

# **A Framework for Virtual Patient Navigation Applications**

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# Abstract

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According to the Canadian Cancer Society, half of Ontario's population will be diagnosed with cancer in their lifetime. Many patients being assessed for cancer however become overwhelmed when having to manage information overload, many appointments with different instructions and locations, and recommendations on how to improve their lifestyle. This causes much anxiety and uncertainty among patients. Some cancer assessment clinics offer some guidance in the form of paper-based *patient navigators*, which provide much reliable information to patients but are limited in terms of dynamic updates to appointments, opportunities for sharing knowledge between healthcare providers and patients, and of patients supporting each other.

This thesis proposes a new web-based, mobile, and user-friendly *virtual patient navigator* application framework named *Care Ami*, which incorporates the information found in an existing paper-based navigator along with the new features such as remote updates to personal care paths and calendars, personalized navigation guidance, sharing of symptoms/medications information, and peer group support. Unlike existing solutions, Care Ami is configurable to support multiple types of diseases (e.g., lung cancer and breast cancer). This application is evaluated through testing and the usage of heuristic evaluation guidelines related to usability, and a comparison with related work highlights its many benefits.

# Acknowledgment

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# List of Acronyms

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<b>Acronym</b>	<b>Definition</b>
ACM	Association for Computing Machinery
API	Application Programming Interface
CAC	Cancer Assessment Clinic
CMS	Content Management System
DAP-EPS	Diagnostic Assessment Program Electronic Pathway Solution
FAQ	Frequently Asked Questions
HTTPS	Hypertext Transfer Protocol Secure
IEEE	Institute of Electrical and Electronics Engineers
IT	Information Technology
LIN	Lupus Interactive Navigator
OIN	Oncology Interactive Navigator
PDO	PHP Data Objects
PHP	(recursive acronym for) PHP: Hypertext Preprocessor
PN	Patient Navigator
SQL	Structured Query Language
TOH	The Ottawa Hospital
TOHCC	The Ottawa Hospital Cancer Centre
VPN	Virtual Patient Navigation
URL	Unified Resource Locator

# Chapter 1. Introduction

---

Despite the many technology advancements in healthcare, there is still a need to provide tools that can improve the quality of patients' healthcare processes. For instance, during the diagnosis of a complex disease such as cancer, patients experience much friction and anxiety during their journey. This thesis introduces a new *virtual patient navigator* application called *Care Ami*, which aims to improve patient experience during their healthcare journey. This chapter expands on the thesis motivation, problem context, and goals. The selected research methodology is also presented. The thesis contributions and an outline of the rest of the thesis conclude this chapter.

## 1.1 Motivation

This thesis is motivated by the need to improve patient experience at the *Cancer Assessment Clinic (CAC)* of *The Ottawa Hospital (TOH)* and at *The Ottawa Hospital Cancer Centre (TOHCC)*. During the assessment of patients for cancer, a process that can last several weeks, patients have to go through many tests and have to manage much information, appointments, instructions, and suggestions. This can make patients uncertain about what to do exactly, and can raise their fear of not being taken care of properly. Such feelings are further amplified in patients who are anxious or physically sick and disoriented. For lung cancer, the CAC currently uses a paper-based solution to guide the patients throughout their multi-week assessment journey. This paper-based solution, called a patient navigator, has severe limitations in terms of real-time updates (e.g., of test appointments) and interactions supporting the sharing of health information between patients and care providers.

Working in a real healthcare environment was another motivation for this thesis. This thesis results from a collaborative project conducted by the University of Ottawa and The Ottawa Hospital in which a prototype application for lung cancer assessment patients

was developed. Working in a healthcare environment allows us to think about real problems by taking into consideration the concerns and requirements of patients, family members, nurses, physicians, social workers, and IT personnel.

Another motivation was the understanding of the limitations of existing technologies in that context, especially *virtual* patient navigator applications that connect patients (or their families) online through a web or mobile application and provide reliable information and interactions in support of healthcare journeys. Understanding such limitations helps discover opportunities for improvement.

Lastly, a personal motivation related to the exploration of the integration of new computer technologies in the healthcare system motivated me to work on this thesis.

## 1.2 Problem Context

According to the Canadian Cancer Society, 50% of Ontario's population will be diagnosed with cancer in their lifetime, and around 25% will die of cancer [9]. Cancer is one of the deadliest diseases in Canada and can be very overwhelming for the patients. During the assessment and diagnosis of cancer, a patient has to undergo several tests and consults (e.g., biopsy for diagnostics, staging, and others related to treatment options) over a period of several weeks. Patients find such journey complex: they become uncertain about what to do as they have to manage a significant amount of diversified information, complex appointments schedule (which may be changing), many instructions (e.g., fasting before a particular test, and finding where to get a test in a large hospital), and recommendations on how to have a healthy lifestyle.

TOH's CAC provides many services related to the assessment and diagnosis for different types of cancers (lung, esophageal, colorectal, and prostate). For lung cancer, the CAC uses a paper-based passport [61] that provides reliable information and allows a patient to document his/her symptoms and medications. However, it does not dynamically adapt to the journey's changes and does not allow any interaction between the patient and the healthcare providers. This barrier can introduce a feeling of fear and uncertainties among patients.

### 1.3 Thesis Goals

The hypothesis explored in this thesis is that we can improve on the current state of practice by developing a generalized web/mobile application (a virtual patient navigator) supporting multiple diseases (even beyond cancer) that can monitor and guide patients throughout their diagnostic journey in the healthcare system and that can improve the interaction level between patients and healthcare providers. Our belief is that the usage of such application can help reduce patient fears and uncertainties and improve the overall patient experience.

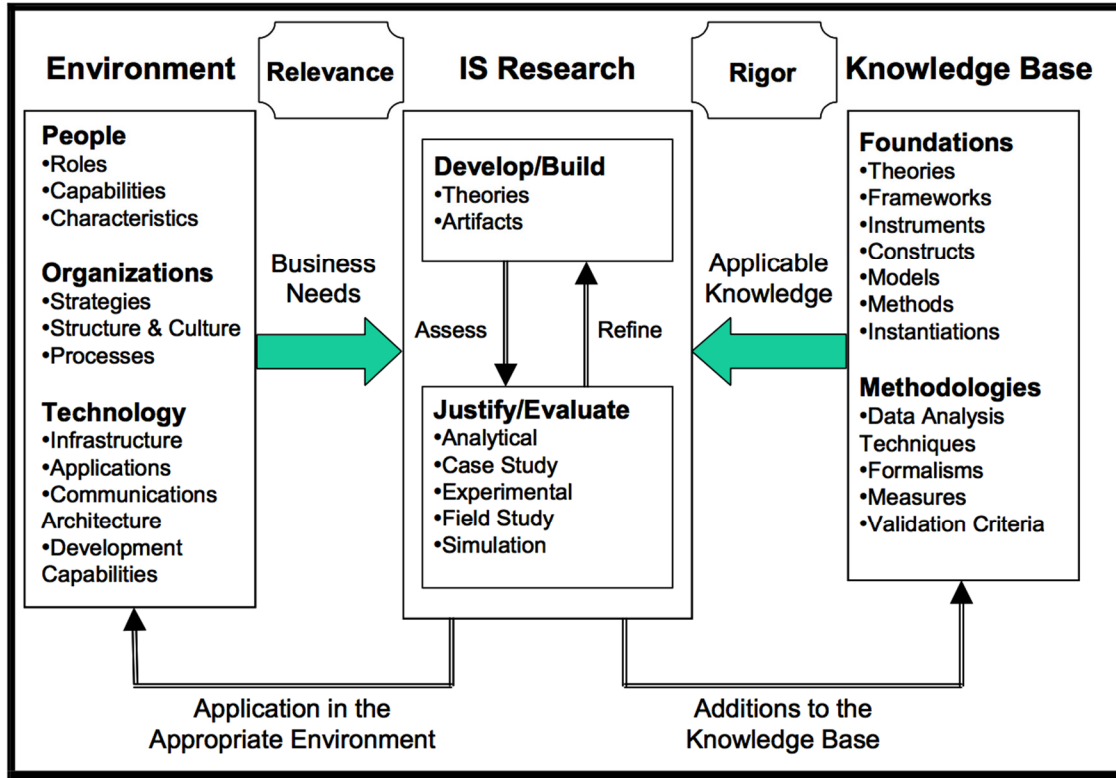
The main goals of this thesis aiming to cover the research hypothesis are:

1. Identifying the technical requirements for a virtual patient navigator application for the CAC;
2. Designing and prototyping this virtual patient navigator application;
3. Evaluating the application.

### 1.4 Methodology

In order to conduct research effectively, there is a need to have a proper research methodology [50]. Since this thesis aims to develop an artifact (i.e., a virtual patient navigator) in a given context (i.e., cancer assessment), our selected research methodology is inspired from Hevner's *Design Science Methodology in Information System (IS)*.

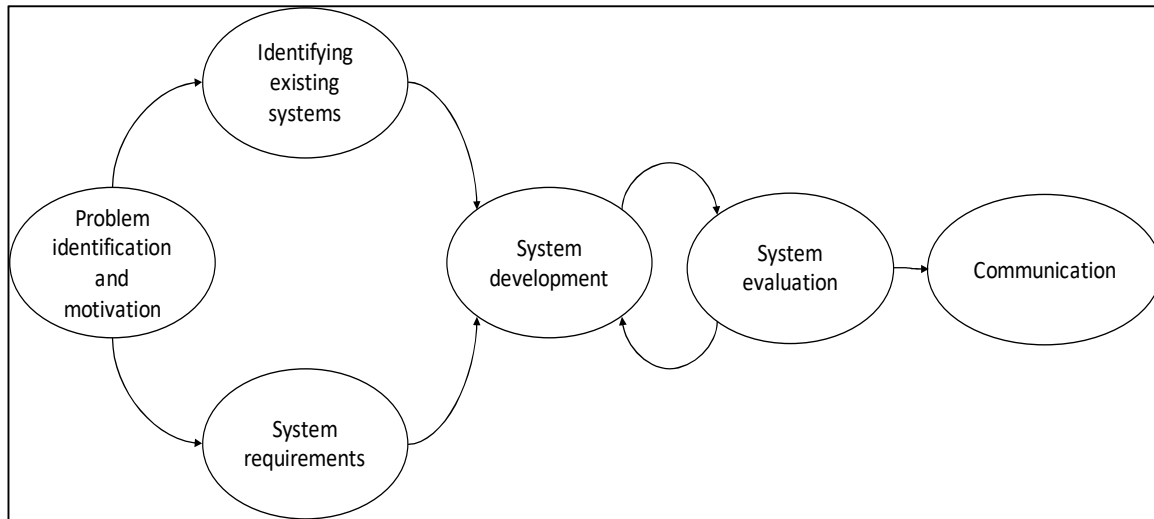
Hevner's Design Science Methodology targets the Information Technology (IT) field with the purpose of developing and evaluating IT artifacts to solve a recognized problem [29]. This research process consists of a development phase and an evaluation phase, which are at the center of the design science research framework illustrated in Figure 1-1. The artifact in design science is developed and evaluated based on the environment and knowledge base components. The environment component helps in finding the business needs and their relevance; in our context, this environment is composed of patients, physicians, and other CAC and TOH stakeholders. The knowledge base component helps in providing the appropriate knowledge to design the system; this is in part provided by existing patient navigation systems and by development technologies such as Content Management Systems (CMS). The design science research methodology has several guidelines, summarized in Figure 1-2.



**Figure 1-1** Design Science Research Framework (adapted from Hevner et al. [29])

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

**Figure 1-2** Design Science Research Guidelines (adapted from Hevner et al. [29])



**Figure 1-3** Thesis methodology

Based on the design science methodology, this thesis' methodology, shown in Figure 1-3, is composed of several steps.

- **Problem identification and motivation:** in this step, the problems faced by patients during their assessment are identified.
- **Identifying existing systems:** here, the features of existing patient navigator systems and their problems should be studied.
- **System requirements:** this step involves gathering requirements from patients, the healthcare providers at The Ottawa Hospital, other CAC/TOH stakeholders, and the literature.
- **System development:** this step focuses on the development of a virtual patient navigator system that helps improve the overall patient experience during the healthcare journey of patients being assessed for cancer.
- **System evaluation:** in this step, the developed system is evaluated through testing and the use (by the developer) of Nielson's heuristic evaluation guidelines related to usability [53][54]. Although a formal usability study involving real users (patients, nurses, physicians, clerks, and administrators) would be highly beneficial here, this option was not followed due to the difficulties and time needed to obtain proper ethics approval from the University of Ottawa and from TOH.

- **Communication:** this step involves sharing the research results by writing this thesis and research publications.

## 1.5 Thesis Contribution

The main research contributions of this thesis include the design and implementation of a new virtual patient navigation application named *Care Ami*<sup>1</sup>. Care Ami was designed based on the requirements identified during several meetings with the stakeholders. This application is designed for The Ottawa Hospital (a major teaching hospital in Ontario, Canada) and can support patients throughout their assessment and diagnosis journey. Supporting multiple roles, including nurse/physician, patient, and clerk, this application can be accessed from multiple device types (desktops, tablets, or mobile phones). The evaluation also shows that Care Ami fits the collected requirements better than existing virtual patient navigators.

## 1.6 Publications

As the methodology suggests early communication of the research results, this thesis has led to one conference paper so far:

- **Chandhoke, G.S.**, Grewal, A.S., Pathak, V., Singh, S., Ziabari, M.K., Amyot, D., Mouftah, H., Michalowski, W., Fung-Kee-Fung, M., Smylie, J., and Shin, S.: A Virtual Patient Navigation Application for Lung Cancer Assessment Patients. In: *7th Int. MCETECH Conference on e-Technologies (MCETECH 2017)*, Ottawa, Canada, May 2017. LNBIP 289, Springer (to appear) [11].

In this paper, in collaboration with Ajaydeep S. Grewal, Venus Pathak, and Simrandeep Singh, I developed and implemented the first Care Ami prototype, which targeted lung cancer. Mir Kamyar Ziabari was responsible for performing manual testing of this application. I was the lead analyst and developer, and I was in charge of the literature review.

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<sup>1</sup> “Ami” means *friend* in French; this is meant to reflect the bilingual (English/French) nature of TOH.

This thesis substantially extends the paper's work by generalizing the application for multiple types of diseases, by performing testing covering the requirements, by using heuristic evaluation guidelines to assess usability, and by providing refined requirements, detailed design information, many bug fixes, and several new features.

## 1.7 Thesis Outline

The rest of this thesis is outlined as follows:

- Chapter 2: presents background about patient navigation systems, including the paper-based approach currently used at TOH/CAC, and about the Drupal CMS used to develop the Care Ami framework.
- Chapter 3: discusses the main existing systems related to virtual patient navigation, with a brief assessment of their features.
- Chapter 4: presents the main goals and requirements for Care Ami. Then, it discusses the application's architecture and implementation.
- Chapter 5: explains the usability evaluation (based on guidelines) and manual testing used to evaluate the Care Ami framework. It also highlights several challenges identified along the way.
- Chapter 6: provides a comparison between Care Ami and closely-related competing systems and discusses threats to the validity of this thesis.
- Chapter 7: concludes the thesis and presents important future work items.

Note also that Appendix A describes the Drupal modules that are used to implement Care Ami framework, whereas Appendix B shows the permissions assigned to each role (nurse/physician, clerk, patient/family member, super-administrator, and administrator in our case) in the application.

## Chapter 2. Background

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This chapter provides important background information about patient navigation in healthcare. It mainly focuses on a brief introduction to patient navigation, its benefits, and its main types. Also, the paper-based approach used by The Ottawa Hospital is briefly introduced. In addition, this chapter presents the Drupal content management system used to develop the Care Ami framework proposed in this thesis. These background concepts will help the reader better understand the remaining chapters of the thesis.

### 2.1 Patient Navigation

According to the American College of Surgeons:

*“A **patient navigation process**, driven by a community needs assessment, is established to address healthcare disparities and barriers to care for patients. Resources to address identified barriers may be provided either on-site or by referral to community-based or national organizations. The navigation process is evaluated, documented, and reported to the cancer committee annually. The patient navigation process is modified or enhanced each year to address additional barriers identified by the community needs assessment” [1]*

A *patient navigation system*, automated or not, supports a patient navigation process or program. The first patient navigation program was introduced by Dr. Harold Freeman and his team in Harlem, New York. The main purpose of the system proposed was to support cancer screening for underserved populations [19]. The patient navigation concept was formed based on the findings of the *American Cancer Society National Hearings on Cancer in the Poor*, which found that substantial barriers are faced by poor people when trying to access healthcare services and that the available information for cancer was not very effective. Patient navigation was found to eliminate some barriers faced by the patients during the diagnosis and treatment of cancer [20][21]. Further, patient navigation programs

can assist patients in getting proper treatment of other chronic diseases along with cancer [21].

Patient navigation may also help providing information to the patients, support during their treatment, and assistance with survivorship issues [38]. Several studies have shown the positive impact of patient navigation programs on patients [6][23][35][45][56].

### **2.1.1 Benefits of Patient Navigation**

Patient navigation programs are effective in helping patients by improving their journey through complex healthcare systems. The most common benefits of the patient navigation system include:

- Improving patients' education by providing information regarding their diagnosis and treatment.
- Better interaction between the patients and their healthcare providers.
- Improving timeliness and follow-up to diagnosis.
- Providing social and emotional support.
- Providing proper plans of care.
- Improving patient satisfaction.

### **2.1.2 Types of Patient Navigation Systems**

According to Canadian Partnership Against Cancer, patient navigation (PN) systems are of three types: professional, peer-based, and virtual [43].

#### **• Professional Patient Navigation**

In a *professional patient navigation* system, the patient navigators are trained professionals who possess broad knowledge about the healthcare system. In healthcare, case managers or nurses are generally described as patient navigators. Other terms used to describe the professional patient navigator role include clinical coordinator, cancer support nurse, follow-up nurse, and cancer coordinator [16].

The role of a professional patient navigator includes helping the newly diagnosed patients by informing and teaching them about disease-related knowledge, helping with

follow-ups, assessing patient needs, and providing special support to patients during their journey [17][18]. Professional patient navigation may provide better continuity of care and higher satisfaction to patients by providing them with adequate knowledge about their disease and proper plans of care. The involvement of professional patient navigators during the patient's journey may also reduce the hospitalization duration and lead to better emotional quality of life [18].

