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NURSING #PATIENTFIRST

National Cancer Control Programme

Scoping Review

Nursing configuration in ambulatory haematology/ oncology day unit settings

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Executive Summary

The incidence of cancer is increasing nationally and internationally (Department of Health, 2017) and Irish healthcare policy promotes person-centred care as close as possible to where people live (House of the Oireachtas, 2017). The focus of this review is on the nursing configuration in ambulatory haematology/oncology day unit settings. Throughout this report, the term Ambulatory Haematology Oncology Day Units (AHODU) will be used to include ambulatory care, day care facilities and infusion centres.

The aim of this scoping review was to systematically search the literature and describe the role of the nurse, the appropriate skill mix, and to identify models or tools used to determine appropriate nurse staffing within AHODU where Systemic Anti-Cancer Therapy (SACT) is delivered. The JBI methodology for scoping reviews (Peters et al., 2020) was used for this scoping review.

Two separate searches were conducted, one focused on "acuity and scheduling" (n= 7919 records) within AHODU and the second focused on the 'role of the nurse' (n=7,345) within AHODU. A total of 116 studies were deemed eligible following title and abstract and full text screening. Of these, 66 were obtained through the 'acuity/scheduling' search and 50 were obtained through the 'role of the nurse' search.

Findings from this review suggest patient scheduling, patient acuity, skill mix, and the competencies of the nurse allocated to the patient are all inter-connected. We identified 13 existing acuity tools, and these were used in Canada, USA, Turkey and Australia. Acuity tools are being used to provide a reflection of nursing time required for safe patient care. Developing such tools needs consideration of patient acuity, the nursing cohort using the tool and the setting in which the proposed tool is to be used. Additionally, resource implications, validity, reliability, and adaptation need to be reflected on. Staff-to-patient or staff-to-chair ratios can be a simplistic method in determining staffing levels, however, often they do not reflect patient acuity or complexity of the treatment been administered in AHODU. There appears to be no internationally agreed nurse-to-patient ratio within AHODU and no evidence linking ratios to quality care outcomes. Ratios identified in this review do not feature nurses' grade, competencies or skill level, or the complexity of treatment being administered.

Delivery of SACT is highly specialised and complex and nurses working in AHODU undertake many and varied activities, for example, core nursing tasks and administrative responsibilities as well as the provision of psycho-social and educational needs and the management of unscheduled care. Their role also includes provision of telephone triage and in some cases, the delivery of SACT in community settings. While there is variability in the nurses' titles, roles, responsibilities, and scope of practice in AHODUs, it is important that staff skill and experience be considered when determining appropriate nurse staffing configuration. In some cases, certain tasks could be undertaken by others such as administrators or health care assistants. Finally, patient scheduling should be determined in a way that maximises the usage of skill mix in AHODUs.

The Department of Health (2018; 2022) identified that determining safe and appropriate staffing levels and skill mix in medical and surgical wards as well as in Emergency

Departments (ED) is a complex process. This is also true for AHODU. The four assumptions of the safe staffing framework can be applied to AHODU settings.

1) Patient care needs differ, and the individual care needs as well as the complexity of the SACT treatment will influence the amount of nursing input required and the amount of time the patient needs to stay in AHODU. This scoping review identified a number of acuity tools used in AHODU. Further research is required to determine the validity and reliability of a modified tool in identifying patients' needs in AHODU and to determine how nursing hours are calculated in AHODU.

2) Determining the skill mix and number of nurses required is key to maintaining high quality care in AHODU. The number of AHODU nurses with the required SACT competencies needs to be continuously monitored. Each AHODU should identify the number and percentage of nurses with the required SACT competencies needed to deliver a safe high-quality service. Further consideration is required before a recommended ratio of RGN to HCA, within the AHODU, is decided.

3) Features of the organisational environment will influence the organisation of care e.g the number of chairs, the availability of single rooms, pharmacy and administrative support. Efficient scheduling will impact on patient flow and the working environment of nurses and HCAs within AHODUs.

4) The final assumption of the safe staffing framework focuses on patient and staff outcomes. One of the staff outcomes reported in the literature was the amount of overtime that nurses had to do to complete patients SACT treatment regimen. Patient outcomes include waiting times for the commencement of SACT regimes and length of time waiting for SACT on the day of treatment. Each AHODU should monitor patient and staff outcomes.

