on the adoption and acceptance of technologies have focused on the use of these simpler technologies, and have used university students as subjects. It is therefore important to look at these models using a more complex technology applied within a new context to subjects other than students. This research will hence examine the use of DSS within a health context using general practitioners (GPs) as subjects.

The purpose of this research is theory building in order to develop and explore a theoretical model that will, in future, provide a basis to examine the acceptance of DSS, and perform some preliminary testing of this model. By using the UTAUT as a starting point, this research will add to the area of technology acceptance by further investigating the UTAUT and adapting it to DSS acceptance. Moreover, this research will
examine technology acceptance in the context of GPs, who are independent workers who make individual decisions. Thus the research question is: How and why do general practitioners use decision support systems?

The next section will present the initial model developed for this study, followed by a description of the case methodology used to gather data to further develop and test the model. Results are then discussed and the final model developed through this research is presented. The paper concludes with implications for research and practice.

2. Model development

The initial model developed for this research (Figure 1) is based on the UTAUT with some adaptations. Within the UTAUT, performance expectancy is the degree to which the individual believes that using the technology will help them improve their work performance [64], and has consistently been found to be a significant predictor of usage intention [57, 61, 64]. Effort expectancy relates to how easy the individual finds using the system [64]. Social influence is defined as the degree to which individuals feel that significant others believe they should use the technology [64], and has been found to have a direct impact on behavioural intention [61]. The final construct of the model is facilitating conditions, defined as the extent to which the individual believes that organisational and technical support exists to use the system [64]. Previous studies support the inclusion of facilitating conditions in the model [27, 64]. In the UTAUT, facilitating conditions do not influence the intention to use, but instead determine actual use behaviour [64]. In some studies, social influence was found not to be significant, especially in professional contexts such as healthcare [9, 10, 26]. However, these constructs remain in the model to allow further examination of whether they are relevant to the healthcare context, since previous research has identified their significance [57, 63].
In addition, the UTAUT has four moderating variables: gender, age, experience and voluntariness, which impact on the relationships of the four constructs (performance expectancy, effort expectancy, social influence and facilitating conditions). The gender of the user is predicted to influence three of the constructs: performance expectancy, which is stronger for men, and effort expectancy and social influence, which are greater for women [64]. The age of the users moderates all four constructs [64]. Experience, which refers to the degree of experience the user has with the system that is to be used, is identified as influencing effort expectancy, social influence and facilitating conditions. Finally, voluntariness, which refers to whether the system is mandatory or voluntary, will only influence the social influence construct [64].

Turning specifically to general practitioners, a number of factors that constitute performance expectancy and facilitating conditions were identified from the literature. For performance expectancy, professional development [64], time savings [52] and cost savings [49] may influence the GPs’ perception of the usefulness of DSS. For facilitating conditions, training [1, 38], integration [53], security [53] and workflow [29, 38] were identified as factors that might influence GPs’ use of DSS.

One further construct that may influence the GPs’ use of DSS, involvement, was identified. Involvement in the creation of DSS may lead to feelings of ownership and therefore lead to increased use of the system [41, 44, 53]. Involvement is not possible with all individuals. However, because DSS for clinical applications require extensive knowledge based on expert medical data or guidelines, involvement from GPs is possible. Therefore, this factor was added to examine whether GPs’ involvement in the creation of DSS will influence use.
Because the GPs’ use of DSS is voluntary, the moderating variable, voluntariness of use, was not applicable and so was not included in the model. Figure 1 depicts the theoretical model on which this research is based.

3. Research method

This research follows a qualitative approach since, unlike quantitative methods, this enables the gathering of in-depth information from respondents [6]. In addition, qualitative research can enable the elicitation of rich information due to its flexible nature [23] and can therefore provide new insight into the research question [12]. As a result, research areas that are under-explored, such as this research, can benefit through the use of qualitative methods and theory building [15]. As this research collects in-depth information in order to understand a real world situation, the approach fits well within the realism paradigm and therefore is appropriate for this research. Although the UTAUT model is typically used in a positivist mode, this study aims to build rather than test theory and thus uses UTAUT qualitatively, which is often done when exploration of
the model is the aim [42]. The selection of UTAUT was primarily driven by its high quality compared to competing models.