- **Peer Patient Navigation**

In a *peer patient navigation* system, the patient navigators are community health workers who share similarities with patients regarding their language, social, and cultural background [15]. They are sometimes also called *lay patient navigators*. These peer patient navigators are selected from the community and are trained under professional clinical supervision [18].

A peer patient navigator is responsible for providing informal support, counseling, scheduling of appointments, and screening tests follow-ups, and for helping patients by arranging transportation to the healthcare destination [59]. Various studies have shown the effectiveness of peer patient navigation in providing continuity of care, and social and cultural support to the patients [15][39][46].

- **Virtual Patient Navigation**

A *virtual patient navigation* system connects patients (and their family members) online through a web or mobile application and provides reliable health information and convenient access to services while enabling patients and healthcare providers to save time [27].

Virtual patient navigators can be considered as an amalgamation of professional and peer PN, but through a web or mobile application. The role of virtual patient navigator includes providing: information about the disease and its treatment to the patients, proper plan of care, emotional and social support, better interaction between patient and healthcare providers, and patient engagement. Studies have shown the positive impact of virtual PN technology on the patient's healthcare journey [28][40].

## 2.2 TOH Patient Navigation Approach

In the recent past, TOH used a systems approach to re-engineer its lung cancer diagnosis process in a way that improved the overall patient experience, mainly by reducing the total wait time from referral to the first treatment [22]. In addition, TOH follows an approach similar to professional patient navigation by providing a paper-based *passport* [61] (shown in Figure 2-1) to the patients undergoing lung cancer assessment to support their care journey and to reduce their fears and uncertainties. This passport provides much reliable information about tests and medical terms, and it enables the patients to collect information about their medications, symptoms, appointments, questions for physicians, etc. However, such paper-based solution cannot support a direct contact between the care providers and the patient, nor it can adapt dynamically to changes in a patient’s journey. Also, using this paper-based solution, it would be difficult to provide additional features such as map-based navigation guidance (required in a large hospital), peer communication between patients, and support for decision making.

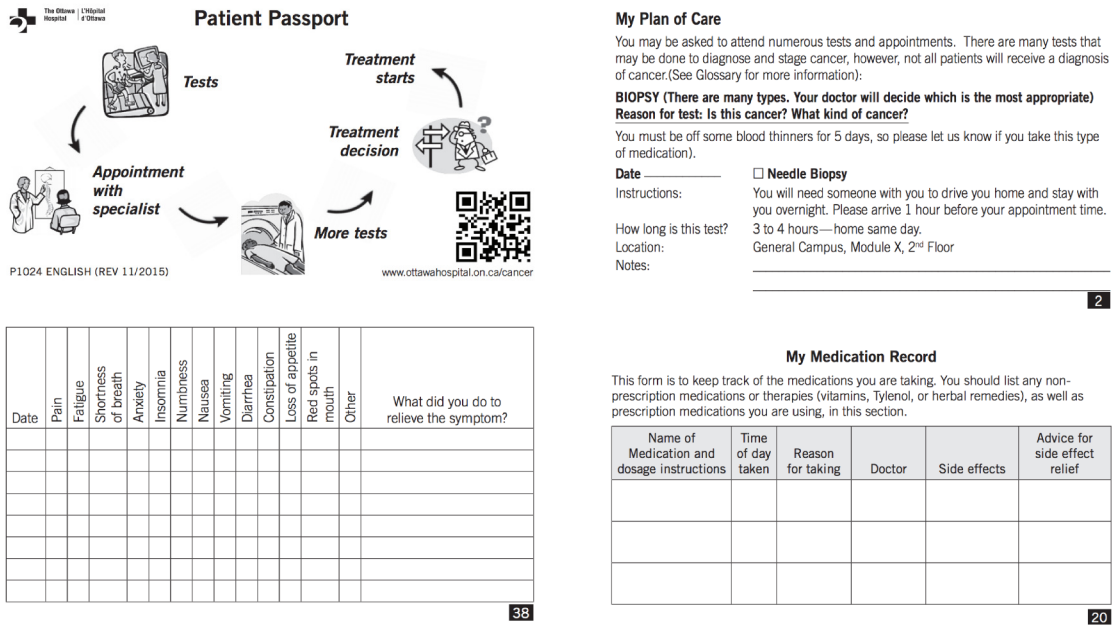


Figure 2-1 Four sample pages from TOH’s existing paper-based passport

## 2.3 Drupal Content Management System

A content management system (CMS) is “a software package that provides some level of automation for the tasks required to effectively manage content” [4]. A CMS is used for developing websites quickly and allows users to publish, edit, and modify content of any type. A CMS also allows users to create and reuse plugins providing extended functionalities. There exist a significant number of CMSs that are written in different programming languages [42]. One of the most popular and successful open source content management framework is *Drupal* [14]. This CMS, written in the PHP language, is used to develop flexible websites.

Background on Drupal is important because this is the technology we selected for implementing the Care Ami virtual patient navigation application. The main features of Drupal include:

- **Open source CMS** – Drupal is a free open source CMS that allows users to add multiple modules and plugins to a website.
- **Availability of functionalities** – Drupal offer a large collection of functionalities (over 35,000 modules) that make the development of websites efficient. Drupal has three types of *modules*: core, contributed, and custom. Core modules are the necessary modules that are required for basic functionalities of the website. Contributed modules are developed by Drupal’s community members and can be installed manually. Custom modules are the modules created by the administrators of one website based on required, specific functionalities.
- **Different content types** – Content types contain multiple data types (fields) that are used to add content on the website. Drupal core allows adding the content on the website using two content types: *article* and *basic page*. Custom content types can also be created by the users and administrators.
- **Advanced user management** – Drupal supports role-based control of access to the website. Multiple roles (or types of users) can be created on the website and read/modify permissions can be assigned to each one.
- **Security** – Drupal provides built-in security that protects the website from common critical internet vulnerabilities.

- **Large community support** – Drupal enjoys the support of a large community that helps administrators in getting documentation and answers to questions.

## 2.4 Chapter Summary

In this chapter, basic terminology used in this thesis was presented, together with information on patient navigation systems, including their benefits and common types. The existing paper-based approach used by The Ottawa Hospital was also discussed, and the Drupal content management system was briefly introduced. The next chapter will review and characterize existing literature on web-based and/or mobile-based applications for virtual patient navigation.

## Chapter 3. Literature Review

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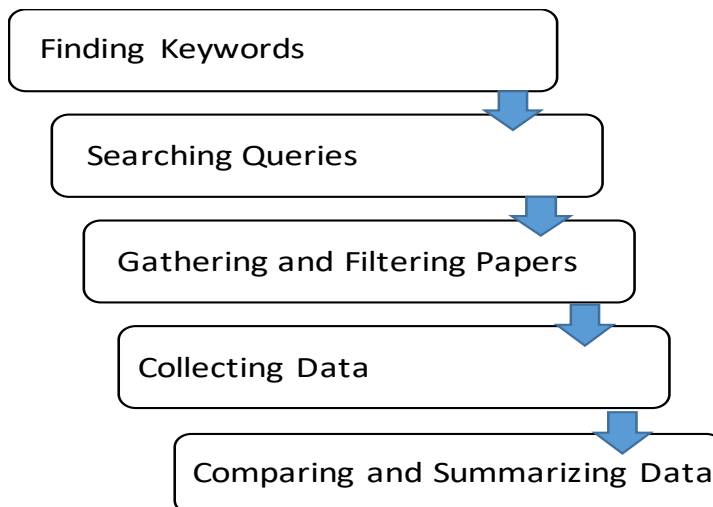
This chapter provides a literature review of virtual patient navigation systems in healthcare. Relevant and valid scientific papers as well as commercial solutions were searched and selected systematically. The review is done by examining the existing patient navigation systems that use technologies (web or mobile based) to reduce patient fears and uncertainty thereby improving the patient experience. The eight selected approaches are compared and summarized as well.

### 3.1 Literature Review Methodology

Our review methodology is inspired from the systematic literature review approach for software engineering developed by Kitchenham et al. [41]. In our review methodology, the five steps shown in Figure 3-1 are used to gather most of the existing virtual PN approaches relevant to our research. In the following subsections, the steps used in conducting the literature review are discussed in details.

### 3.2 Finding Keywords

This research investigates the online-based patient navigation systems that can improve the experience of patients during their healthcare journey. Through the iterative exploration of papers, important keywords used for querying scientific databases were found to include: virtual patient navigation, web-based, patient advocate, healthcare, and interactive. We used common technical and medical databases in this review: Scopus (which covers IEEE Xplore, ACM Digital Library, Springer, Elsevier, and others), Web of Science, Medline (Ovid), ProQuest, and Google Scholar. Google's regular search engine was also used to find additional information about related commercial systems.



**Figure 3-1:** Steps used in conducting the literature review

### 3.3 Searching Queries

The abstract query we used is:

*("patient navigat\*" OR "patient advocate" OR "healthcare advocate" OR "healthcare navigat\*")*  
*AND*  
*("virtual" OR "web-based" OR "interactive")*

This abstract query was tailored to the specific syntax and limitations of each search engine. Furthermore, Google Scholar was searched based on titles only (as there is no way to search abstracts on that engine), Medline (Ovid) was searched using abstracts only, and the other databases were searched using abstracts and titles. No time limit was enforced.

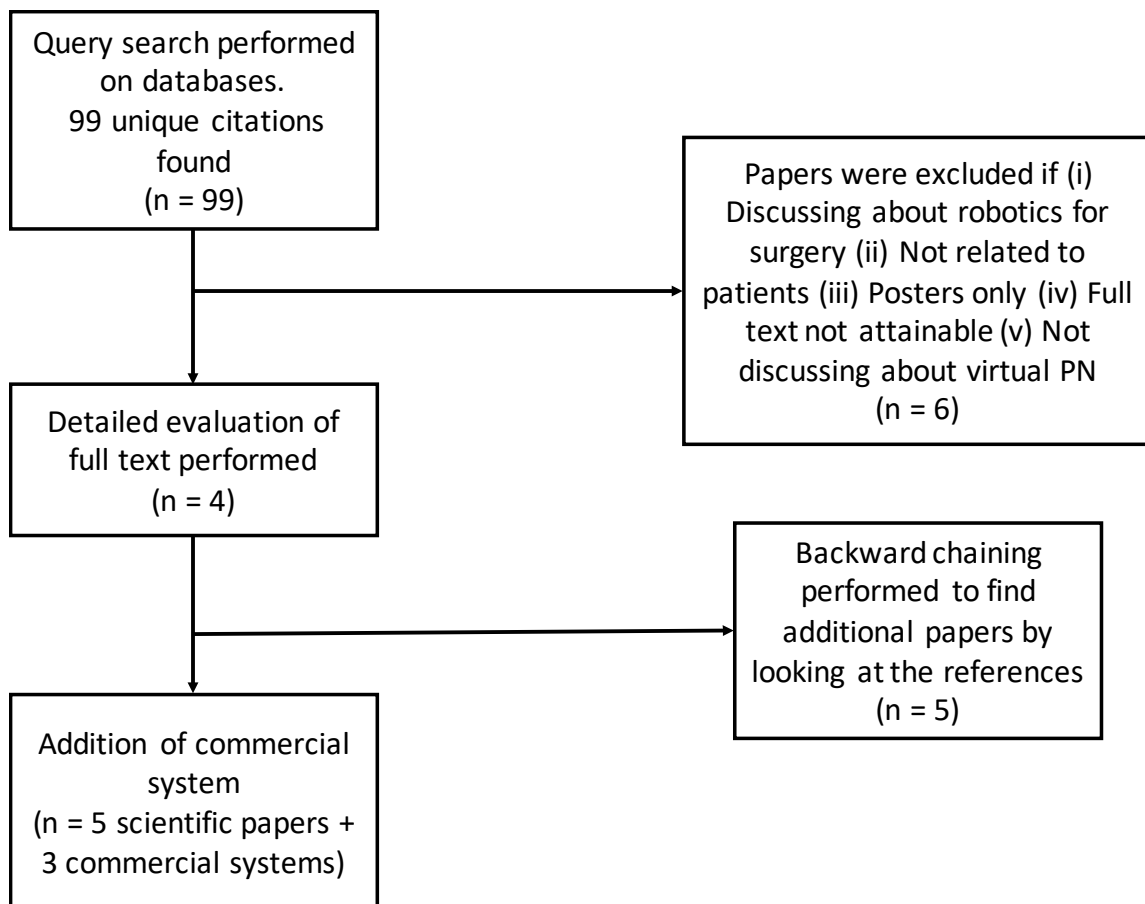
### 3.4 Gathering and Filtering Relevant Papers

The query resulted in 99 unique scientific papers. Many irrelevant papers were quickly removed based on titles and abstracts through exclusion criteria: papers unrelated to patient navigation in healthcare (many were about robotics for surgery), applications for helping healthcare providers only (instead of supporting patients), papers that were just abstracts or posters, and PN systems that were professional or peer-based (not virtual).

The 6 remaining papers were reviewed again by going through their introduction, results, methods, and conclusions in detail. This quality assessment step further reduced

the number of relevant papers to 4 scientific papers. Additionally, a few top commercial systems were also selected to be reviewed. 2 systems [32][48] were identified from the top results returned by Google when searching for “patient navigation mobile application” and one system [7] was explicitly mentioned by The Ottawa Hospital collaborators during one of our meetings. That commercial system had no scientific publication related to it, hence it was not found by our query.

An additional backward chaining step was used, which consisted in looking at the references of the 4 scientific papers (plus a survey paper) for including additional relevant systems. As a result, we added another virtual PN systems, the Gabby System [24], for a total of 8 papers. How we gathered and selected the relevant papers is summarized in Figure 3-2.



**Figure 3-2** Workflow diagram summarizing the gathering and selection of papers

### 3.5 Collecting Data

The relevant papers included in the review are shown in Table 3-1. They include the scientific papers as well as the commercial systems related to virtual patient navigation.

**Table 3-1** Relevant systems related to virtual patient navigation systems

Article Code	System Name	Search Engine	Year	References
P1	Oncology Interactive Navigator (OIN)	Scopus	2013	[44]
P2	Lupus Interactive Navigator (LIN)	Scopus	2016	[51]
P3	A web-based portal to improve patient navigation	ProQuest	2014	[31]
P4	Accenture patient navigation application	Google	2013	[32]
P5	Patient navigator by MobileCare247	Google	~2012	[48]
P6	Gabby system – Virtual patient advocate	Reference	2013	[24]
P7	Project RED – Virtual patient advocate	Google Scholar	2010	[5][33][34]
P8	Diagnostic Assessment Program – Electronic Pathway Solution (DAP-EPS)	Google	2011	[7]

Virtual patient navigation (VPN) helps in simplifying treatment processes, services, and potential barriers of the patient journey [43]. The increasing use of such technology in healthcare can also result in improving patient quality of life and self-care, patients spending less time during their health visits, and patients having clearer expectations [26].

In 2013, a web-based interactive tool called *Oncology Interactive Navigator* (OIN) was developed for patients suffering from colorectal cancer and melanoma (skin cancer) [44]. OIN was the first patient navigation tool developed in Canada. The purpose of OIN was to create awareness among patients along with providing high-quality, evidence-based information concerning their diagnosis and treatment, psychosocial adjustment to cancer, and community supportive care services. Haase et al. showed that patients were pleased with the comprehensive informational support and were becoming less dependent on healthcare providers [28].

Based on OIN, another virtual navigation tool called *Lupus Interactive Navigator* (LIN) was developed for patients suffering from Lupus in order to provide optimal care

and to enable patients to self-manage their disease. The purpose of LIN was to engage patients and provide high-quality evidence-based information, managing symptoms and medications, accessing community support services, and providing information about incorporating a healthy lifestyle [51]. Also, a survey conducted by Neville et al. showed that the patients were pleased by the use of a web-based tool that was easy to use and highly accepted for providing high-quality credible information about their disease and medications, and self-management of their disease [51].

A mobile application prototype was developed by Accenture to overcome barriers to treatment, guide patients to care and improve healthcare outcomes [32]. According to Horowitz, the purpose of this application was to help the patient navigators in providing healthcare services to the patients and in reducing patient admission and emergency room visits. In addition, the *MobileCare247* team developed a patient navigator tool to ensure the well-being of patients by providing them with knowledge and support [48].

In 2014, a web-based application was developed by Highfield and Hanks to improve the patient navigation of patients in underserved communities [31]. The main focus of this web-based tool is to meet the needs of patient navigators in serving underserved populations and providing them access to low-cost and free healthcare. Features like having a bilingual website and finding nearby clinics have helped the patient navigators in providing healthcare access to the underserved population [31].

With the use of technology in patient navigation, additional support and information is provided to the patient [40]. A virtual patient advocate/navigator called *Gabby System* was developed at the Boston Medical Centre. Gardiner et al. describe it as a computerized animated character that is claimed to reduce preconception risks among women [24]. *Gabby System* uses a virtual avatar character named *Gabby*, which provides women information about such risks and helps them bring positive changes to their life. Further, survey results have shown that the *Gabby System* was easy to use and reliable by women with low literacy [24].

Another virtual advocate system, *Project RED*, was developed by the Boston Medical Centre to improve the overall patient safety. *Project RED* uses a virtual avatar character named *Louise*, which was developed for reducing the rate of re-admissions to the hospital

by providing high-quality information to the patients about their disease and about the necessity of incorporating a healthy lifestyle. The purpose of Project RED is to educate the patients by providing them with high-quality information, and providing post-discharge guidance plan [33][34]. Additionally, Project RED supports multiple languages to help patients from different cultures. A survey has shown that Project RED is capable of reducing the overall rate of hospital re-admissions [5], thus improving the patient's overall experience.

Developed by Cancer Care Ontario, the *Diagnostic Assessment Program Electronic Pathway Solution*, or DAP-EPS [7], helps patients navigate through their diagnostic journey. With the explicit support for lung and colorectal cancers, DAP-EPS provides a pathway to patients from screening to staging stages. Additionally, it offers support for multiple languages (English and French).