This study was conducted in two stages. The first stage followed the convergent interviewing technique [15] and the second stage followed with the case study method [68]. Convergent interviews with five GPs were conducted to allow exploration of the issues identified within the literature. During these interviews, three additional factors were identified: consultation issue, patient presence and trust in the knowledge base. The consultation issue factor appeared to fit into the performance expectancy construct, since it was a form of usefulness, specifically with regard to the consultation issue at hand. As a result it was added as one of the performance expectancy items. In addition, the presence of the patient was identified as either a hindrance of use, giving the impression that the GP was not knowledgeable, or a facilitator of use, giving patients greater confidence in the GP’s decision; patient presence was hence also added to the performance expectancy construct. Trust in the knowledge base did not appear to fit within any of the UTAUT constructs, and so was treated as a separate factor influencing the intention of GPs to use DSS. With the identification of the new factors (highlighted in grey), the conceptual model for this research is shown in Figure 2.

Following on from the convergent interviews, the second stage used the case study approach. This was appropriate since the study answered “how” and “why” questions, examined contemporary events and the researcher had little control over the events of the research [68]. Multiple cases, involving 37 GPs, were selected to improve the quality of the data collected [45, 68], and enable the gathering of rich information suitable for theory building [48]. The information required by this study was abstract and broad, rendering a holistic approach appropriate [68], within which a single unit of analysis was used. In this research, the unit of analysis is the individual GP’s acceptance and use of DSS. Thus, this research uses a holistic multiple case design.
Replication logic rather than sampling logic is appropriate for multiple case studies [68] and was therefore employed within this study. Cases were selected so that differences rather than similarities between cases were provided for predictable reasons [48, 68]. Such theoretical replication was achieved by this study as GPs of differing education background (Australian trained and non-Australian trained) were purposefully selected to explore any differing outcomes. The selection of cases was therefore made on the basis of source of medical education: Australian and overseas. Snowball sampling, where two GPs from each of the two groups were initially approached and asked to give referrals to other GPs, was employed since it was the most suitable approach given the relative inaccessibility of GPs [31]. Although such sampling may be biased, since participants may be similar to the individuals who referred them [45], this was not problematic within this study since a reasonable mix of education type along with computer use were the major requirements of the study.

**Figure 2.** Updated model used in this research, with new factors highlighted in grey

- **Moderating Variables:** Gender, Age, Experience
An interview protocol was developed from the literature and initial convergent interviews, to improve consistency and thus reliability [68]. The protocol began with an introduction and ethical considerations, followed by rapport building open questions. Finally, questions addressed three specific research issues derived from the research question of: why do GPs use DSS?; why do GPs not use DSS?; and how can GPs’ use of DSS be increased? Respondents also completed a brief questionnaire acquiring basic demographic information and behavioural information related to their computer usage and skills levels. The types of DSS suggested to the GPs were those that fit within category Types 3 and 4, described previously; specifically, an example of a Diagnostic system was provided to the GPs.

The analysis of data was manually undertaken following the four stages recommended for qualitative data [45]: theme identification; coding data to themes; data displays and interpretation of themes and displays; and drawing conclusions. Initial themes came from prior theory, research issues and the convergent interviews. The data from the interviews were then organised into the identified themes. While coding the data, more themes emerged, which resulted in further re-coding. Matrices and tables were generated to display the data, which led to interpreting the themes. The interpretation included cross-case analysis since generalisation was a research goal, along with within-case analysis to allow unique aspects within cases to be identified [48].

4. Results and discussion

In this section, we present the results of our case studies in two main sections. The first section presents a profile of respondents in terms of key demographic characteristics and how these compare to the population, followed by a description of the key behavioural characteristics of respondents in relation to computer and DSS usage. The
second section reports and discusses our findings specifically in relation to: the four major UTAUT constructs of usefulness, facilitating conditions, ease of use and social influence; our further constructs of trust in the knowledge base and involvement; and finally the three moderating variables of age, gender and experience.