### 3.6 Comparing and Summarizing Data

In this section, the existing virtual navigation approaches, shown in Table 3-1, are categorized and compared. The categorization is done based on ten criteria (A1-A10) that correspond to the high-level requirements for Care Ami (to explained further in the next section, especially in Table 4-2), plus one more criterion corresponding to the validation level:

- Whether *information about the diagnosis* is provided (A1) – the value is set to *yes* only if the details about the diagnosis or treatment are provided by the system.
- Whether *patients are engaged* in the system (A2) – the value is set to *yes* only if the patient is allowed to input her/his information (regarding their medications, symptoms, and questions) into the system.
- Whether *follow-up plans during/after the assessment* are provided (A3) – the value is set to *yes* only if the system enables the healthcare provider to book an appointment for the patient, with email reminders. The value is set to +/- if the healthcare provider can follow up with the patient through any other means of communication.

- Whether *role-based access* is supported (A4) – the value is set to *yes* only if the system ensures that information can be read/written only by specific roles.
- Whether *peer support* is provided (A5) – the value is set to *yes* only if the system provides support to the patient during their healthcare journey.
- Whether *maps* are displayed (A6) – the value is set to *yes* only if maps (e.g., Google Maps or static/bitmap/PDF maps) to buildings and rooms are integrated into the system. The value is set to +/- if only textual directions to reach the healthcare providers are provided.
- Whether *healthy lifestyle information during/after the treatment* is provided (A7) – the value is set to *yes* only if the system provides information regarding incorporation of healthy habits into a patient’s life.
- Whether the interface supports *multiple languages* (A8) – the value is set to *yes* only if the system supports more than one language.
- Whether *mobile devices* are supported (A9) – the value is set to *yes* only if the system supports mobile apps or mobile web browsers.
- Whether *multiple types of diseases* are supported (A10) – the value is set to *yes* only if the system supports more than one disease, +/- if only the infrastructure to do so is there, and *no* otherwise.
- *Validation* of the application – the value is set to *yes* if there is some validation regarding the implementation and usefulness of the system, +/- if there is an implementation only, and *no* otherwise.

As shown in Table 3-1, the oldest system related to virtual patient navigation is P7, proposed in 2010. The technology-based patient navigation approach is still maturing and research on that topic is still ongoing.

The comparison results are summarized in Table 3-2, where green is satisfactory, yellow is partial, and red is unsatisfactory. Article P3 and P4 are not exactly online systems for patients only, as they target human patient navigators who can further guide the patients through their healthcare journey. The other articles (P1, P2, P5, P6, P7, and P8) focus on patients by providing them with reliable information about diagnoses and treatments. The systems in articles P1 (OIN) and P2 (LIN), which are based on similar technologies, lack

the engagement of patients and do not include any feature to provide navigational maps, treatment plans, and support for multiple languages. Also, in articles P6 (Gabby) and P7 (Project RED), which are developed by the same institution (Boston Medical Centre), the VPN systems engage the patients in the applications. However, these systems lack support to the patients and do not allow different roles (e.g., physician, nurse, etc.) to access the application. Lastly, the DAP-EPS solution in article P8 covers the highest number of requirements among all existing systems, but lacks support for peer support and maps to rooms (during appointments). In a nutshell, most systems target the sharing of reliable information about diagnoses and treatments. However, features for providing peer support, navigational maps, and support for multiple type of diseases are often ignored. In Section 6.1, these patient navigation systems will be discussed more precisely in the context of our Care Ami framework.

**Table 3-2** Related work

Article	Information Provided About Diagnosis	Patient Engagement	Follow-up Plan	Role-Based Access	Peer Support Network	Map Display	Healthy Lifestyle	Multi-Language	Support Mobile Devices	Multiple Types of Diseases	Validation
P1	Yes	No	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes
P2	Yes	No	No	Yes	Yes	No	Yes	No	Yes	No	Yes
P3	No	No	No	Yes	No	+/-	No	Yes	Yes	No	Yes
P4	No	Yes	Yes	No	No	+/-	No	No	Yes	No	No
P5	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No
P6	Yes	Yes	+/-	No	No	No	Yes	No	Yes	No	Yes
P7	Yes	Yes	+/-	No	No	No	Yes	Yes	No	No	Yes
P8	Yes	Yes	Yes	Yes	No	+/-	Yes	Yes	Yes	Yes	Yes

### 3.7 Chapter Summary

In this chapter, we identified existing systems related to virtual patient navigation. These systems were briefly discussed, evaluated, and compared. Almost all provide information to the patients about their diagnosis and about incorporating healthy lifestyle practices. Only a few, however, support multiple diseases, multiple languages, peer support, and integration of navigation maps into the application. According to Table 3-2, P8 (DAP-EPS)

currently covers the highest number of requirements mentioned in Section 3.6. But some gap remains, especially as we get into the specifics of low-level requirements.

The next chapter presents the goals, architecture, design, and implementation of our proposed VPN application, Care Ami, including many of its unique features.

# Chapter 4. The Care Ami Application Framework

---

This chapter presents and discusses the goals, requirements, architecture, and implementation of our proposed application framework, *Care Ami*. The term *framework* here refers to the ability of generalizing support to multiple applications, for example, many diseases or types of cancers. In addition, this chapter explains several technology decisions made during the design and implementation of Care Ami.

## 4.1 Issues and Goals

As discussed in the problem description and in Chapter 2, various problems are faced by patients during the diagnosis and treatment of their disease. Patients often lack proper support and they have to keep track of many appointments and various information that make their healthcare journey very complex, especially as many such patients are sick and anxious. Also, as discussed in Chapter 2, the paper-based *passport* solution provided by The Ottawa Hospital reduces some fears and uncertainties of patients. However, this passport is not able to adapt dynamically according to changes in a patient’s journey and does not enable a direct exchange of information between the patients and the healthcare providers. In this context, there is a need for an online application that better supports patients during their diagnosis and treatment.

In this research, our proposed application, Care Ami, aims to overcome the issues mentioned above. The primary goals of Care Ami are shown in Table 4-1.

**Table 4-1** Primary goals of the Care Ami application framework

Goal ID	Goal Description
G1	Improve the overall patient experience, reduce uncertainty, and reduce fears of not being taken care of/about.
G2	Improve interactions between patients and nurses/physicians.
G3	Provide a generalizable framework as a clinical care support tool in various contexts.

## 4.2 Requirements

The ten high-level requirements used to compare the existing virtual PN systems (in Section 3.6) were refined into 23 sub-requirements identified by discussing with the Care Ami stakeholders (first for the lung cancer assessment, and then for general diseases) and by examining the literature. Table 4-2 shows the requirements along with their sub-requirements and corresponding goals. These requirements were validated during several meetings with physicians and nurses (co-authors of [11]), who were also in touch with information technology personnel, patients, a social worker, and patients' family members at TOH. One more high-level requirement (A11) is about security and privacy is identified as these concerns are very important in a healthcare context. However, A11 does not fall within the scope of our study, especially as these concerns are usually addressed by the components selected and then later by the integration with the hospital's infrastructure.

Furthermore, for our proposed application, several roles were identified, namely patients, hospital clerks, nurses/physicians, site administrators (e.g., for lung cancer), and super administrators (for the computing infrastructure), each having their own read/write access privileges to the application. Table 4-2 also shows how requirements contribute to the goals identified in Table 4-1.

**Table 4-2** System requirements

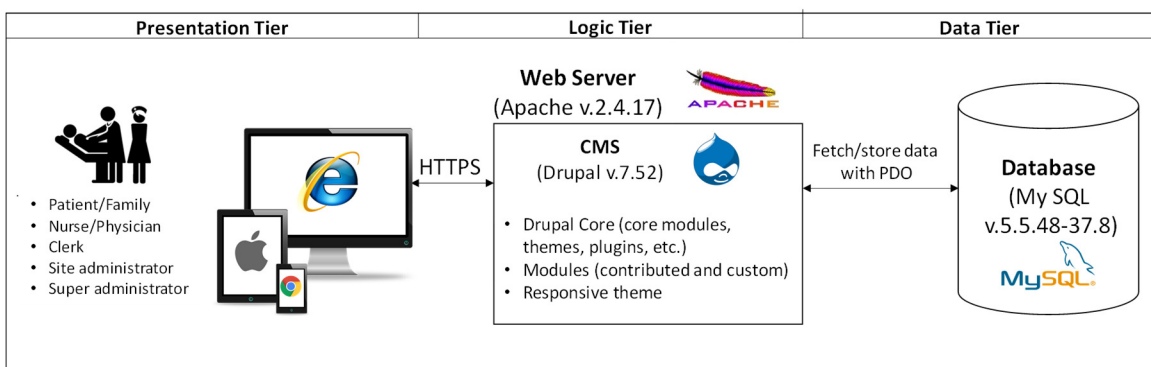
High-Level Requirements	Req. ID	Sub-Requirements	Goals
A1 - Provide information about the diagnosis and healthcare providers [25]	R1	List the major symptoms of the disease.	G1
	R2	Provide essential and reliable information about the diagnostic plan.	G1
	R3	Provide information about the medical staff involved in the patient's management.	G2
A2 - Support patient engagement [30]	R4	Provide different features for patients to document their medications, symptoms, and questions.	G2
A3 - Provide a follow-up plan	R5	Provide a visual indication and description of a patient's stage of treatment.	G1, G2

High-Level Requirements	Req. ID	Sub-Requirements	Goals
	R6	Provide a calendar that contains information about the tests and appointments of the patient and the exact time and date of the appointment/test in addition to a description of the test that will be taken.	G1, G2
	R7	Provide a mechanism to import the calendar content to personal calendars.	G1, G2
	R8	Provide clerks with the means to revise and update the content of the calendar.	G1, G2
	R9	Send an email notification to the patient when an appointment is booked.	G1, G2
	R10	Send a reminder email two days before each test or appointment.	G1, G2
A4 - Enforce role-based access [58]	R11	Provide an editable profile for each user.	G3
	R12	Provide each user the relevant type of access, view, and features.	G3
	R13	Provide permissions to patient users to cancel their account at any time.	G3
A5 - Create a peer support group [62]	R14	Provide a private peer network of other patients being diagnosed, to help them interact with and support each other.	G1
	R15	Provide the contact information of reliable support communities for the target disease.	G1
A6 - Display maps integrated with appointments [60]	R16	Provide a map to the hospital floor where the test or appointment will be held, with an indication of the room.	G1
	R17	Provide hospital parking information.	G1
	R18	Provide information about how to get to the hospital using public transportation.	G1
A7 - Provide information about a healthy Lifestyle [63]	R19	Provide reliable informative and videos about how to maintain a healthy lifestyle during the patient's journey.	G1, G2

High-Level Requirements	Req. ID	Sub-Requirements	Goals
A8 - Support official Languages [10]	R20	Provide information in the relevant languages (English and French for TOH).	G1
A9 - Support different screen size devices	R21	Support Android and Apple iOS mobile phones and tablets.	G1
A10 - Support multiple type of diseases	R22	Support multiple sections, one for each type of disease.	G3
	R23	Provide patients with the ability to share their information with nurses/physicians and between multiple sections.	G2, G3
A11 - Ensure security and privacy	R24	Protect users and data against common security attacks and privacy leakages, and comply with relevant regulations.	G3

### 4.3 Care Ami Architecture

In order to meet the system requirements mentioned in Table 4-2, a multi-tier architecture was used for Care Ami, as shown in Figure 4-1. This architecture shows the overall structure of components (and sub-components), their links, and specific technologies used in our implementation.

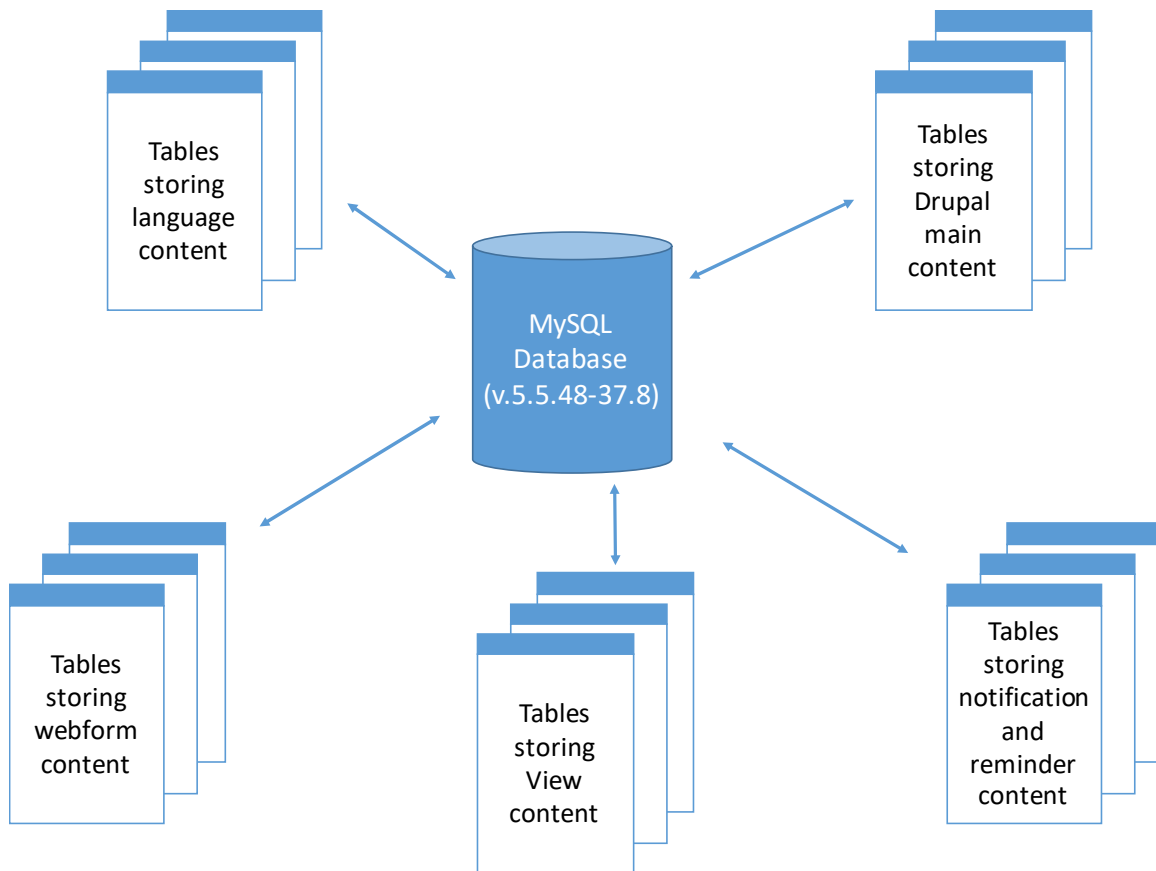


**Figure 4-1** Care Ami architecture

The functions of the three tiers of the architecture are described in the following subsections.

### 4.3.1 Data Tier

In the data layer, a database management system (MySQL V5.5.48-37.8 here) is used to manage and store the information in the form of multiple tables. Figure 4-2 shows the main tables that are stored in the database, and are defined below.



**Figure 4-2** Overview of the tables in the MySQL database

1. Tables storing Drupal’s main content: These tables store the information of the Drupal core’s content, which includes users, user-roles, menus, taxonomy terms, nodes, page-content, etc. This content is multi-lingual by default.
2. Tables storing notification and reminder content: These tables manage the information related to the notification and the reminder emails.
3. Tables storing view content: These tables contain the information that is viewed by multiple users of the website (appointment, patient’s information accessed by nurse/physician, etc.). They also have tables storing the information of external CSS classes created for the design of the website.

4. Tables storing webform content: These tables have the information that is documented by the patients related to their medications, symptoms, and questions.
5. Tables storing language content: These tables store the information of the website in both official languages, English and French.

Drupal (version 7.52) uses the Drupal 7 Database API to interact directly with the database system. This Database API is based on object-oriented design concepts and provides good security checks as well. To perform interactions between Drupal and the database, the Database API uses *PHP Data Objects* (PDO) as a serialized means of communication.

### 4.3.2 Logic Tier

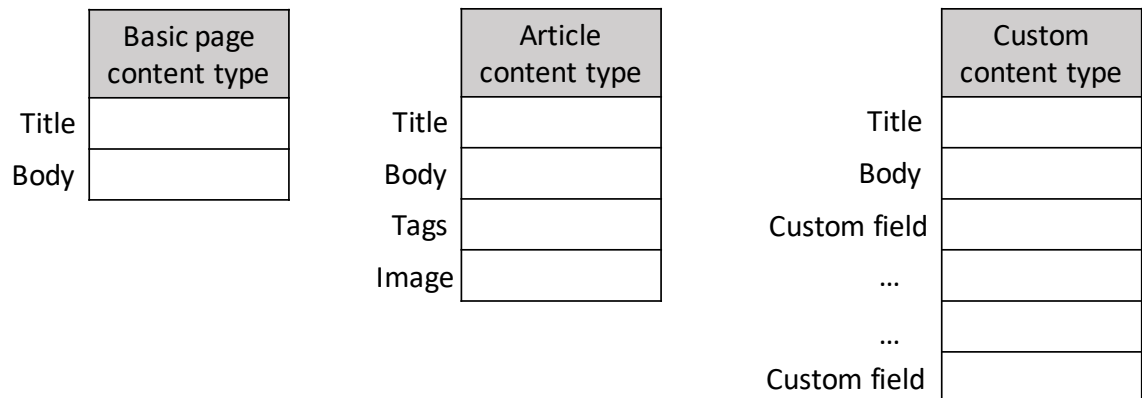
In the logic tier, a web server hosts the Drupal CMS and interacts with users' web browsers in the presentation tier via secure HTTPS communication. In our case, we are using Apache v.2.4.17 as a web server and Drupal v.7.52 as a CMS. Drupal 7 was favored over Drupal 8 because of the large selection of reliable modules available mainly for version 7 but not for version 8. The components of Drupal are: (1) Drupal core (2) External modules (3) External themes.

	Drupal Core APIs
Default Themes	Entity API
	Fields API
	Form API
Default Modules	Menu API
	Blocks API
	Database API
Common Libraries	Schema API

**Figure 4-3** Drupal core architecture

- **Drupal Core:** The core has all the necessary files that are required to provide the basic functionality of the CMS website. The Drupal core components are highlighted in Figure 4-3.

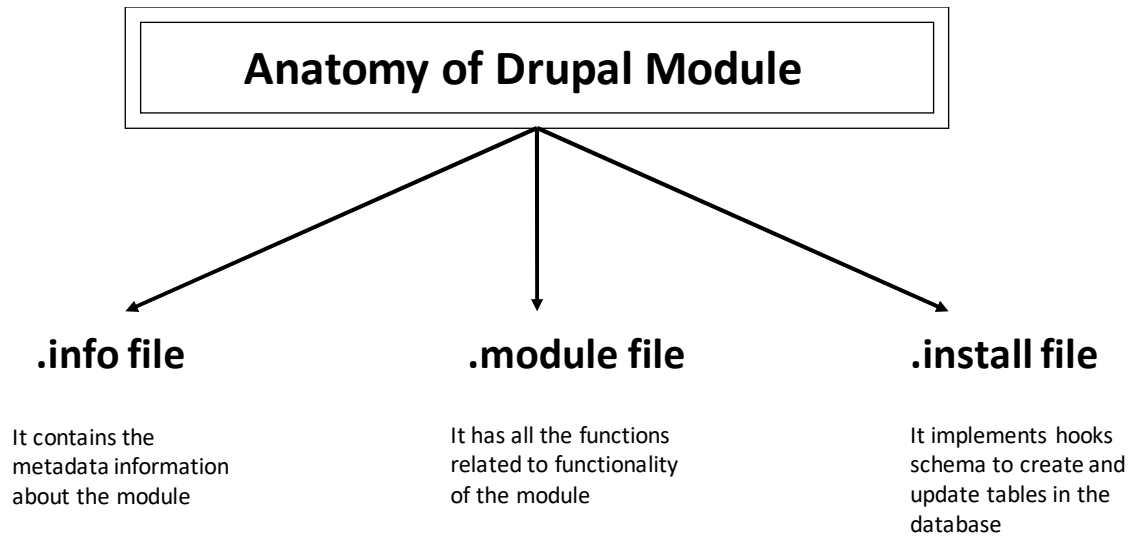
- a. Common Libraries – They are the files (mostly JavaScript and CSS files) that are crucial to design and maintain the website.
- b. Default Themes – They are the core themes that provides styles to the website. By default, Drupal 7 provides four core themes, namely: Bartik, Seven, Stark, and Garland.
- c. Default Modules – Drupal Core’s default modules provide the basic functionality of the website and are required to make any Drupal website work.
- d. Drupal Core APIs:
  - i. Entity API – This API handles the entities and their properties. There are three entity types, namely: (1) Node (2) Users (3) Taxonomy. *Nodes* are content types each having a bundle of fields. By default, there are two type of content type: basic page and articles. Drupal allows the creation of custom content type as well with multiple custom fields as shown in Figure 4-4. *Users* allow to create multiple users on the website, where each of the users can be assigned different roles and permissions. *Taxonomy* helps in organizing the website’s contents by tagging and classifying them.



**Figure 4-4** Nodes in Drupal

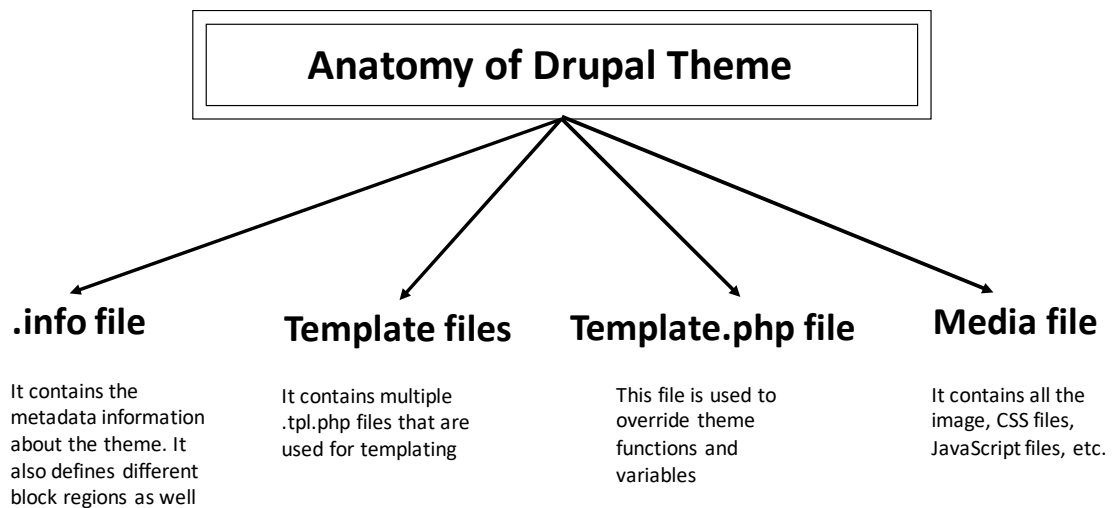
- ii. Fields API – Using this API, custom fields can be added to any Drupal entity type (users, node, etc.). This API also manages the storing, fetching, and viewing of the field data.

- iii. Form API - This API provides forms to a Drupal website used to capture user's responses in a simple and secure way.
  - iv. Menu API – This API helps with the navigation of the website by allowing one to create menu links pointing to different routes or URLs of the website.
  - v. Blocks API – Using this API, different content of the website can be configured as blocks. This API allows one to display those blocks to different regions (e.g., header, footer, sidebar, etc.) of the website.
  - vi. Database API – This API allows to perform the interaction between the Drupal and the database system. The Database API in Drupal 7 minimizes the need to write complex SQL queries to manage and fetch data from the database by using PHP's PDO as a means of communication.
  - vii. Schema API – This API allows the modules to create, modify, and delete tables in the database.
- External Modules: They provide additional functionalities to the Drupal website. They are either contributed modules, which are created by the Drupal's community members and can be installed manually, or custom modules, which are created by the administrator based on the required functionality. Drupal modules are written in the PHP scripting language and require PHP functions named *hooks* to interact with Drupal and extend the functionality of other modules. The anatomy of a Drupal module is shown in Figure 4-5.



**Figure 4-5** Anatomy of a Drupal module

- External Themes: They enhance the visual style of the application. The base theme selected for this application is the *Professional Theme v.7.x-2.05* [57]. This responsive theme can automatically adjust the web pages and menus to different screen sizes (for desktops, tablets, and mobile phones). The anatomy of a Drupal theme is shown in Figure 4-6.



**Figure 4-6** Anatomy of a Drupal theme

### 4.3.3 Presentation Tier

In the presentation tier, there are multiple users, including the patients (and their family members), nurses/physicians, clerks, site administrators, and super administrators, who can

access the application on their devices. Care Ami is a web-based application that only needs internet access to run on the web browser of a device. It also supports multiple devices, such as desktops, tablets, and mobile phones. User requests are processed by the web server that provides files to the users and are then rendered on the web browser.

## 4.4 Implementation

For the implementation of Care Ami, different technologies were studied and evaluated in order to meet the system requirements mentioned in Table 4-2. First, a JavaScript-based client framework to develop mobile and web applications, Aurelia [3], was studied. Next, a tool to develop cross platform mobile applications using C# programming language, Xamarin™ [64] was evaluated. Then, a JavaScript-based MEAN stack [47] was considered. However, based on the system goals and requirements of having an application with role-based access and having multiple sections to support multiple diseases, it was decided to move towards a Content Management System (CMS) based solution because a CMS already provides such basic features. Among popular CMS solutions such as WordPress and Joomla! [12], *Drupal* [14], a feature-rich and community-supported free solution, has been selected. This choice was strongly influenced by the collaboration with The Ottawa Hospital and the University of Ottawa, since both institutions use Drupal for their web-based content management and hence could provide proper maintenance and technical support after deployment of Care Ami.

In the data tier, *MySQL* (version 5.5.48-37.8) is used as a database system. MySQL is a free, open source, and reliable solution here [49]. For the logic tier, *Apache* (version 2.4.17), again a reliable and free solution, and the most popular server on the Internet [2], is used as a web server to host the Drupal CMS. The 132 modules used by Care Ami that provide important additional functionalities to the basic Drupal site are listed in Appendix A. The Care Ami prototype was first developed as one site that only supported lung cancer [11]. In thesis, in order to make it generalized by supporting multiple diseases, sections for breast cancer and prostate cancer were also added.

The implementation of the main features of the Care Ami framework are discussed next.

## 4.4.1 Documentation of Health-Related Information by Patients

Care Ami provides necessary features for patients to document their health-related information, for their personal records or to share it with nurses/physicians remotely. In the patient account, there are three pages in which they can document their health information: My Symptoms (Figure 4-7), My Medications (Figure 4-8), and My Questions (Figure 4-9).

### My Questions

Date	Question	Answer	Edit	Delete
Thu, 02/23/2017	How long is the medication process?	2 months	<a href="#">edit</a>	<a href="#">Delete</a>
Wed, 02/22/2017	Why am I always in pain?	Take Tylenol when pain becomes uncontrollable	<a href="#">edit</a>	<a href="#">Delete</a>

1 of 7 [next >](#)

### My Questions

Submitted by uottawa on Wed, 11/02/2016 - 21:56

This form is to keep track of your questions.

Date \*

Time \*  :   am  pm

Question

Answer

Figure 4-7 My Questions page

### Symptoms

Date	Symptoms	Others, please specify	What did you do to relieve the symptoms?	Edit	Delete
Thu, 02/23/2017	<ul style="list-style-type: none"> <li>Anxiety</li> <li>Diarrhea</li> </ul>		Taking pills	<a href="#">edit</a>	<a href="#">Delete</a>
Wed, 02/22/2017	<ul style="list-style-type: none"> <li>Pain</li> <li>Fatigue</li> <li>Shortness of Breath</li> <li>Nausea</li> <li>Vomiting</li> <li>Loss of Appetite</li> </ul>			<a href="#">edit</a>	<a href="#">Delete</a>
Sat, 02/11/2017	<ul style="list-style-type: none"> <li>Pain</li> <li>Insomnia</li> </ul>		nothing	<a href="#">edit</a>	<a href="#">Delete</a>

1 of 4 [next >](#)

### Record My Symptoms

Submitted by uottawa on Wed, 11/02/2016 - 20:53

This form is to keep track of the medications you are taking.

Date \*

Time \*  :   am  pm

Symptoms

- Pain
- Fatigue
- Shortness of Breath
- Anxiety
- Insomnia
- Numbness
- Nausea
- Vomiting
- Diarrhea
- Constipation
- Loss of Appetite
- Red spots in mouth
- Other

What did you do to relieve the symptoms?

**Figure 4-8** My Symptoms page

### Medication Webform

Date	Time	Name of Medication and Dosage Instructions	Reason for Taking	Doctor	Side Effect	Advice for Side Affect Relief	Edit	Delete
Mon, 02/13/2017	4:23 pm	Advil	Headache	Dr John	NA	NA	<a href="#">edit</a>	<a href="#">Delete</a>
Sat, 02/11/2017	2:03 pm	Advil	Fever	Dr John	Nothing	N/a	<a href="#">edit</a>	<a href="#">Delete</a>
Thu, 12/22/2016	5:26 pm	Tyrenol	Pain	Dr Mike	Felt sleepy	NA	<a href="#">edit</a>	<a href="#">Delete</a>

[« first](#) [« previous](#) [1](#) [2](#)

### Record My Medication

Submitted by Anonymous (not verified) on Sat, 02/11/2017 - 14:14

This form is to keep track of the medications you are taking.

Date \*

Time \*  :   am  pm

Name of Medication and Dosage Instructions

Reason for Taking

Doctor

Side Effect

Advice for Side Affect Relief

[Print This Page](#)

Figure 4-9 My Medications page

All these pages are very much similar in their structure, as shown in Figure 4-7, Figure 4-8, and Figure 4-9. On each page, there is a form in which the patient can input health-related information. Another block view displays the previous inputs of the patients in a tabular format by fetching the data from the database. Previous inputs can be visualized, edited, or deleted.

In *My Symptoms*, a patient can record the symptoms, date, and precautions taken during the diagnosis of their cancer. In *My Medications*, a patient can record medications and dosage instructions, time when the medication is taken, the name of the doctor who prescribed the medication, the reason for taking this medication, its side effects, and advice for side-effect relief. The *My Questions* feature is more of a personal record page in which the patients can record the questions that they have to support discussions with the physicians/nurses during their next meeting or over the phone (so patients do not forget these questions). The patients can even record the answers to those questions, at a later date if required, by editing the question.

#### **4.4.2 Role Based Access Control**

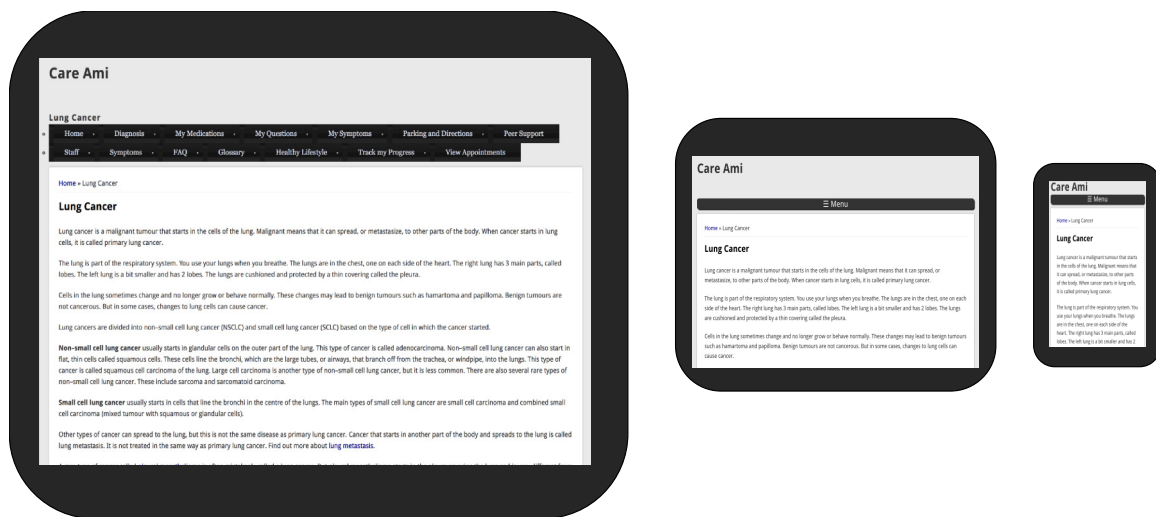
One important benefit of using CMSs is that they support role-based access control out of the box. In Care Ami, there are five different roles and each role has its own permissions (which are shown in detail in Appendix B) based on the requirements collected from the framework's stakeholders. The different roles in Care Ami are:

1. Patient/Family Members – they are capable of documenting health information (symptoms, medications, and questions), view test/consultation appointments on the calendar, and modify their accounts. Additionally, they can add patient personal information such as age, height, weight, health insurance number, etc. in the patient profile.
2. Clerks – they are responsible for adding new patients and assigning the type of disease (cancer). They can also edit and delete patient accounts. In addition, they can create, reschedule, or delete patient appointments and set the current stage of a patient's healthcare journey along the care process.

3. Nurses/Physicians – they have the ability to view the (shared) patient’s information, e.g., about symptoms and medications.
4. Super Administrators – they are responsible for configuring and maintaining the Drupal server itself, and its modules. They have full access to Care Ami.
5. Administrators – they also have the full access to the website except that they cannot view patient information. Administrators can also configure and maintain the Care Ami framework.

### 4.4.3 User Interface

To provide the good visual style to the application, an elegant Drupal theme is required. The *Professional Theme* (version 7.x-2.05) [57] was selected as the base theme for the application. This is a free, responsive theme that automatically adjusts the screen size (e.g., the menu bar) based on the device (desktop, tablet, or mobile phone) as shown in Figure 4-10. Additional CSS code is also written to enhance the style further for the front page, menu block on every page, and progress bar.



**Figure 4-10** User Interface of different screen devices: (1) desktop (2) tablet (3) mobile phone

### 4.4.4 Support for Multiple Diseases

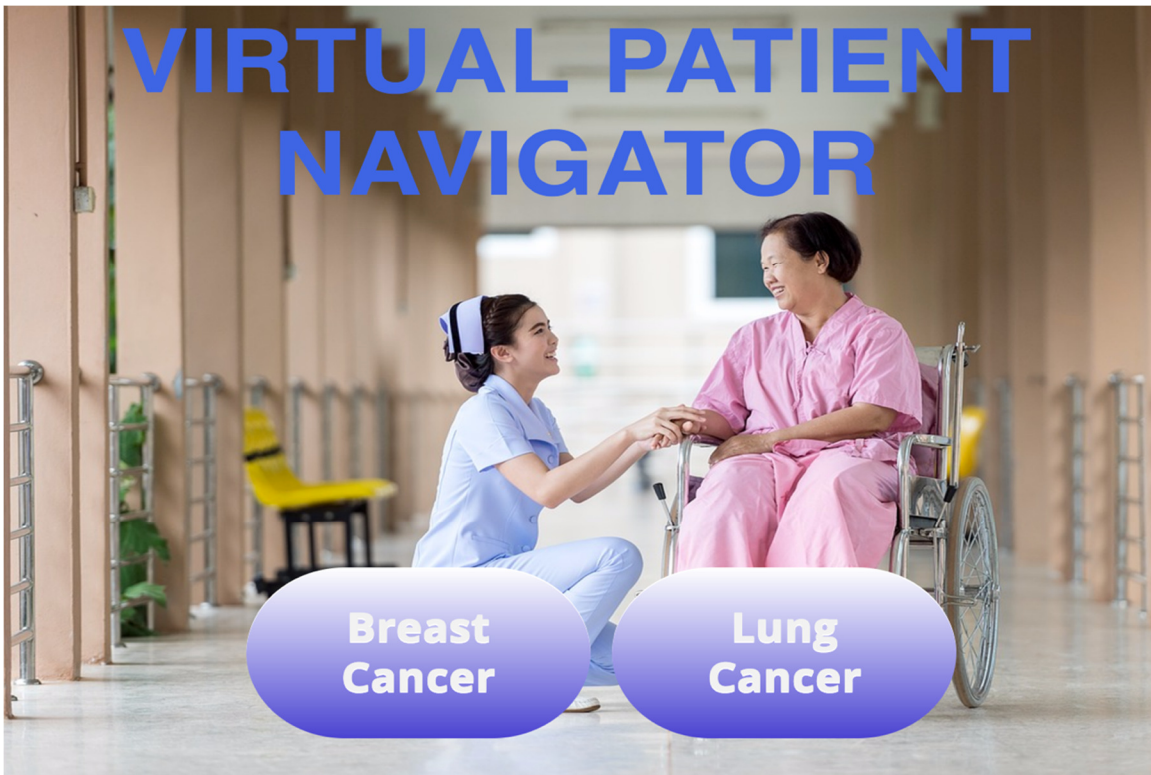
Care Ami is a general application framework that can include multiple sections each supporting one disease. In this thesis, Care Ami supports lung cancer, and placeholders for

breast and prostate cancers. Other types of diseases, even unrelated to cancer, can be added by creating a new section on the website. When a user logs in to the application, he/she will view the relevant, subscribed sections. For example, if the user has access to lung and breast cancer, then only the lung and breast cancer sections will be displayed, as shown in Figure 4-11.