4.1 Profile of respondents

Thirty-seven GPs participated in face-to-face interviews. Each interview took between 30 and 50 minutes, and all GPs approached agreed to participate. Overall, there were more male GPs than female (65% males versus 35% females), with 24 males and 13 females. This ratio of more male GPs than female GPs is in line with the national profile of GPs within Australia [14]. In terms of practice size, most GPs worked in a practice that had two or more GPs (65%), with the remaining 35% working in solo practices. This ratio of practice size is different from that of the national statistics, which indicated that 69% of practices are solo while 32% have two or more GPs [3]. Participants in this research were obtained through snowball sampling, and it is therefore likely that the numbers belonging to a group practice will be relatively high, since GPs often recommended colleagues in their practice. There were 20 Australian and 17 overseas educated GPs. Turning to the number of years of total GP experience, respondents ranged from one to 32 years, with the majority (51%) having worked as GPs for 10 to 19 years. Years of experience were also reflected in the age of the GPs, with the majority (43%) ranging between the ages of 41 to 50. The age of the participants falls in line with the national statistics of GP ages. The number of young GPs is nationally low and is decreasing yearly, whereas the number of older GPs has been steadily increasing [14].

Computer usage and expertise ranged widely among the GPs. All GPs used a computer for over 21 hours per week, with constant computer use when they are in their offices as they all maintained patient records on the computer. In terms of competence, 51% of
GPs were moderately competent, 22% had low competence and 8% had very low competence. On the other side of the scale, 14% had high computer competence, and only 5% indicated very high competence. Nine GPs had received computer training, with the remaining 28 GPs (76%) having no professional training. In summary, computer usage and competence varied considerably among participants.

When reviewing the profile of participants, two key patterns were noteworthy. First, in terms of the GPs' education and age, most of the older GPs (51 years and over) were overseas trained. Younger GPs (under 40 years old) were mainly Australian educated, with only three being trained overseas. Typically, overseas trained doctors often come into the country at a later age and arrive with several years of GP experience. The second pattern was regarding education and computer usage. Most of the overseas trained doctors only used computers in practice once they started work in Australia. In addition, of the 11 GPs who were below moderate in computer competence, the majority were overseas trained (seven). From the seven GPs who stated that they were above moderate competence, only two were overseas trained.

In relation to DSS usage, of the 37 respondents, only seven GPs currently used some form of system, with a further 20 having heard of but not using them and ten never having heard of DSS. Within the DSS-users, two types of DSS were used, a system for skin problems (used by 5 GPs) and a second for heart measurements (used by 5 GPs), with 3 GPs using both. Six GPs currently using DSS were overseas trained, with only one Australian educated GP. Of these six overseas trained GPs none were lower than moderate in their computer competence, with one having high competence. Of the 20 GPs (54%) who had heard of DSS but did not use them, the majority were Australian educated, with only two being overseas trained. Of the final group of 10 GPs who were not aware that DSS existed only one was Australian educated, with the other nine overseas trained.
Given the research purpose of exploring how and why GPs use DSS, subsequent analysis will explore patterns within and between these three sub groups of respondents. The 7 GPs currently using DSS will be referred to as Group 1. This group of respondents can give valuable insights in how and why they adopted DSS. The 20 GPs who had heard of DSS but were not currently using them will be referred to as Group 2. This group will give valuable insight into why DSS are not adopted by GPs. The final group of 10 GPs who had never heard of DSS will be Group 3 and will provide valuable insight into what might make a GP adopt DSS.

4.2 Findings in relation to The Model

4.2.1 Usefulness

This construct was operationalised by five items as shown in Table 1. The first of these, consultation issue, was related to the degree to which the GPs believe that DSS would be able to help them with the issue presented during the consultation. "As GPs, we are not specialised in one specific field of medicine. There are times when a patient presents with a complaint that is uncommon" (OF05). The second item, professional development, referred to whether the GPs believed that using DSS would help them develop their professional skills. "If you keep getting a situation where you are perplexed, using the decision support system will provide you with guidance, and eventually you won’t have to use it for that particular situation anymore...hence you have learned and improved yourself" (AM06). The third item, patient presence, was related to the degree to which the GPs believe the patients’ presence impacted on their use of DSS. "I think it is good for the patient to have confidence in what the doctor is saying, but that is not a reason for me to use the system. I will only use it if I want to narrow down my diagnosis." (AM06). Cost was the fourth item, and related to the belief that using DSS would result in cost savings.

1 The coding scheme for the interview extracts comprises the following: overseas (O) or Australian (A) trained; male (M) or female (F); and case number. For example, OF05 and AM06 refer to case numbers 5 (an overseas trained female) and 6 (an Australian trained male) respectively.
Finally, the fifth item, time, was related to the belief that using such a system would result in time savings. "I use it not because it will save me time or even money, it’s a form of support for my decisions...it can sometimes help me sleep better at night...!" (OM03).

**Table 1**

Importance of Usefulness as a driver for use/non use of DSS.

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (n = 7)</th>
<th>Group 2 (n = 20)</th>
<th>Group 3 (n = 10)</th>
<th>Overall importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultation issue</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Professional development</td>
<td>√</td>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
<tr>
<td>Patient presence</td>
<td>m</td>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
<tr>
<td>Time</td>
<td>×</td>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
<tr>
<td>Cost</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>

*√ = important; × = not important; m = mixed response*

All three groups of GPs agreed that the consultation issue was the key driver of their use or non use of DSS. Group 1 respondents highlighted the complexity of the presenting consultation issue and the usefulness of DSS in such cases as the reason why they were currently using DSS. Conversely, all 20 GPs in Group 2 (aware but not currently using DSS) agreed that the consultation issue was the key reason for their non-use of DSS. These GPs did not find DSS helpful during the consultation. The majority of these GPs were Australian educated. All 20 GPs did note that if they found a particular decision support system useful they would use it. However, this had not been the case. Turning to Group 3, respondents who had never heard of DSS, the consultation issue was identified as the most important factor that would encourage these GPs to use DSS. These GPs
believed that if the system was useful to them on a complex consultation issue then they would use it.

All three groups of respondents nominated professional development as the second most important usefulness criteria impacting their use/non use of DSS. Group 1 respondents saw professional development as closely related to the complexity of the consultation issue since the use of the system in complex issues would help them develop their professional skills by learning from it. Twelve of the 20 GPs in Group 2 noted that DSS would not help them with professional development. Finally, six of the ten GPs who had never used DSS noted that if such a system was useful during a consultation with complex issues then using it would help them improve their skills.

The third usefulness factor, patient presence, also generated contradictory responses between the three groups of respondents. Four of the seven GPs who currently used DSS found that patients were more confident when they used a computer system to support their decisions. The overseas trained GPs in this group felt more strongly about gaining the patients’ confidence. This reflected their feelings of uncertainty regarding the complex issue. Conversely, four GPs in Group 2 noted that they would feel uncomfortable using a decision support system in front of the patient. These respondents identified themselves as having low computer competence. They were afraid of not knowing how to use the system in front of the patient. Seven out of ten GPs who had never used DSS thought that using such a system in the presence of the patient may be a hindrance. These seven GPs all had either a low or very low computer confidence.

Time was not considered important by any current users of DSS, even though using DSS actually caused more time to be spent in the consultation. However, this extra time was compensated for by the usefulness of the DSS. Six Group 2 GPs identified time as a reason for their non-use of DSS. They stated that DSS would waste time during the
consultation. They noted that time in a consultation is very important, and if the system is not exceptionally useful then they would not use it. Four of the ten GPs who had never used DSS noted that they would also use DSS if they would help save time.

Finally, cost was not identified as important by any of the GPs. Costs were not reduced as a result of using DSS. For the GPs, patient care was the focus rather than financial gains, especially with the use of technology.

The importance of usefulness to the use of DSS is evident from these findings, especially in relation to the consultation issue, with GPs who found DSS useful adopting them and GPs who did not find them useful not using them. Other research supports this finding, as usefulness has consistently been found to be a significant predictor of usage intention [57, 61, 64]. Other studies of physicians' use of technology also found that the technology's usefulness to them was crucial for their acceptance [10, 28, 44]. Chau and Hu [10] suggested that this strong attitude towards usefulness by physicians is perhaps embedded in their view of technology as a helping tool, "...acceptable only when demonstrating proven or desired utility in their practice" (p. 307). Furthermore, it was found a number of doctors doubt the existence of useful information in DSS [18].