Different sections have their own private information as well. For example, a patient's information (medications, questions, etc.) for the lung cancer section is stored separately and is only visible in the lung cancer section. However, a common calendar to view the appointments of all types of diseases for a patient is shared across all the sections.

Users who do not have access to one type of section are not allowed to visit that section. Still, extending the common functionalities of the website to other sections is also a very easy task. It only involves three steps for a new section: (1) Cloning the node (2) Changing the URL alias of that cloned node (3) Setting the reference to the particular type of disease. For example, to implement the common functionality of "My Medication" in the breast and prostate cancer sections, there are three steps: (1) Cloning "My Medication" in the lung cancer section twice, (2) Changing the URL alias of the cloned nodes to "/cancer/breast/medications" and "/cancer/prostate/medications" for the breast and prostate cancer sections respectively, and (3) Select the references for breast and prostate cancer such that these pages can only be accessed if the patient has a particular type of cancer.

The ability to support multiple diseases in one application reduces the need to have separate applications for different types of diseases, hence simplifying maintenance for healthcare institutions. This important feature will also help patients with multiple morbidities (e.g., lung and breast cancers) as they will have access to a one-stop site for handling all their navigation needs. All stakeholders will also benefit from a common user interface across disease sites, and from not having to input the same information multiple times.



**Figure 4-11** Multiple sections of Care Ami with a user having access to (i) the lung cancer section only (top) and (ii) the breast and lung cancer sections (bottom)

## 4.4.5 Patient Information Sharing

Enabling patient information to be viewed by the nurse/physician will help improving the interaction quality between these users. This will reduce the burden of setting an appointment, thus saving overall time for both patients and nurse/physician. Patients have the option to share their personal information with a nurse/physician (or not, should they prefer to keep this information private). This can set to “Yes” or “No” in the patient profile. When it is set as “Yes”, the nurses/physicians the ability to view the patient’s information if they have access to that type of cancer. For example, a nurse/physician having access to the lung and breast cancer sections of the website can only view the information of lung or breast cancer patients (Figure 4-12). For prostate cancer patients, an error message will be displayed (Figure 4-13).

### Patient Medication

Enter the name of the patient

**Patient Name**

Apply Reset

Enter a comma separated list of user names.

Date	Time	Name of Medication and Dosage Instructions	Reason for Taking	Doctor	Side Effect	Advice for Side Affect Relief	Edit	Delete
Sat, 02/11/2017	2:03 pm	Advil	Fever	Uottawa	Nothing	N/a	<a href="#">Edit</a>	<a href="#">Delete</a>
Thu, 12/22/2016	5:26 pm	Advil	Fever	Mr. ZZZ	Nothin	NA	<a href="#">Edit</a>	<a href="#">Delete</a>

« first < previous 1 2

**Figure 4-12** Viewing patient information when the patient has allowed sharing this information

## Patient Medication

Enter the name of the patient

**Patient Name**

Apply    Reset

Enter a comma separated list of user names.

**Access denied. Entered user has either disabled the sharing information in their patient profile or no input from the user.**

**Figure 4-13** Viewing patient information when the patient has not allowed sharing this information

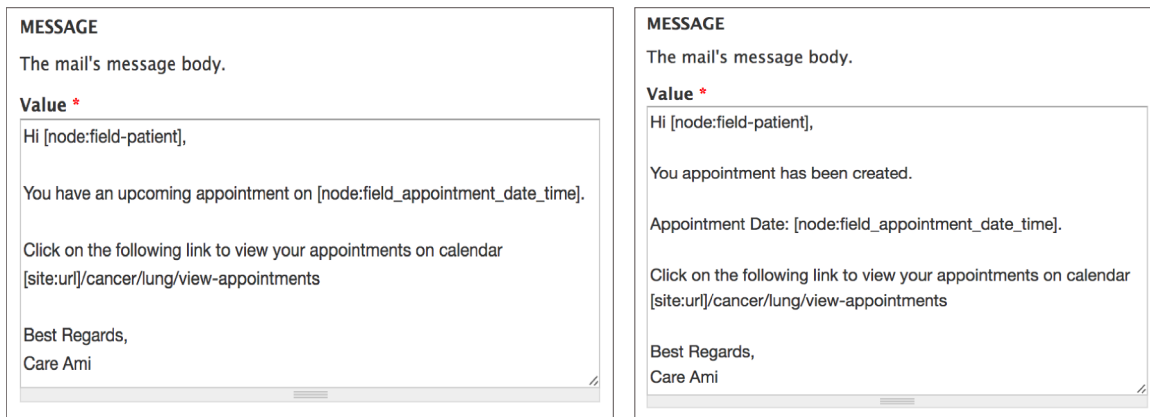
#### 4.4.6 Community and Peer Support for Patients

One of the main requirements of a patient navigator is to provide peer and social support to the patient. Care Ami facilitates social support that can encourage patients and provide a higher locus of control over the course of their healthcare journey. Care Ami can provide such support to patients in two ways. One is peer support, and other is providing community support. In *peer support*, a patient has the ability to join a private Facebook group managed by an Administrator to get connected with other patients in similar situations and having similar conditions. A connected patient can send a request to the group that has to be approved by the administrator. There is no moderator for such group, and patients are free to leave whenever they want. Care Ami also provides *community support* by providing additional information along with their contact information about the reliable and trustworthy community services present in the hospital area (e.g., the Ottawa region and the Ontario province). Providing trustworthy sources raises awareness in their existence and enables patients to avoid searching for such support and contacting unreliable or irrelevant institutions.

## 4.4.7 Appointments with Notifications and Reminders

During the assessment of the disease, patients have to manage complex appointments schedules which could change during their healthcare journey. Care Ami provides a calendar feature for the patients that allows them to view their appointments schedule along. This is supplemented with email notifications and with reminders sent two days prior to the appointment.

Appointments are created and managed by the clerk role. They can create new patient appointments, reschedule, or delete the appointments (for lab tests or consultations with physicians). When the appointment is created, edited, or deleted by the clerk, an automatic email notification is sent to the patient, telling him/her to connect to Care Ami for the details. A reminder is also sent to the patient two days prior to the appointment. The template used for the notification and reminder is shown in Figure 4-14. The name and the appointment details of the patient are automatically fetched from the database by Drupal.



**Figure 4-14** Template for (1) Appointment reminder (2) Appointment notification

In addition, while connected to his/her account, a patient can view the appointments and their details as shown in Figure 4-15 and Figure 4-16. Through the button at the bottom-left of Figure 4-15, the patient also has the ability to download the calendar in the *ics* (iCalendar) file format, which can then be integrated with personal calendars (Apple iCal, Yahoo, Calendar, and Microsoft Outlook Calendar).

## View Appointments

In the following calendar, you will find your appointments and its information. You can sort on the basis of month, week, or day. Also, click on the appointment to find more information (test/consultation, location, test type, etc). You can also download the calendar by clicking on the small icon below the calendar.

Today 🕒 🕒 🕒 **January 2017** Month Week Day

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2 <span style="background-color: #0056b3; color: white; padding: 2px;">12:30 - 1:30 CT scan for Venus</span>	3	4	5	6	7
8	9	10	11	12	13 <span style="background-color: #0056b3; color: white; padding: 2px;">12:45 - 1:45 CT SCAN FOR VENUS IN JAN CHANGED</span>	14
15	16 <span style="background-color: #0056b3; color: white; padding: 2px;">3:00 - 4:00 Echocardiogra m Test</span>	17	18	19	20	21
22	23	24	25 <span style="background-color: #0056b3; color: white; padding: 2px;">10:00 - 11:00 2D Test</span>	26	27	28
29	30	31	1	2	3	4
5	6	7	8	9	10	11

[Download Calendar](#)

**Figure 4-15** Patient's appointment feature, with calendar download

## Echocardiogram Test

Venus

Test

**Appointment Date/Time:** Monday, January 16, 2017 -

15:00 to 16:00

## 2D Echocardiogram

**Test Name:** 2D Echocardiogram

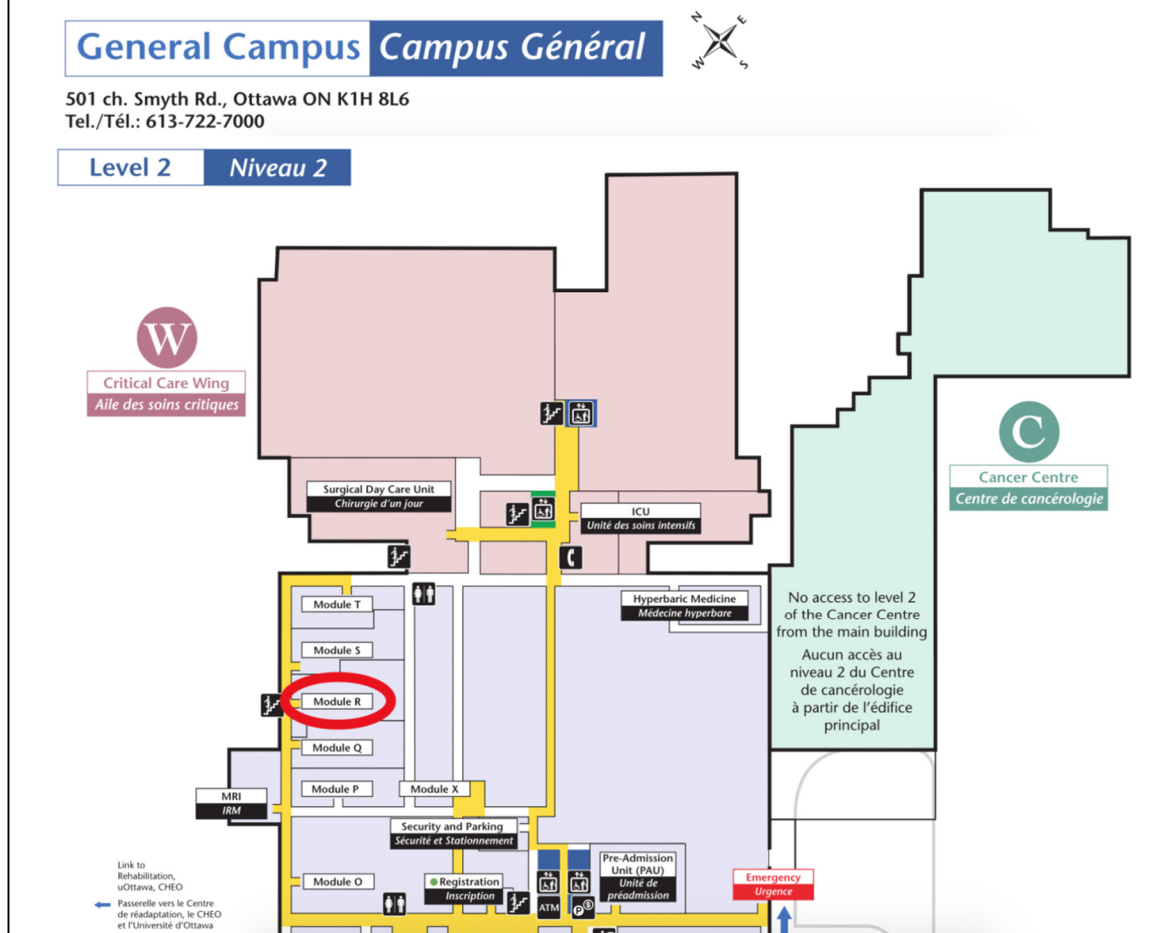
**Test Description:**

An echocardiogram is a special ultrasound examination of the heart that provides your doctor with live pictures of your heart to evaluate the anatomy and function of the heart muscle, chambers, and valves. It is the same technology that is used to look at unborn babies in a pregnant woman. It is a painless examination that takes approximately 30 to 45 minutes to perform. A specially trained technologist called a sonographer will attach electrodes to your chest so that we may record your heart's rhythm. You will be asked to remove your clothing from the waist up and change into a hospital gown. You will be asked to lie down on your left side on the exam table. The lights will be dimmed during the examination. The sonographer will put gel on an ultrasound transducer which will be applied to your chest to look at your heart. The recorded pictures will be analyzed later by a cardiologist who will send a report to your physician. If parts of your heart muscle are not well seen, you may be given an intravenous injection of a medication called Definity which will allow us to see your heart better and increase the accuracy of the test.

**Test Instructions:** No preparation necessary.

**Room Name:** Module R

**Location:**



**Figure 4-16** Appointment details with map and highlighted target location

When a patient clicks on an appointment on the calendar (Figure 4-15), Care Ami provides important information related to that appointment (Figure 4-16), such as the appointment's date/time/location, and a zoomable and printable floor map of the building. If the appointment is for a test, then all the related information (name, description, and test instructions) about the test is displayed. If the appointment is for a consultation with a physician, then the physician's name and a link to his/her biography is displayed. Zoomable and printable floor maps are associated with every appointment description, in order to guide patients to the exact location and floor where their appointment is going to take place. For example, as the TOH buildings are particularly difficult to navigate, this feature helps patients reduce their anxiety (about being late) and uncertainty levels (about where to go).

#### 4.4.8 Visualization of a Patient's Current Stage

It is important for patients to understand in what stage of the assessment process they are involved, together with previous and next stages. A new visualization feature was implemented for the lung cancer section (only). This feature visualizes the different stages of the lung cancer assessment process and highlights the stage where the patient currently is (Figure 4-17). A description of the stage is also provided when the mouse is hovered on the stage label. The current stage of the patient can be set by the Clerk or inferred automatically from the patient's context (e.g., by looking at the tests already performed).

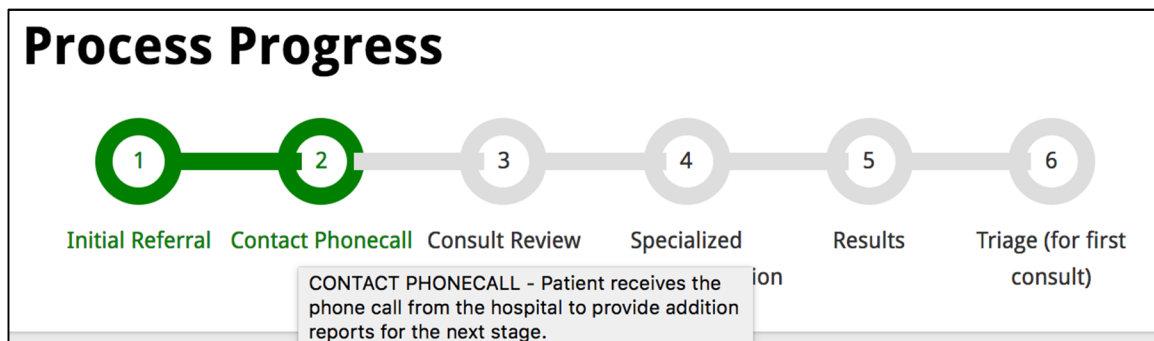


Figure 4-17 Patient's process progress

In the lung cancer assessment process, there are six sequential stages:

1. **Initial Referral** – This refers to the stage when the patient is referred to the hospital, usually by a family physician or another TOH physician.

2. **Contact Phone Call** – This is a stage when the patient is contacted by TOH for the first time. The patient might then be asked to provide certain reports for a review process. The patient could be offered a Care Ami account at that stage (or later).
3. **Consult Review** – The reports submitted by the patients or referring physician are reviewed by specialists. Depending on the results of this review, the patient might be asked to submit additional information, or she/he might be scheduled for a visit to the TOH Cancer Assessment Clinic for additional tests and assessments (this special visit is called “navigation day”).
4. **Specialized Testing/Navigation Day** – This is the first time the patient visits the hospital. On this day, she/he is scheduled to undergo a series of tests. The intention here is to complete all the required tests and registration-related formalities on that day.
5. **Results** – This stage refers to the day when tests’ results become available. These results are then analyzed and, depending on the outcome, the patient might be asked to undergo additional tests or she/he might be referred for a specialist consult.
6. **Triage** (for the first consult) – This is a final stage for Care Ami: the patient is referred to a specialized service of TOH, for treatment or for discharge.

A custom Drupal module was created to implement this feature. In this module, *hooks* are used to get the patient’s data from the database, modify it, and then store it back to the database. Additional CSS code is also written to improve the visual look of the progress bar and display the description of each stage.

#### **4.4.9 Provision of Important Information**

Care Ami provides additional important information (shown in Figure 4-18) that can help patients navigate through their healthcare journey with little hassle. Pages such as parking and directions, staff information, healthy lifestyle advice, common symptoms to check, frequently asked questions (FAQ), and a glossary are provided by Care Ami. On the Parking and directions page, the patients can find transit-related information for reaching the

healthcare institution (TOH has multiple campuses). On the staff information page, patients can search for the physicians who are in the same department of their cancer type, and get their biographies. The healthy lifestyle page provides advice and videos on how to adhere to a healthy lifestyle in the context of the disease under assessment. Additionally, this page provides trusted information and helpful tips about the diet and daily exercises relevant to the patient. The symptoms, FAQ, and glossary pages provide additional trustworthy information for each type of cancer. All of these pages are static, and do not have interactive forms. They cover the information of the paper-based passport currently provided by TOH, but also take care of new forms of medias (e.g., videos) and of existing information found on the Web (e.g., on the TOH site itself). These pages can be updated by section administrators as new information becomes available or when revisions are needed.

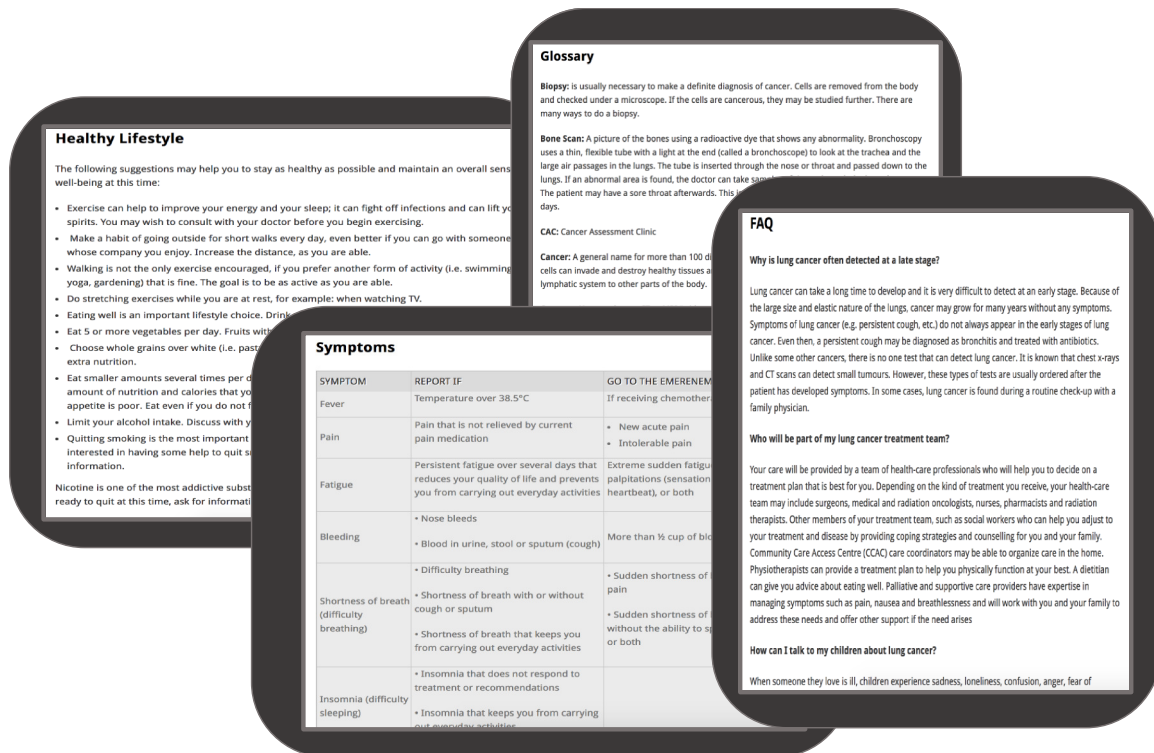


Figure 4-18 Important static web pages

#### 4.4.10 Support for Multiple Languages

In order to satisfy requirement R20 in Table 4-2, it was decided that Care Ami would support both official languages used in Ottawa (English and French). Users can switch from one language to another at any time. As The Ottawa Hospital Cancer Centre also serves

the Inuit population from Nunavut [13], support for the Inuktitut language could also be considered in the future.

## **4.5 Chapter Summary**

In this chapter, we discussed Care Ami's goals and requirements in order to design a relevant architecture. The architecture's components (data tier, logic tier, and presentation tier) were discussed in detail along the way. The implementation of Care Ami, done mainly with the Drupal CMS and the modules listed in Appendix A, covers many features and most of the system requirements mentioned in Table 4-2.

The next chapter will present the developer-driven evaluation of usability based on heuristic evaluation guidelines and manual testing performed on Care Ami.

## Chapter 5. Evaluation and Testing

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This chapter presents the evaluation of the usability of Care Ami based on usability guidelines and the manual testing of its features and functionalities. This chapter also reports on the test results and on challenging issues faced while performing the evaluation and testing of the application.

### 5.1 Evaluation Based on Heuristic Evaluation Guidelines

The usability of an application can be done in many ways. On one hand, a conventional usability study usually involves users performing tasks, with outcomes measured in terms of times, error rates, and perceived ease of use. On the other hand, *heuristic evaluations*, performed to find potential gaps in the user interface (UI) of an application on different platforms (laptop, desktop, and mobile phone), do not require real user participants. Although the results of a heuristic evaluation are often less precise than in a usability study, the heuristic approach is still selected here as getting the ethics approval for a usability study would have required too much time, especially as patients would have been involved. In addition, heuristic evaluations usually require a minimum of three experts (about UIs or the domain). However, as this approach would also have required ethics approval, the guidelines are only assessed by the thesis author.

#### 5.1.1 Overview of Heuristic Evaluation Guidelines

The primary goal of a heuristic evaluation is to find the gaps and usability problems in the UI of a system. The UI guidelines provided by Nielsen [53] are widely used in an evaluation context and should be kept in mind when designing the UI of a system. The guidelines (or *heuristics*) proposed by Nielsen are summarized in Table 5-1:

**Table 5-1** Ten usability heuristics for user interface design (based on [53])

S. No.	Heuristic	Heuristic Description
H1	Visibility of system status	The system should keep the users informed about what is going on through visual indicators within some reasonable time
H2	Match between system and the real world	The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order
H3	User control and freedom	Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Need to support undo and redo options
H4	Consistency and standards	Users should not have to wonder whether different words, situations, or actions mean the same thing
H5	Error prevention	Even better than good error messages are a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present the users with a confirmation option before they commit to the action
H6	Recognition rather than recall	Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate
H7	Flexibility and efficiency of use	Accelerators, unseen by the novice user, may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions
H8	Aesthetic and minimalist design	Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility
H9	Help users recognize, diagnose, and recover from errors	Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution

S. No.	Heuristic	Heuristic Description
H10	Help and documentation	Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large

Further, the usability problems are prioritized and given a severity rating. According to Nielsen [54], such severity ratings are given on the scale of 0 to 4 and are as follows:

0 = I do not agree that this is a usability problem at all

1 = Cosmetic problem only: need not be fixed unless extra time is available on project

2 = Minor usability problem: fixing this should be given low priority

3 = Major usability problem: important to fix, so should be given high priority

4 = Usability catastrophe: imperative to fix this before product can be released

In a recent systematic literature review, Jimenez et al. [36] identified 57 studies (published between 2008 and 2015) where heuristics were used to assess the usability of application. Among them, 34 studies used Nielsen's heuristics, at times combined to others. Nielsen's heuristics and scoring system are used to evaluate the usability of Care Ami.

### 5.1.2 Tasks

Since Care Ami is a role-based application, it is necessary to evaluate this application based on the different roles supported. For the evaluation, it is assumed that the super-administrator and administrator roles have knowledge about the Drupal CMS (their primary UI) and hence the evaluation is mainly done for the roles of clerk, nurse/physician, and patient by performing their core tasks. Furthermore, the UI of the application is evaluated on different platforms, including desktop, tablet, and mobile phone, for the patient role. Table 5-2 shows the tasks performed to evaluate the Care Ami framework.

**Table 5-2** Tasks performed to evaluate Care Ami

Role	Tasks Performed	Device Used
Clerk	1. Add, modify, and view patient account and their profile 2. Add calendar events (appointments)	Apple MacBook Pro (laptop)
Nurse/Physician	1. View patient’s medical information.	Apple MacBook Pro (laptop)
Patient	1. Document their information. 2. View calendar events. 3. Modify/delete their account profile	Apple MacBook Pro (laptop), Apple iPad mini (tablet), Xiomi MI4 (mobile phone)

### 5.1.3 Usability Problems

The heuristics listed in Section 5.1.1 are used for the usability evaluation of Care Ami. Problems in the UI are identified and categorized according to the heuristics used. The findings and usability problems detected in Care Ami here are shown in Table 5-3.

Table 5-3 consists of seven columns. The first column is the problem number, whereas the second column describes the usability problems found. The third column defines the type of heuristic for that particular problem. Column four shows the severity ranking on the scale of 0 – 4. Columns five and six specify the affected role and the device on which problem is detected. Finally, the current status of that particular problem in the latest version of Care Ami (i.e., whether resolving the problem was done or not in the latest release) is shown in the last column.

**Table 5-3** Usability problems detected in Care Ami

No.	Usability Problem	Heuristic	Severity Ranking	Role Affected	Device	Status
1	On the login screen, the appearance of error even if the login attempt is not performed by the user	H8, H1	2	Clerk, Nurse/Physician, Patient	Laptop, Tablet, Mobile Phone	Done

No.	Usability Problem	Heuristic	Severity Ranking	Role Affected	Device	Status
2	After logging to the website, the user is unsure of which cancer type to select. E.g., Lung cancer user sees other types of cancers, which can confuse the user	H1, H7	3	Clerk, Nurse/Physician, Patient	Laptop, Tablet, Mobile Phone	Done
3	User is unable to select the cancer menu to go back to other sections of the website when an appointment is created	H1, H3	2	Clerk	Laptop	Done
4	Extra irrelevant information displayed when create an appointment, peer support, and basic page of cancer types are accessed by the clerk	H2, H8	1	Clerk	Laptop	Not done
5	Unclear error message is displayed when nurse/physician access the patient's information of other cancer types	H1, H7, H8	2	Nurse/Physician	Laptop	Done
6	Color and brightness contrast are not good between "Virtual Patient Navigator" text and the background image on the home page	H8	1	Clerk, Nurse/Physician, Patient	Laptop, Tablet, Mobile Phone	Done
7	Editing and deleting the existing appointment of the patient is very complex	H2, H7, H10	3	Clerk	Laptop	Done
8	Modifying patient profile is very complex	H2, H7, H10,	3	Clerk, Patient	Laptop, Tablet, Mobile Phone	Done
9	Information about downloading the appointment is unclear. No text used to highlight the downloading option	H2	3	Patient	Laptop, Tablet, Mobile Phone	Done

No.	Usability Problem	Heuristic	Severity Ranking	Role Affected	Device	Status
10	There is no navigational support when editing the patient's profile. This can confuse the user about what to do next	H1, H3, H6	2	Clerk, Patient	Laptop, Tablet, Mobile Phone	Done
11	On the patient symptoms and patient medications page, message "Enter the name of the patient" is displayed after the search bar	H7	1	Nurse/Physician	Laptop	Done
12	Menu for different types of cancers is not responsive on small screens	H4, H8	1	Patient	Tablet, Mobile Phone	Done
13	Appointment calendar for the patient is not fully displayed on the small screens. Patient is only able to view half calendar	H4, H8	4	Patient	Tablet, Mobile Phone	Done
14	When the home page is opened in mobile phone, the button for lung cancer is smaller compared to breast and prostate cancer buttons	H4	0	Patient	Mobile Phone	Not done
15	Home page background is not displayed	H4	1	Patient	Tablet, Mobile Phone	Done
16	For the My Symptoms, My Medications, and My Questions pages, there is no way to edit or delete the submission	H3, H5	3	Patient	Laptop, Tablet, Mobile Phone	Done
17	Unnecessary clickable links for the tests are displayed on the diagnosis page	H7, H8	2	Patient	Laptop, Tablet, Mobile Phone	Done
18	The font size of the tests on the diagnosis page is too large	H4	1	Patient	Laptop, Tablet, Mobile Phone	Done

No.	Usability Problem	Heuristic	Severity Ranking	Role Affected	Device	Status
19	Previous submission by the patient on my symptoms, my medications, and my questions are not fully displayed on the small screen devices	H4	3	Patient	Tablet, Mobile Phone	Done
20	Symptoms pages of different types of cancer are fully displayed on the small screen devices	H4	3	Patient	Tablet, Mobile Phone	Done
21	When modifying the patient profile, the presence of “N/A” other than “Yes” and “No” can confuse the patient. Also, the create an appointment page has a “None” option when selecting the appointment type field, which can confuse the clerk	H4, H7	2	Clerk, Patient	Laptop, Tablet, Mobile Phone	Done
22	Adding new patients and modifying their profiles is very complex	H2, H10	3	Clerk	Laptop	Done

### 5.1.4 Evaluation Conclusion

The guidelines of heuristic evaluations were used to check Care Ami in order to find issues in the user interface of the framework. A total of 22 usability issues, including several major problems (2, 13, and 16), were identified. To improve the user experience of the users, all major problems and most other issues were resolved. However, two small usability problems that are not critical to the application are yet to be resolved at this time. This usability evaluation was hence beneficial as it helped address problems not specified explicitly in the original requirements.

## 5.2 Testing of Care Ami

Manual testing was performed to assess and improve the quality of Care Ami. A total of 59 test cases were written for three main categories: (1) access control, (2) menu visibility,

and (3) functionality. These tests provide basic coverage of the first 23 sub-requirements from Table 4-2. Based on these categories, the testing is performed for the nurse/physician, clerk, and patient roles. The presence of three sections for lung, breast, and prostate cancer enables the testing of variations in access control and information sharing that are sufficient for representing a larger set of sections.

### 5.2.1 Access Control

Since our application supports multiple sites, one for each disease, testing has to be performed to ensure that a role who has access only to particular diseases is unable to access the sites of the other diseases on the server.

The six test cases covering the nurse/physician role are shown in Table 5-4.

**Table 5-4** Access control test cases for the Nurse/Physician role

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T1	When the nurses/physicians having access to lung cancer (one site) log in to Care Ami, they should not be able to access the breast and prostate cancer sections.	Front page after login should only display the lung cancer link. Links for breast and prostate cancer should not be displayed	Front page after login only displayed lung cancer link	R12, R22	Pass
T2	When the nurses/physicians having access to lung and breast cancer (multiple sites) log in to Care Ami, they should not be able to access the prostate cancer section.	Front page after login should only display the lung and breast cancer links. Link for prostate cancer should not be displayed	Front page after login only displayed lung cancer and breast cancer links	R12, R22	Pass
T3	When the nurses/physicians having access to lung cancer (one site) type the URL of the breast and prostate cancer pages, they should not be allowed to access those pages.	Error should be displayed	Access denied error displayed	R12, R22	Fail

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T4	When the nurses/physicians having access to lung and breast cancer (multiple sites) type the URL of the prostate cancer pages, they should not be allowed to access those pages.	Error should be displayed	Access denied error displayed	R12, R22	<b>Fail</b>
T5	When the nurses/physicians type the URL of the menus of patient and clerk roles having the same type of cancer, they should not be allowed to access those menus.	Error should be displayed	Access denied error displayed	R12, R22	<b>Pass</b>
T6	Showing the content of the website in both English and French languages for the nurse/physician role.	Website should be displayed in English and French	Website is displayed in English and French	R20	<b>Pass</b>

The six test cases covering the clerk role are shown in Table 5-5:

**Table 5-5** Access control test cases for the Clerk role

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T7	When the clerks having access to lung cancer (one site) log in to the Care Ami, they should not be able to access the breast and prostate cancer sections.	Front page after login should only display the lung cancer link. Links for breast and prostate cancer sites should not be displayed	Front page after login only displayed lung cancer link	R12, R22	<b>Pass</b>
T8	When the clerks having access to lung and breast cancers (multiple sites) log in to Care Ami, they should not be able to access the prostate cancer section.	Front page after login should only display the lung and breast cancer links. Link for prostate cancer should not be displayed	Front page after login only displayed lung cancer and breast cancer links	R12, R22	<b>Pass</b>

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T9	When the clerks having access to the lung cancer (one site) type the URL of the breast and prostate cancer pages, they should not be allowed to access those pages.	Error should be displayed	Access denied error displayed	R12, R22	<b>Fail</b>
T10	When the clerks having access to lung and breast cancers (multiple sites) type the URL of the prostate cancer pages, they should not be allowed to access those pages.	Error should be displayed	Access denied error displayed	R12, R22	<b>Fail</b>
T11	When the clerks type the URL of the menus of patient and nurse/physician roles having the same type of cancer, they should not be allowed to access those menus.	Error should be displayed	Access denied error displayed	R12, R22	<b>Pass</b>
T12	Showing the content of the website in both English and French languages for the clerk role.	Website should be displayed in both English and French	Website is displayed in both English and French	R20	<b>Pass</b>

The seven test cases covering the patient role are shown in Table 5-6:

**Table 5-6** Access control test cases for the Patient role

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T13	When the patients having access to lung cancer (one site) log in to Care Ami, they should not be able to access the breast and prostate cancer sections.	Front page after login should only display the lung cancer link. Links for breast and prostate cancer should not be displayed	Front page after login only displayed lung cancer link	R12, R22	<b>Pass</b>

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T14	When the patients having access to lung and breast cancers (multiple sites) log in to Care Ami, they should not be able to access prostate cancer section.	Front page after login should only display the lung and breast cancer links. Link for prostate cancer should not be displayed	Front page after login only displayed lung cancer and breast cancer links	R12, R22	Pass
T15	When the patients having access to lung cancer (one site) type the URL of the breast and prostate cancer pages, they should not be allowed to access those pages.	Error should be displayed	Access denied error displayed	R12, R22	Fail
T16	When the patients having access to lung and breast cancers (multiple sites) type the URL of the prostate cancer pages, they should not be allowed to access those pages.	Error should be displayed	Access denied error displayed	R12, R22	Fail
T17	When the patients type the URL of the menus of clerk and nurse/physician roles having the same type of cancer, they should not be allowed to access those menus.	Error should be displayed	Access denied error displayed	R12, R22	Pass
T18	Showing the content of the website in both English and French languages for the patient role.	Website should be displayed in both English and French	Website is displayed in both English and French	R20	Pass
T19	Accessing the Care Ami from smaller screen devices (tablets and mobile phones).	Website should be accessed from tablets and mobile phones as well	Website is accessible from laptop, tablet, and mobile phone	R21	Pass

## 5.2.2 Menu Visibility

Each role has different functionalities, which are accessible from the menu at the top of each page. Menus should be tailored to each and every role.