With regard to usefulness in terms of professional development, this research found that the use of DSS could improve the GPs’ professional skills, and as a result positively influence usage of the system. Lin et al. [35] noted that the usefulness benefits are more likely to be associated with technology that is used for work than personal purposes. This supports our findings, as the system in this study was work related and the usefulness was directly associated with work and professional improvement benefits.

Conversely, in relation to time it was found that using DSS was detrimental. This finding is supported by research that suggests that using more complex technology adds time to
the process rather than reducing it [28, 33, 52, 54]. Although time was increased by using DSS, if the system was found to be useful then this extra time was accepted. All three groups of GPs noted that if DSS were to provide time savings then this would provide an extra advantage and therefore an additional reason for DSS use. However, the influence of time was not as strong as the other factors and was seen to be merely a minor benefit. This finding was supported by Jensen and Aanestad [28] as well as Spil et al. [54], who examined the use of electronic patient records.

Patient presence was a usefulness factor identified as a possible barrier to the use of DSS. While GPs who currently use DSS found that the use of technology to support their decisions increased patient confidence, in contrast, a number of Group 2 GPs felt uncomfortable about using DSS in the presence of the patient. Supporting or contradictory research for this finding was not identified in the literature, and this may therefore represent an additional factor that can explain the non-use of technology.

Finally, cost was not considered an important usefulness factor, since cost saving was not a reason for GPs using DSS. Within the health context, cost savings may not be achieved directly, but instead indirectly through other methods, such as better quality service and therefore increased patient satisfaction and loyalty [49]. This was not identified from this research, but is worth noting as possible future research.

4.2.2 Facilitating conditions

This construct was operationalised by four items: workflow, training, security and integration as shown in Table 2. Current users did not consider workflow influential in their use of DSS, whereas all Group 2 respondents agreed that disruption to workflow was a major factor in their decision not to use DSS. "If the system was working behind the scenes and didn’t waste time in the consultation, then perhaps it would be ok. But to stop and open up another application, no..." (OM06). These GPs noted that using an additional system would disrupt the workflow during the consultation. All ten GPs who had never
used DSS identified workflow as a condition for using DSS. They would be more likely to use such a system if it did not disrupt the flow of the consultation, whereas if they had to stop doing what they were doing to use it then they would be less likely to do so.

Table 2
Importance of Facilitating conditions as a driver for DSS use/non use.

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Overall importance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current users</td>
<td>Aware but non user</td>
<td>Unaware</td>
<td>m</td>
</tr>
<tr>
<td>Workflow</td>
<td>×</td>
<td>√</td>
<td>√</td>
<td>m</td>
</tr>
<tr>
<td>Training</td>
<td>m</td>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
<tr>
<td>Security</td>
<td>m</td>
<td>m</td>
<td>×</td>
<td>m</td>
</tr>
<tr>
<td>Integration</td>
<td>×</td>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
</tbody>
</table>

* √ = important; × = not important; m = mixed response

Training, as a facilitating factor, was identified by three of the seven GPs who used DSS as a factor making them more comfortable using DSS. “Ever since I have had training in computers, I feel I can use any system.” (OM01). These three GPs all had some form of professional computer training. This factor was not the key reason for their use of the system, but helped facilitate their use of it. The other four current users did not think that training was important since they were currently using DSS with no professional training. However, they did note that their moderate to high competence in computers helped overcome any fears they may have had in terms of using DSS. All 13 GPs in group 2 who identified training as a reason for non-use of DSS were not confident in using computers and so believed they needed training before they could use them. Further, eight out of the ten GPs who had never used DSS considered training important. These GPs all had a low to very low computer competence. The two GPs in this group who had average computer competence did not think training was an issue.
Integration was not considered an issue by any current DSS user; however, it was considered a reason for non-use by 17 GPs in Group 2. It was important for these GPs that DSS be well integrated into their current systems. They found that most of the systems they tried in the past have had integration issues. "It [decision support system] often causes the entire system to slow down..." (AF01). Seven of the ten GPs who had never used DSS considered integration a factor that would enable them to use DSS if they were well integrated into their current practice software.

Security was identified as risks to the data in the current system, for example patient records, and was not considered important by current DSS users. Four GPs (out of 20) in Group 2 identified security as a concern and so would be very wary of using DSS. “Clashes in software can also cause security problems...” (AF01). These GPs all reported a computer competence of high to very high. This high competence is perhaps the reason for their awareness of security problems. The GPs who had never used DSS did not consider security important as they were not aware of any security issues. Due to its low impact on the GPs, security was deemed not to be an influence on the use of DSS.