To define the test cases for nurse/physician role, one test objective is used in Table 5-7:

**Table 5-7** Menu visibility test case for the Nurse/Physician role

Test Case Id	Test Objective	Expected Output	Actual Output	Status (Pass/Fail)
T20	Menu visibility for nurses/physicians having access to lung cancer.	When the nurses/physicians having access to lung cancer log in to Care Ami, the “Home”, “Patient Symptoms”, and “Patient Medications” links should only be visible in the menu on the home page	“Home”, “Patient Medication”, and “Patient Symptoms” links are displayed in the menu	Pass

One test case for the clerk role is shown in Table 5-8:

**Table 5-8** Menu visibility test case for the Clerk role

Test Case Id	Test Objective	Expected Output	Actual Output	Status (Pass/Fail)
T21	Menu visibility for clerks having access to lung cancer.	When the clerks having access to lung cancer log in to Care Ami, the “Home”, “Peer-Support”, “Staff”, “Add/Modify Users”, “Create an Appointment”, “Process Status” and “Help” links should only be visible in the menu on the home page	“Home”, “Peer-Support”, “Staff”, “Add/Modify Users”, “Create an Appointment”, and “Process Status” links are displayed in the menu	Pass

One test case for the patient role is shown in Table 5-9.

**Table 5-9** Menu visibility test case for the Patient role

Test Case Id	Test Objective	Expected Output	Actual Output	Status (Pass/Fail)
T22	Menu visibility for patients having access to lung cancer.	When the patients having access to lung cancer log in to Care Ami, the “Home”, “Diagnosis”, “My Medications”, “My Questions”, “My Symptoms”, “Peer-Support”, “Parking and Directions”, “Symptoms”, “Staff”, “FAQ”, “Glossary”, “Healthy Lifestyle”, “Track my Progress”, “View Appointments”, and “Help” links should only be visible in the menu on the home page	“Home”, “Diagnosis”, “My Medications”, “My Questions”, “My Symptoms”, “Peer-Support”, “Parking and Directions”, “Symptoms”, “Staff”, “FAQ”, “Glossary”, “Healthy Lifestyle”, “Track my Progress”, and “View Appointments” links are displayed in the menu	Pass

### 5.2.3 Functionality

Since our application is role-based, each of the non-administrative roles (nurse/physician, clerk, and patient) has different functionalities. Eight functionality test objectives for the nurse/physician role are defined in Table 5-10.

**Table 5-10** Functionality test cases for the Nurse/Physician role

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T23	Viewing symptoms of the lung cancer patient by the nurses/physicians having access to lung cancer when the patient has shared his/her information.	Patient symptoms should be displayed to the nurse/physician without any error message	Patient symptoms are displayed	R23	Pass
T24	Viewing symptoms of the prostate cancer patients by the nurse/physician having access to lung cancer when the patient has shared his/her information.	Patient symptoms should not be displayed. Instead, a relevant error message should be displayed	Patient symptoms are not displayed. Relevant error message is also displayed.	R23	Pass

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T25	Viewing symptoms of the lung cancer patient by the nurse/physician having access to lung cancer when the patient has not shared his/her information.	Patient symptoms should not be displayed. Instead, a relevant error message should be displayed	Patient symptoms are not displayed. Relevant error message is also displayed.	R23	Pass
T26	Viewing symptoms of the prostate cancer patient by the nurse/physician having access to lung cancer when the patient has not shared his/her information.	Patient symptoms should not be displayed. Instead, a relevant error message should be displayed	Patient symptoms are not displayed. Relevant error message is also displayed.	R23	Pass
T27	Viewing medications of the lung cancer patient by the nurse/physician having access to lung cancer when the patient has shared his/her information.	Patient medications should be displayed to the nurse/physician without any error message	Patient medications are displayed	R23	Pass
T28	Viewing medications of the prostate cancer patients by the nurse/physician having access to lung when the patient has shared his/her information.	Patient medications should not be displayed. Instead, a relevant error message should be displayed	Patient medications are not displayed. Relevant error message is also displayed.	R23	Pass
T29	Viewing medications of the lung cancer patient by the nurse/physician having access to lung cancer when the patient has not shared his/her information.	Patient medications should not be displayed. Instead, a relevant error message should be displayed	Patient medications are not displayed. Relevant error message is also displayed.	R23	Pass
T30	Viewing symptoms of the prostate cancer patient by the nurse/physician having access to lung cancer when the patient has not shared his/her information.	Patient medications should not be displayed. Instead, a relevant error message should be displayed	Patient medications are not displayed. Relevant error message is also displayed.	R23	Pass

Six functionality test objectives for the clerk role are defined in Table 5-11:

**Table 5-11** Functionality test cases for clerk role

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T31	Creating an appointment for the lung cancer patient by the clerk.	Appointment should be created for the patient	Appointment is created for the patient	R8	Pass
T32	Modifying an appointment for the lung cancer patient by the clerk.	The clerk should be able to modify the appointment of the patient	The clerk is able to make changes in the previously created appointment of the patient	R8	Pass
T33	Deleting an appointment for the lung cancer patient by the clerk.	The clerk should be able to delete the appointment of the patient	The clerk is able to delete the previously created appointment of the patient	R8	Pass
T34	Creating the account for a new lung cancer patient by the clerk.	The clerk should be able to create new lung cancer patient users	The clerk is able to create new lung cancer patient users	R11	Pass
T35	Modifying and deleting the account of the lung cancer patient and changing his/her patient profile by the clerk.	The clerk should be able to modify and delete the account of the lung cancer patient. Also, clerk should be able to change patient profile except “sharing information with nurse/physician” field, which is only accessible to patients and super-admin	The clerk is able to modify and delete the lung cancer patient’s account along with the capability of changing a patient profile. Also, the “sharing information with nurse/physician” field is not visible	R11	Pass
T36	Setting the current process status of the lung cancer patient by the clerk.	The clerk should be able to change the current status of the lung cancer patient	The clerk can change the current status of the lung cancer patient	R5	Pass

Test objectives for the nurse/physician role are defined in Table 5-12:

**Table 5-12** Functionality test cases for patient role

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T37	Receive notification on the patient's email id when an appointment is created by the clerk.	The patient should receive an email notification along with details about when the appointment is created	A notification is received by the patient along with the details about when an appointment is created	R9	Pass
T38	Receive notification on the patient's email id when appointment is modified or deleted by the clerk.	The patient should receive an email notification along with details about when the appointment is modified or deleted	A notification is received by the patient along with the details about when an appointment is modified or deleted	R9	Pass
T39	Getting a reminder email on the patient's email id two days before the appointment.	The patient should receive an email reminder two days prior to the appointment	Email reminder is received by the patient two days prior to the appointment	R10	Pass
T40	Getting a reminder email on the patient's email id two days before when the appointment is modified.	The patient should receive an email reminder two days prior to the modified appointment	Email reminder is received by the patient two days prior to the modified appointment	R10	Pass
T41	Recording symptoms by the patient.	Recording the symptoms in the lung cancer section should only be visible in the lung cancer section. It should not be visible in the symptoms of breast or prostate cancers	Symptoms recorded in lung cancer is only visible in the lung cancer section	R4	Pass
T42	Editing/deleting the recorded symptoms by the patient.	The patient should be able to modify/delete the recorded symptoms	Patient is able to modify/delete the recorded symptoms	R4	Pass

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T43	Recording medications by the patient.	Recording the medications in the lung cancer section should only be visible in the lung cancer section. It should not be visible in the medications of breast or prostate cancer sections	Medications recorded in lung cancer is only visible in the lung cancer section	R4	Pass
T44	Editing/deleting the recorded medications by the patient.	The patient should be able to modify/delete the recorded medications	Patient is able to modify/delete the recorded medications	R4	Pass
T45	Recording questions by the patient.	Recording the questions in lung cancer section should only be visible in the lung cancer section. It should not be visible in the questions of breast or prostate cancers	Questions recorded in lung cancer is only visible in the lung cancer section	R4	Pass
T46	Editing/deleting the recorded questions by the patient.	The patient should be able to modify/delete the recorded questions	Patient is able to modify/delete the recorded questions	R4	Pass
T47	Showing current stage and description of the patient on “Track my Progress” page in the lung cancer section of the website.	The current stage of the patient set by the clerk and its description should be displayed in the patient’s account	The current stage of the patient is shown in the patient’s account. The description is not displayed on tablets/mobile phones.	R5	Fail
T48	Viewing appointments on the calendar.	The patient should be able to view all the created appointment by the clerk on the calendar	The patient is able to view all the appointments created by the clerk	R6	Pass

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T49	Viewing modified/deleted appointments on the calendar.	The patient should be able to view all the modified appointments. Previous appointments that were modified should not be shown on the calendar along with deleted appointments	The patient is able to view previous appointments as well along with edited appointments	R6	Pass
T50	Modifying patient profile.	The patient should be able to change his/her own patient profile along with the “sharing information with nurse/physician” field	The patient is able to modify his/her own patient profile along with the “sharing information with nurse/physician” field	R11	Pass
T51	Viewing appointment details along with the room number on the maps.	The patient should be able to view the appointment details, including appointment date, location, test type, and room numbers on the maps	The patient is able to view all the details related to the appointment. Room numbers are shown as red circles on the static map	R16	Pass
T52	Connecting with other peers and provide community support.	The patient should be able to connect to other peers by joining the private Facebook group and be able to find the contact information of reliable cancer support communities	The patient is able to send requests to the admin of the private Facebook group and view contact information about the community support	R14, R15	Pass
T53	Downloading calendar.	The patient should be able to download his/her appointments	The patient is able to download the calendar as an “.ics” file	R7	Pass

Test Case Id	Test Objective	Expected Output	Actual Output	Req. ID	Status (Pass/Fail)
T54	Deactivating/deleting account.	The patient should be able to delete or deactivate his/her account at any point of time	The patient is capable of deleting or deactivating his/her account.	R13	Pass
T55	Viewing disease related symptoms.	The patient should be able to view the symptoms related to his/her disease under the “Symptoms” page	The patient is able to view the symptoms	R1	Pass
T56	Viewing information about diagnostic plan.	The patient should be able to view the diagnostic information related to his/her disease under the “Diagnostic” page	The patient is able to view the diagnostic information	R2	Pass
T57	Viewing name of the staff and their brief information.	The patient should be able to view information related to the staff under the “Staff” page	The patient is able to view name of the staff along with the link that shows brief biography about them	R3	Pass
T58	Viewing information that helps in maintaining a healthy lifestyle.	The patient should be able to view healthy lifestyle information under the “Healthy Lifestyle” page	The patient is able to view healthy lifestyle information	R19	Pass
T59	Viewing parking transit information to reach the hospital.	The patient should be able to find parking information along with the public transport usage under the “Parking and Directions” page	The patient is able to view parking and transit information	R17, R18	Pass

## 5.2.4 Testing Conclusion

Manual testing of Care Ami was performed to further check the quality of the application. The test cases covered requirements R1-R23 in Table 4-2. Among the 59 test cases, a few

major failed test cases (T5, T11, T17, T38, T40, T42, T44, and T46) were identified and then rectified. However, seven failed test cases (T3, T4, T9, T10, T15, T16, and T47) are yet to be resolved at this time.

### **5.3 Challenges**

Many challenges were faced while doing the evaluation of the Care Ami framework, including the following:

1. User-based validation of Care Ami could not be performed at The Ottawa Hospital. Instead, an evaluation based on guidelines was performed at the University of Ottawa.
2. According to Nielson et al. [52], at least three expert evaluators are needed to find the gaps in the UI. However, in our case, only the thesis author was responsible for performing the usability evaluation of Care Ami, with a verification done by one supervisor.
3. It was very difficult to make changes to some Drupal default pages (e.g., adding menus, blocks, etc.) and this was causing problems in the navigation of the website. However, additional help guides were added to simplify some of the specific tasks for the roles.

### **5.4 Chapter Summary**

This chapter discussed the evaluation and testing of Care Ami. A usability evaluation based on heuristics was performed to find usability gaps and problems in the user interface of the application. An additional suite of 59 test cases were defined and checked manually on the application. The evaluation and the testing were performed on devices having different screen sizes (desktop, tablet, and mobile phone). High priority gaps in the user interface and the functionality were identified and rectified to improve the usability and robustness of the application. Some tests are still failing but are expected to be solved in the near future.

The next chapter presents the comparison of Care Ami with related work.

## Chapter 6. Discussion

In this chapter, Care Ami is evaluated and compared with closely related systems (discussed in Chapter 3) against the main categories of requirements found in Section 4.2, excluding A11 on security/privacy (outside the scope of this thesis). In addition, the limitations and threats to the validity of this research study are discussed.

### 6.1 Comparison with Related Work

This section provides a brief comparison of Care Ami with the related work presented in Chapter 3 and identified through the literature review. In Section 3.6, we evaluated and assessed the different systems based on the high-level requirements discussed in Table 3-2. Table 6-1 (replicating Table 3-2 along with the addition of Care Ami row at the bottom) summarizes the comparison of our proposed application with the related systems.

**Table 6-1** Comparison with related work

Article	Information Provided About Diagnosis	Patient Engagement	Follow-up Plan	Role-Based Access	Peer Support Network	Map Display	Healthy Lifestyle	Multi-Language	Support Mobile Devices	Multiple Types of Diseases	Validation
P1	Yes	No	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes
P2	Yes	No	No	Yes	Yes	No	Yes	No	Yes	No	Yes
P3	No	No	No	Yes	No	+/-	No	Yes	Yes	No	Yes
P4	No	Yes	Yes	No	No	+/-	No	No	Yes	No	No
P5	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	No
P6	Yes	Yes	+/-	No	No	No	Yes	No	Yes	No	Yes
P7	Yes	Yes	+/-	No	No	No	Yes	Yes	No	No	Yes
P8	Yes	Yes	Yes	Yes	No	+/-	Yes	Yes	Yes	Yes	Yes
<b>Care Ami</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>+/-</b>

As shown in Table 6-1, in articles P3 and P4, human patient navigators use tools for providing healthcare navigation to the patients. All the other systems have as common objective a focus on patients by providing them with high-quality and reliable information about

diagnosis/treatment processes. None of the systems meets all requirements, but Care Ami scores well on most of them.

In terms of supporting multiple types of diseases (R9), Care Ami, being based on Drupal, has most of the infrastructure in place to do so, with current full support for lung cancer, and partial support for breast and prostate cancers. However, Care Ami can be extended to support many other diseases as well. Care Ami was implemented and demonstrated to stakeholders with positive feedback, but it is yet to be deployed and validated formally at the hospital.

The closest competitor to Care Ami at this point (P8 in Table 6-1) is the DAP-EPS system developed by Cancer Care Ontario [7]. DAP-EPS does support two types of cancer assessment processes and has been deployed and validated [8]. However, maps to rooms are not provided (only maps to buildings are present), and peer support is unavailable. DAP-EPS was not also not deployed at TOH in part because of the required high level of integration with existing health information systems (e.g., to report test results while ensuring privacy).<sup>2</sup>

## **6.2 Limitations and Threats to Validity**

This section discusses limitations and potential threats to the validity of this thesis work. As proposed by Perry et al. [55], three types of validity threats are discussed here:

- Construct validity: verifies the hypothesis/system claims based on the tests performed
- Internal validity: examines any bias in performing the thesis work
- External validity: determines whether the extension of experiment results to other cases or situations is possible or not.

### **6.2.1 Construct Validity**

The major threats to construct validity are:

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<sup>2</sup> As of March 24, 2017 (after the initial submission of this thesis), Cancer Care Ontario decided to shut down DAP-EPS as they determined that system not to be sustainable as a province-wide tool.

- The actual deployment of Care Ami in the healthcare facility has not yet been done. Therefore, it is difficult to prove its usefulness and effectiveness from the perspective of the users (patients, nurses, physicians, administrators).
- Security and privacy concerns (high-level requirement A11) are not considered explicitly in this research. Encrypting the data/communication is simple to do with Drupal, Apache, and MySQL, but this is insufficient in a healthcare environment. Legal concerns related to the collection, use, disclosure, and deletion of private healthcare data need to be discussed within the deployment environment. Additionally, concerns regarding compliance to hospital policies and dependencies to external applications (such as a Facebook group for peer support) are not taken into account here.
- The technical integration of our application with the hospital's health information system is not done yet.

### 6.2.2 Internal Validity

The major threats to internal validity are:

- One of the obvious threats is the selection of the related studies and solutions. The thesis author might have been biased in researching related work as this was only performed by one person, though the process of selection of the related work was mitigated by the constant feedback of one of the supervisors.
- As discussed by Nielson et al. [52], at least three expert evaluators are needed to properly and independently assess the gaps in the user interface of an application. However, the evaluation of Care Ami was performed only by the thesis author, which may have been biased during the evaluation.
- Actual experiments were not performed on the systems mentioned in the related work. Instead, the assessment of the related work is solely based on the literature review, and the comparison with Care Ami is based on that information.

### **6.2.3 External Validity**

One major threat to external validity is:

- Care Ami could not be evaluated by the healthcare providers or patients. Evaluation and testing were performed by the thesis author only. It is not guaranteed that the results obtained from patients and providers would confirm the results obtained in this thesis. In addition, the requirements were strongly influenced by TOH stakeholders, and other hospitals could have different requirements. Therefore, to generalize and finalize the application, it has to be evaluated and tested several times by patients/providers, from different institutions.

### **6.3 Chapter Summary**

This chapter discussed how Care Ami compares to competing virtual patient navigation systems, and several benefits were highlighted. Various threats to validity were identified and summarized. In both cases, the lack of user-based validation is an issue that remains to be addressed. The next chapter provides concluding remarks about this thesis and discusses future work items.

## Chapter 7. Conclusions and Future Work

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This chapter recalls the main contribution of the thesis and discusses future opportunities.

### 7.1 Conclusion

While being assessed for cancer, many patients suffer from a fear of not being properly informed and are uncertain about what information to trust and what to do next. Virtual PN systems can improve the overall experience of such patients by addressing these fears and guiding patients throughout their care journey.

This thesis contributes the requirements, architecture, and a CMS-based implementation of a virtual PN framework called Care Ami, which supports patients undergoing cancer assessment in an Ontarian hospital. The main thesis goals covering the research hypothesis (Section 1.3) are satisfied in the following way:

1. *Identifying the technical requirements for a virtual patient navigator application for the CAC*: the goals and requirements of Care Ami are respectively available in Sections 4.1 and 4.2.
2. *Designing and prototyping this virtual patient navigator application*: the architecture and implementation of Care Ami are described in Sections 4.3 and 4.4.
3. *Evaluation the application*: this was done using heuristic evaluation guidelines related to usability (Section 5.1) and manual testing of access control, menu visibility, and functionalities (Section 5.2). The evaluation was further supplemented with a comparison with related work (Section 6.1) and a discussion of limitations (Section 6.2).

The main feature provided by Care Ami that satisfy the goals of the application (G1-G3) identified in this thesis (Section 4.1) are the following:

1. Care Ami provides many patient-oriented features that go beyond the existing paper-based solutions, including: dynamic appointments updates with e-mail reminders, navigation maps, personal health information that can be shared with

nurses and physicians, status information along the assessment process, peer support, and a wealth of reliable online information on medical conditions, on tests, on healthcare lifestyle tips, and on the hospital itself and its healthcare providers (hence contributing positively to goal G1).

2. Care Ami improves the experience of nurses and physicians as they can have access to a patient's symptoms and medications when a patient contacts/meets them and they can likely save efforts setting and confirming appointments. Physicians will also likely have more productive consults with patients as the former will spend less time explaining basic concepts and treatments covered by the application or discussing unreliable sources of health information (hence helping satisfy goal G2).
3. Care Ami generalizes the notion of single application and provides a framework to support multiple types of cancers and other diseases (hence satisfying goal G3).

## 7.2 Future Work

Although Care Ami satisfies most of the identified requirements and goes beyond related virtual PN systems discovered during our literature survey, the limitations we identified in the previous section lead to many future work items. To address some of these limitations, we present the following future opportunities:

1. Improve and extend Care Ami by integrating Google Maps Indoor, so patients can be told how to navigate (in real-time, on their phones/tablets) inside the hospital building.
2. Address the security and privacy concerns that currently prevent the deployment and formal usability/usefulness studies.
3. Perform usability studies involving real patients, physicians/nurses, clerks, and administrators (e.g., the usability of the addition of a new section also needs to be evaluated).
4. Integrate Care Ami with the information system infrastructure of the host hospital. Opportunities exist in getting appointments, patient data, and patient medication from existing systems.

5. Provide a feature to dynamically update the current stage of the patient (i.e., the “Track my Progress” feature discussed in Section 4.4.8).
6. Explore the suitability of similar applications in non-cancer contexts such as supporting the management of high-risk multiple pregnancies, where interactions with patients normally span over multiple months (instead of 3 weeks, as is the case with Care Ami) and where context-based decision-making needs to be supported.
7. Integrate artificial intelligence algorithms that would allow Care Ami to extract patient preferences using natural language processing, thus allowing a better treatment plan for the patients.

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## Appendix A: Drupal Modules

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Table 7-1 shows the Drupal modules (core, contributed, and custom) that are used in the development of Care Ami framework. See [https://www.drupal.org/project/project\\_module](https://www.drupal.org/project/project_module) for their description.

**Table 7-1** Drupal modules used in Care Ami

Access by Term (ABT)	Address Field	Administration menu
Administration menu	Administration views	Advanced Queues
Adminimal Theme		
Advanced Queues example	Advanced Queues Test	Block
Calendar	Chaos tools	Comment
Conditional Fields	Contact	Content translation
Context	Context layouts	Context UI
Contextual links	CSS Injector	Dashboard
Date	Date All Day	Date API
Date iCal	Date Popup	Date popup timepicker
Date Repeat API	Date Repeat Field	Date Tools
Date Views	Email	Entity API
Entity Bundle Plugin	Entity Bundle Plugin Test	Entity Reference Behavior Example
Entity tokens	Entity Translation	Entity Translation Menu
Features	Field	Field collection
Field Group	Field Permissions	Field SQL storage
Field translation	Field UI	File
Filter	FullCalendar	Image
IMCE	IMCE Mkdir	IMCE Wysiwyg API bridge
Inline Entity Form	Internationalization	Job Scheduler
Job Scheduler Trigger	jQuery Update	Libraries
Link	List	Locale
Localization update	Localize Fields	Localize Fields UI
Markup	Menu	Menu attributes
Menu item visibility	Menu translation	Module filter
MultiBlock	Multilingual content	Multilingual select
Node	Node clone	Node Reference
Notify	Notify Views Integration	Number
Options	Path	Path translation
Pathauto	Phone	PHP filter
PHPMailer	Printer-friendly pages	Printer-friendly pages UI
Profile2	Progress Bar	Redirect 403 to User Login
Rules	Rules Scheduler	Rules translation

Rules UI	Search	Simple Password Reset
Smart Trim	String translation	Synchronize translations
System	Taxonomy	Taxonomy translation
Telephone	Testing	Text
Title	Token	Toolbar
Translation redirect	Translation sets	Update manager
URL	User	User mail translation
User Reference	Variable	Variable example
Variable realm	Variable store	Variable translation
Variable views	Views	Views Bootstrap
Views Bulk Operations	Views content panes	Views UI
Webform	Webform Multiple	Wysiwyg

# Appendix B: Drupal – Roles and Permissions

Table 7-2 shows the chosen permissions given to the different roles (super-administrator, administrator, clerk, nurse/physician, and patient/family member). Each role can be assigned a different set of permissions. By default, there are also two roles provided by Drupal: Authenticated Users and Administrators.

**Table 7-2** Care Ami’s access control permissions, per role

PERMISSION	SUPER ADMINISTRATOR	ADMINISTRATOR	CLERK	NURSE/PHYSICIAN	PATIENT/FAMILY MEMBER	ANONYMOUS USER	AUTHENTICATED USER
<b>Access by Term (ABT)</b>							
<b>Assign fields to control node view access</b> <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Assign fields to control node update access</b> <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Assign fields to control node delete access</b> <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Allow users to edit ABT terms on profile page.</b> <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Allow users to view ABT terms on profile page.</b> <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Allow users to edit ABT terms on node page.</b> <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Allow users to view ABT terms on node page.</b> <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<b>Administration menu</b>								
<b>Access administration menu</b>	Display the administration menu at the top of each page.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Flush caches</b>	Access links to flush caches in the administration menu.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Display Drupal links</b>	Provide Drupal.org links in the administration menu.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Block</b>								
<b>Administer blocks</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>CSS Injector</b>								
<b>Administer CSS Injection</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Chaos tools</b>								
<b>Use CTools importer</b>	The import functionality allows users to execute arbitrary PHP code, so extreme caution must be taken. <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Comment</b>								
<b>Administer comments and comment settings</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>View comments</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Post comments</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Skip comment approval</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Edit own comments</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Conditional Fields</b>								
<b>Administer dependencies</b>	View, edit and delete field dependencies.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Contact</b>								
<b>Administer contact forms and contact form settings</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Use the site-wide contact form</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Use users' personal contact forms</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Content translation</b>								
<b>Translate content</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Context UI</b>								
<b>Administer contexts</b>	Associate menus, views, blocks, etc. with different contexts to structure your site.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Access all blocks</b>	Allows users to access all rendered blocks via an AJAX callback. If you have some blocks that should not be rendered for some users but need those users to be able to use context UI, then implement <code>hook_context_allow_ajax_block_access</code> with the necessary logic.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<b>Contextual links</b>								
<b>Use contextual links</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use contextual links to perform actions related to elements on a page.								
<b>Dashboard</b>								
<b>View the administrative dashboard</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Customizing the dashboard requires the <a href="#">Administer blocks</a> permission.								
<b>Date Repeat Field</b>								
<b>View Repeating Dates</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allow user to see a page with all the times a date repeats.								
<b>Date Tools</b>								
<b>Administer date tools</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Entity Translation</b>								
<b>Administer entity translation</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Select which entities can be translated.								
<b>Toggle field translatability</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Toggle translatability of fields performing a bulk update.								
<b>Translate any entity</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Translate field content for any fieldable entity.								
<b>Translate entities of type Node</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Translate field content for entities of type Node.								
<b>Translate entities of type Taxonomy term</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Translate field content for entities of type Taxonomy term.								
<b>Features</b>								
<b>Administer features</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perform administration tasks on features. <i>Warning: Give to trusted roles only; this permission has security implications.</i>								
<b>Manage features</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
View, enable and disable features. <i>Warning: Give to trusted roles only; this permission has security implications.</i>								
<b>Generate features</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allow feature exports to be generated and written directly to site. <i>Warning: Give to trusted roles only; this permission has security implications.</i>								
<b>Edit feature machine name</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allows editing machine name of a disabled feature <i>Warning: Give to trusted roles only; this permission has security implications.</i>								
<b>Field</b>								
<b>Administer fields</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Additional permissions are required based on what the fields are attached to (for example, <a href="#">administer content types</a> to manage fields attached to content). <i>Warning: Give to trusted roles only; this permission has security implications.</i>								
<b>Translate entities of type Node</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Translate field content for entities of type Node.								
<b>Translate entities of type Taxonomy term</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Translate field content for entities of type Taxonomy term.								
<b>Features</b>								
<b>Administer features</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perform administration tasks on features. <i>Warning: Give to trusted roles only; this permission has security implications.</i>								
<b>Manage features</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
View, enable and disable features. <i>Warning: Give to trusted roles only; this permission has security implications.</i>								
<b>Generate features</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allow feature exports to be generated and written directly to site. <i>Warning: Give to trusted roles only; this permission has security implications.</i>								
<b>Edit feature machine name</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allows editing machine name of a disabled feature <i>Warning: Give to trusted roles only; this permission has security implications.</i>								
<b>Field</b>								
<b>Administer fields</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Additional permissions are required based on what the fields are attached to (for example, <a href="#">administer content types</a> to manage fields attached to content). <i>Warning: Give to trusted roles only; this permission has security implications.</i>								

Field Group								
<b>Administer fieldgroups</b>								
Display the administration for fieldgroups.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Field Permissions</b>								
<b>Administer field permissions</b>								
Manage field permissions and field permissions settings. <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Access other users' private fields</b>								
View and edit the stored values of all private fields. <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Create own value for field <i>field_type_of_cancer</i></b>								
This field appears as: "Node:Basic page:Type of Cancer", "Node:Staff:Type of Cancer", "Node:Webform:Type of Cancer", "Profile:Patient Profile:Type of Cancer", "User:User:Type of Cancer".	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Edit own value for field <i>field_type_of_cancer</i></b>								
This field appears as: "Node:Basic page:Type of Cancer", "Node:Staff:Type of Cancer", "Node:Webform:Type of Cancer", "Profile:Patient Profile:Type of Cancer", "User:User:Type of Cancer".	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Edit anyone's value for field <i>field_type_of_cancer</i></b>								
This field appears as: "Node:Basic page:Type of Cancer", "Node:Staff:Type of Cancer", "Node:Webform:Type of Cancer", "Profile:Patient Profile:Type of Cancer", "User:User:Type of Cancer".	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>View own value for field <i>field_type_of_cancer</i></b>								
This field appears as: "Node:Basic page:Type of Cancer", "Node:Staff:Type of Cancer", "Node:Webform:Type of Cancer", "Profile:Patient Profile:Type of Cancer", "User:User:Type of Cancer".	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>View anyone's value for field <i>field_type_of_cancer</i></b>								
This field appears as: "Node:Basic page:Type of Cancer", "Node:Staff:Type of Cancer", "Node:Webform:Type of Cancer", "Profile:Patient Profile:Type of Cancer", "User:User:Type of Cancer".	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Create own value for field <i>field_share_information_with_nur</i></b>								
This field appears as: "Profile:Patient Profile:Share Information with Nurse/Physician".	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Edit own value for field <i>field_share_information_with_nur</i></b>								
This field appears as: "Profile:Patient Profile:Share Information with Nurse/Physician".	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Edit anyone's value for field <i>field_share_information_with_nur</i></b>								
This field appears as: "Profile:Patient Profile:Share Information with Nurse/Physician".	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>View own value for field <i>field_share_information_with_nur</i></b>								
This field appears as: "Profile:Patient Profile:Share Information with Nurse/Physician".	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>View anyone's value for field <i>field_share_information_with_nur</i></b>								
This field appears as: "Profile:Patient Profile:Share Information with Nurse/Physician".	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Field collection</b>								
<b>Administer field collections</b>								
Create and delete fields on field collections.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Filter</b>								
<b>Administer text formats and filters</b>								
Define how text is handled by combining filters into <a href="#">text formats</a> . <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Use the <a href="#">WYSISYG</a> text format</b>								
<i>Warning: This permission may have security implications depending on how the text format is configured.</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Use the <a href="#">Filtered HTML</a> text format</b>								
<i>Warning: This permission may have security implications depending on how the text format is configured.</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Use the <a href="#">Full HTML</a> text format</b>								
<i>Warning: This permission may have security implications depending on how the text format is configured.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Use the <a href="#">PHP code</a> text format</b>								
<i>Warning: This permission may have security implications depending on how the text format is configured.</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>FullCalendar</b>								
<b>Update any FullCalendar event</b>								
Allow user to edit events, ignoring other permissions.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>IMCE</b>								
<b>Administer IMCE</b>								
<i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<b>Image</b>								
<b>Administer image styles</b>	Create and modify styles for generating image modifications such as thumbnails.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Locale</b>								
<b>Administer languages</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Translate interface texts</b>	<i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Menu</b>								
<b>Administer menus and menu items</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Menu attributes</b>								
<b>Administer menu attributes</b>	Administer menu attributes configuration.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Module filter</b>								
<b>Administer Module Filter</b>	Configure how Module Filter performs.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Multilingual content</b>								
<b>Administer content translations</b>	Add or remove existing content to translation sets.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Node</b>								
<b>Bypass content access control</b>	View, edit and delete all content regardless of permission restrictions. <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Administer content types</b>	<i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Administer content</b>	<i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Access the content overview page</b>	Get an overview of <a href="#">all content</a> .	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>View published content</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>View own unpublished content</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>View content revisions</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Revert content revisions</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Delete content revisions</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Appointment: Create new content</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Appointment: Edit own content</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Appointment: Edit any content</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<b>Appointment: Delete own content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Appointment: Delete any content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Article: Create new content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Article: Edit own content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Article: Edit any content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Article: Delete own content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Article: Delete any content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Basic page: Create new content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Basic page: Edit own content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Basic page: Edit any content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Basic page: Delete own content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Basic page: Delete any content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Staff: Create new content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Staff: Edit own content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Staff: Edit any content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Staff: Delete own content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Staff: Delete any content</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Webform</b>							
<b>Webform: Create new content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Webform: Edit own content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Webform: Edit any content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Webform: Delete own content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Webform: Delete any content</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Node clone</b>							
<b>Clone any node</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Clone own nodes.</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Notify</b>							
<b>access notify</b> Allow user to setup and receive notifications when there is new content. Enable this for the anonymous user role if you want notification enabled by default for new users.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>administer notify</b> Administer the notify module	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>administer notify queue</b> Administer the notify queue	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>PHP filter</b>							
<b>Use PHP for settings</b> <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>PHPMailer</b>							
<b>Administer PHPMailer settings</b> <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Page manager</b>							
<b>Use Page Manager</b> Allows users to use most of Page Manager's features, though restricts some of the most powerful, potentially site-damaging features. Note that even the reduced featureset still allows for enormous control over your website. <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Administer Page Manager</b> Allows complete control over Page Manager, i.e., complete control over your site. Grant with extreme caution. <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Path</b>							
<b>Administer URL aliases</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Create and edit URL aliases</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Pathauto</b>							
<b>Administer pathauto</b> Allows a user to configure patterns for automated aliases and bulk delete URL-aliases.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Notify of Path Changes</b> Determines whether or not users are notified.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<b>Printer-friendly pages</b>								
<b>Administer the module</b>	Perform maintenance tasks for the print module.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Access the printer-friendly page</b>	View the printer-friendly pages and the links to them in the original pages.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Printer-friendly pages UI</b>								
<b>Node-specific configuration</b>	Enable access to the per-node settings.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Profile2</b>								
<b>Administer profile types</b>	Create and delete fields on user profiles, and set their permissions.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Administer profiles</b>	Edit and view all user profiles.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Patient Profile: Edit own profile</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Patient Profile: Edit any profile</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Patient Profile: View own profile</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Patient Profile: View any profile</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Progress Bar</b>								
<b>progress_bar submissions</b>	progress_bar submissions description	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Responsive Menus</b>								
<b>Administer Responsive Menus</b>	Configure settings for responsive menus module.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Rules</b>								
<b>Administer rule configurations</b>	Administer rule configurations including events, conditions and actions for which the user has sufficient access permissions.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Bypass Rules access control</b>	Control all configurations regardless of permission restrictions of events, conditions or actions. <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Access the Rules debug log</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Search</b>								
<b>Administer search</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Use search</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Use advanced search</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>String translation</b>								
<b>Translate user-defined strings</b>	Translate user-defined strings that are created as part of content or configuration. <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Translate admin strings</b>	Translate administrative strings with a very permissive XSS/HTML filter that allows all HTML tags. <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>System</b>								
<b>Administer modules</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Administer site configuration</b>	<i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Administer themes</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Administer software updates</b>	<i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Administer actions</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Use the administration pages and help</b>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Use the site in maintenance mode</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>View the administration theme</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>View site reports</b>	<i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Block IP addresses</b>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Taxonomy							
Administer vocabularies and terms	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Edit terms in <i>Appointment Type</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delete terms from <i>Appointment Type</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Edit terms in <i>Cancer Type</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delete terms from <i>Cancer Type</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Edit terms in <i>Specialty</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delete terms from <i>Specialty</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Edit terms in <i>Test Locations</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delete terms from <i>Test Locations</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Edit terms in <i>Tests</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delete terms from <i>Tests</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Testing							
Administer tests <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Toolbar							
Use the administration toolbar	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
User							
Administer permissions <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Administer users <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
View user profiles	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Change own username	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Cancel own user account <i>Note: content may be kept, unpublished, deleted or transferred to the Anonymous user depending on the configured user settings.</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Select method for cancelling own account <i>Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Views							
Administer views <i>Access the views administration pages. Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bypass views access control <i>Bypass access control when accessing views. Warning: Give to trusted roles only; this permission has security implications.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Webform							
Access all webform results <i>Grants access to the "Results" tab on all webform content. Generally an administrative permission.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access own webform results <i>Grants access to the "Results" tab to the author of webform content they have created.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Edit all webform submissions <i>Allows editing of any webform submission by any user. Generally an administrative permission.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delete all webform submissions <i>Allows deleting of any webform submission by any user. Generally an administrative permission.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access own webform submissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Edit own webform submissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delete own webform submissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Content authors: access and edit webform components and settings <i>Grants additional access to the webform components and settings to users who can edit the content. Generally an authenticated user permission.</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>