In brief, facilitating conditions influence the use of DSS by GPs. Specifically, workflow, training and integration were considered the most important, with workflow being the most important of the three facilitating conditions. GPs in Group 2 believed that the use of DSS would disrupt their workflow and thus disturb their train of thought. This finding supports the literature as it was also identified that one of the main causes of GPs’ non-use of DSS is workflow disruption [29]. The influence of workflow in technology acceptance has not been examined in other contexts. Thus, the workflow factor provides additional insight into the acceptance and use of technology.

Training was found to be important for enabling the use of DSS. Although training was more important for the less computer competent GPs, more competent GPs found
training provided an extra advantage and thus would further help in enabling the use of DSS. Consistent with this research, training has been shown to have an impact on the acceptance and use of technology [65].

Finally, integration was also seen as important since a lack of integration has the potential to cause a number of problems that GPs were unable or unwilling to deal with. GPs were wary of new systems as they may not be well integrated or compatible with the systems they currently use. This finding has been identified in earlier research, which found that compatibility is important for technology acceptance [57, 64].

Security was not a key barrier to adoption of DSS. Security appeared to be a concern only when problems occurred, which were seen as rare, since security breaches are often not directly visible to the GP. A recent study supports this low importance, finding that physicians cared more about availability than the reliability of the systems [54].

4.2.3 Ease of use
The third UTAUT construct, ease of use, was considered irrelevant in terms of DSS usage by all seven GPs currently using DSS as shown in Table 3. These GPs did note that an easy system would be quicker to use. However, all the GPs noted that even if a system was hard to use, if it helped with a complex consultation issue then they would take the time to learn it. Ease of use was considered important by three GPs all with low computer competence in Group 2. “I find it very difficult to pick up new software. If I don’t have to use it and it’s hard to use, I just won’t bother.” (AM13). To these three GPs, if a computer system was hard to use they would not use it. They were afraid of making mistakes, particularly with the patient present. Eight of the ten GPs who had never used DSS identified ease of use as important. All of these GPs had low or very low computer competence. To them, a hard to use system would probably not be used.
Table 3
Importance of remaining constructs as drivers for use/non use of DSS.

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Overall importance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current users</td>
<td>Aware but non user</td>
<td>Unaware</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(n = 7)</td>
<td>(n = 20)</td>
<td>(n = 10)</td>
<td></td>
</tr>
<tr>
<td>Ease of use</td>
<td>✗</td>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
<tr>
<td>Social influence</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Trust in the knowledge base</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Involvement</td>
<td>m</td>
<td>m</td>
<td>✗</td>
<td>m</td>
</tr>
</tbody>
</table>

* ✓ = important; ✗ = not important; m = mixed response

The ease of use construct was identified as being an enabling factor for the use of DSS. Respondents noted that, although ease of use was not a factor in their use of DSS, an easy to use system would more likely be used than one that was more difficult. This finding is supported by the literature, which suggests that hard to use systems lead to non-usage [47]. Further, ease of use has been found to be an inconsistent determinant of use [32, 56]. This was also the case with this research, where ease of use was found to be more important to certain GPs, especially those of lower computer competence. This issue of low computer competence is also identified in other research, where ease of use was considered important to those with less experience [27], and less for those with higher computer competency [26]. Hence, although ease of use was not found to contribute to the use or non-use of DSS, it could enable further use of DSS. Therefore, ease of use is important but not essential.

4.2.4 Social influence
The final UTAUT construct was social influence. All GPs who use DSS did not feel that the use of DSS by a significant other made any difference to their current use of DSS (see
Table 3). They did state that if a colleague used a particular system they could use this information to inform their own choices. Social influence was considered irrelevant to all GPs in Group 2, who agreed that they would not use a system simply because another person, important or not, used the system. “It wouldn’t make a difference to me who was using the system. If it was useful to me and only me, then I would use it” (AM02). They did, however, state that if someone they knew were using a decision support system, it would help them become introduced to it and perhaps influence adoption. GPs who had never used DSS did not find social influence an enabler for using DSS.

Social influence was not considered an enabler of DSS use. The GPs strongly agreed that no significant person could influence their decisions on use. This was supported by the literature, with social influence not being found to be a determinant of use [34]. The lack of importance of social influence by doctors is further supported by Hagland [25] who identified that doctors are not easily coerced into using systems they do not like or find useful. This may have been different if the use of DSS by the GPs was made mandatory; as Venkatesh et al. [64] note, social influence is more likely to be significant in situations where the use of technology is mandatory.

4.2.5 Trust in the knowledge base

Although all Group 1 GPs considered trust essential, it was not a primary reason for their use of DSS; however, they would not use such systems if they were untrustworthy. “When you know a lot about computers, you start being more critical of how things are done...” (OM06). Only two Group 1 GPs actually looked into the development of the system that they used. Thus, although all GPs stated that trusting the database was important, the majority seemed to trust DSS implicitly. As summarised in Table 3, Group 2 GPs identified trust in the knowledge base as one of the reasons they did not currently use DSS. These GPs had not trusted the source of the system, that is, the expertise of the people who developed it, both in terms of content and software. Two of these five GPs
had previously used DSS that they felt produced inaccurate advice. The remaining three GPs, who lacked trust in the knowledge base, were of high computer competence and were aware of possible development problems that can arise with DSS. The other 15 GPs in Group 2 thought that the content of the knowledge base was important, but it was not one of the main reasons they were not using DSS. Nine out of the ten GPs who had never used DSS considered this an enabling factor for use of DSS. Trust to these nine GPs was related to the medical expert behind the system; they felt they could trust it if it was based on a well known author or doctor. The way in which the system was developed, or who the software developers were, was not a concern.

Trust in the knowledge base was identified as being an enabler of DSS use. When GPs trusted the system they were comfortable using it. If GPs did not trust the system it would not be used. No findings from the literature regarding trust in the knowledge base were identified. As a result, this finding adds a dimension to acceptance research.

4.2.6 Involvement

In terms of the involvement factor, Group 1 GPs felt that their input into a system did not give them a sense of ownership involvement (see Table 3). “Just because I put my two cents worth doesn’t make it any more my system as any other system” (AM06). Further, only two Group 2 GPs agreed with this factor. These two GPs rated themselves as having very high computer competence and had some professional computer training. These two GPs were in favour of using a system that had some input from them. However, they did note that the degree of input mattered. None of the ten GPs who had never used DSS considered involvement as a reason for using DSS.

Involvement referred to the increased possibility that an individual would use a system if they were involved in its creation, both general [67] and clinical [36], thus creating a sense of ownership. While the GPs had not been involved in DSS creation, they believed
that even if they were involved in the creation of such a system, their involvement would be minor and not constitute ownership. Thus, involvement was not considered an influence for them to use the system, and as a result not included in the final model. This finding appears to contradict a recent study, which found that physicians felt they had a greater influence when they were actively involved in the development of the system [44]. However, the key here is the amount of involvement in developing the decision support system, which is minor for the majority of GPs.

4.2.7 Moderating variables

In terms of the moderating variables, gender, age and experience, this research did not find that gender or age influenced any of the factors. This is contrary to the literature where it is found that gender moderates the factors influencing acceptance [40, 46, 62, 64]. Similarly, the moderating effect of age was also identified in the literature [39, 40, 46, 64], but not in this research. Experience was the only moderating variable identified in this research, which had an influence on ease of use. Experience relates to the use of computers [64], and for GPs in Group 1 it was identified that the more they used DSS the easier it would become. This role and influence of experience on ease of use is also supported in the literature [64].

From the above discussion, it is now possible to address the research question of this study: “How and why do general practitioners use decision support systems?” In general, with technology acceptance research, factors that are not supported are dropped from the final model; for example, TAM2 was created by dropping the attitude construct because it was not significant and adding subjective norms [61]. Thus, the final model (Figure 3) is comprised of the factors that were identified as being important to the acceptance of decision support systems by the GPs in this research.
Our research resulted in the identification of four factors that influence the acceptance and use of DSS, including usefulness, which incorporates three further factors (consultation issue, professional development and time), facilitating conditions, which also includes three further factors (workflow, training, integration), ease of use and trust in the knowledge base. From the model, it can be seen that some of the factors directly influence intention, while others directly influence use. In brief the final model shows how GPs’ use of DSS can be increased by considering the factors that influence use. In order to be used, DSS need to be perceived as useful by the GPs, specifically in terms of the presenting consultation issue. An easy to use system provides a further advantage, and similarly a system from a trusted source is more likely to be used than one from a non-trusted source. In addition, the system must fit into the workflow of the GPs’ consultation and must integrate with current systems. Providing training would also be an advantage, so that GPs do not need to self-train.
5. Conclusions and implications

In summary, this research asked "How and why do general practitioners use decision support systems?" To answer this research issue, all three groups of GPs were able to provide insight. Firstly, Group 3, those who have not heard of DSS, identified factors that would enable them to use DSS. Secondly, Group 2, those who had heard of but do not use DSS, identified factors for not using DSS. These factors would need to be addressed for them to use DSS. Finally, since the GPs in Group 1 were currently using DSS, they identified factors that would enable them to use more DSS. Analysis of these issues led to the development of the model presented previously (Figure 3).

This research has addressed three gaps in the literature: a lack of research testing the UTAUT model, DSS acceptance, and context specific technology acceptance research. This research adds to the area of technology acceptance by providing support for the UTAUT and refining it to DSS acceptance, specifically in the context of GPs. The original UTAUT model was modified by removing the social influence factor and including one additional factor, trust in the knowledge base. Although this research was targeted at GPs, the findings have wider relevance to general users of DSS. Technology acceptance research is often conducted using similar environments and subjects, namely university students, whereas this research examined technology acceptance in the context of GPs, independent professionals who make individual decisions.

This research has practical implications for those who are involved in the use and dissemination of DSS. First are the DSS developers, who will create the systems for the GPs to use with greater knowledge of user requirements. The second group are the GPs, who will be making the decisions to use DSS in practice. Finally, the last group are the people within the health sector who are responsible for increasing the use of computerisation in GPs’ practices. The health sector comprises a range of people, from
practice managers to government officials. This research enables these people to understand why GPs do not readily use DSS, and use the findings to remedy this situation. For example, practice managers may arrange more DSS training rather than promoting DSS for reasons that are not important to the GPs, such as cost savings. In addition, government officials, often the sponsors of DSS development, can target clinical areas where DSS would be seen as useful by the GPs, such as dermatology.

Finally, the main practical implication of this research for GPs is that they will be more aware of the reasons why DSS are used and thereby able to evaluate their own justifications for using or not using DSS with greater clarity. An awareness of such factors can help the GPs re-examine why they actually do or do not use DSS and in turn lead to higher uptake of DSS.

Limitations include the larger number of overseas trained GPs compared to the actual population of practicing GPs. In order to gain access to GPs and be able to interview them, referrals were obtained from other GPs. Therefore, only the GPs who were referred were interviewed and as a result their educational backgrounds were slightly skewed towards overseas trained GPs. However, by having this slightly higher proportion it made the comparisons more valid and reliable as it reduced the difference in size between the Australian and overseas GPs. In terms of other characteristics, such as gender and age, the sample appeared representative of the actual GP population. Finally, the research was conducted using a qualitative approach. However, the aim of this research was to build theory rather than test theory. Therefore, the qualitative approach taken in this research was appropriate.

Areas for future research include exploring additional factors that may influence the use or non-use of DSS. More specifically it was noted that, while Group 1 was predominantly overseas trained, Group 2 was mainly Australian trained, and Group 3 were also mainly overseas trained. This pattern of overseas training suggests that an additional factor
may play a role in further influencing the use or non-use of DSS, perhaps related to how GPs are trained to make decisions. Furthermore, although the influence of patients and the development of DSS were examined through the inclusion of the patient presence and involvement construct, further examination of both the influence of patients and DSS developers could be undertaken. The degree of depth required to examine these areas was outside the scope of this research and would require comprehensive examination from the perspective of patients and DSS developers.

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Highlights

> Clinical DSS have limited uptake by GPs. > This research examines why some GPs use clinical DSS and others do not. > Key factors: usefulness, facilitating conditions, usability, knowledge base trust.