Overall, this review demonstrates the breadth of literature relevant to determining appropriate staffing configuration in AHODU settings. Day-to-day staff planning in the clinical setting, as well as longer term workforce planning, is suggested to be a complex process and one that is multifactorial. This report provides a comprehensive review of the literature and considers the various aspects to be considered in decision making going forward. The following list of recommendations arose from the review.

Recommendations

1	All AHODU nurses, new to the administration of SACT, should be facilitated to complete the NCCP (2021) National SACT Competency Programme. Annual reaccreditation, as per the National SACT Competency programme, is recommended to ensure all AHODU nurses, who administer SACT maintain current competence. SACT competencies is a key determinant of appropriate skill mix within AHODU. Each AHODU should determine the minimum number of nurses with SACT competencies required.
2	Employment of a dedicated clinical facilitator to supervise, educate and support all nurses to care for Oncology/ Haematology patients including supporting nurses to achieve SACT competencies in type 1 and type 2 SACT model of services. Type 3 SACT services should receive support from a clinical facilitator in hospitals with type 1 or type 2 SACT services.
3	Review the scheduling process of SACT services nationally.
4	Review the scope and define the role of the HCA within AHODU to determine the appropriate RGN to HCA ratio within this setting.
5	An AHODU dependency and acuity tool would need to be appropriately configured to effectively measure nursing services as delivered in Ireland. Further research is required to determine the validity and reliability of any acuity tool used.

List of Abbreviations

AHODU	Ambulatory Haematology Oncology Day Unit
ANP	Advanced Nurse Practitioner
AOS	Acute Oncology Service
APP	Advanced Practice Providers
CNM	Clinical Nurse Manager
CNS	Clinical Nurse Specialist
CRN	Clinical resource Nurse
CSF	Clinical Skills Facilitator
FTE	Full-time equivalent
HCA	Health Care Assistant
JBI	Joanna Briggs Institute
NCCP	National Cancer Control Programme
NMBI	Nursing and Midwifery Board of Ireland
NP	Nurse Practitioner
OAM	Oral Anti-Cancer Medications
RN/RGN	Registered Nurse/Registered General Nurse
SACT	Systemic Anti-Cancer Therapy
SN	Staff Nurse
TT	Telephone Triage

Glossary of Terms

Acuity	Acuity refers to the intensity of patient care requirements and involves identifying what a patient represents in terms of workload (Nguyen, 2015).
Acute Oncology Service	The Acute Oncology Service (AOS) CNS ensures there is a patient-centered, timely, response to patient queries when they are experiencing side effects of their treatment or their disease. Patients are triaged, assessed and managed using a validated tool, they are reviewed in hospital if necessary and discharged home in a timely manner, where possible.
Advanced Nurse Practitioner (Ireland)	Highly skilled practitioners and clinical leaders delivering quality care to an agreed group of patients/clients. They are committed to gathering and disseminating nursing research, mentoring nurses, and sharing information in the classroom, clinical environment, on national/international stages and professional publications. Advanced Nurse Practitioners also serve as change agents who coordinate and evaluate health care and formulate policy which advances nursing practice and improves patient/client outcomes (NCCP 2022).
Advanced Practice Provider	Advanced Practice Providers (APPs) are also referred to as Non-physician Nurse Practitioners (NPPs), Advanced Nurse Practice Providers (APRNs), and Physician Assistants (PAs). Their scope of practice allows for significant contributions in cancer care. APPs can also be found in a variety of community, acute care, and tertiary practice settings in different oncology specialties (Reynolds, 2016).
Clinical Nurse Specialist (Ireland)	A CNS is an expert practitioner who has attained, at a minimum, a postgraduate qualification in their specialist area of practice. The role is defined under 5 core competencies - clinical, education, consultation, advocacy, and audit. The CNS is often the main point of contact for patients throughout their treatment (NCCP, 2021).
Clinical Resource Nurse (Canada)	Clinical Resource Nurse (CRN) is a sub-speciality of the registered nurse profession. He/she has specific responsibility over the coordination of the nursing staff that care for a specific patient group. They are responsible for the efficient organisation of staff workflow, accuracy in paperwork, smooth shift transitions, correct and proficient use of medical supplies and devices. (https://www.cna-nursing-schools.com)
Clinical Skills Facilitator (Ireland)	Assist staff by providing support and guidance in the orientation of new staff, working with experienced staff in further developing the necessary skills and competencies needed to care for and manage patients with cancer. They engage directly in clinical practice, and therefore, the role can be embedded in the clinical team, working alongside front line staff. They contribute to the development, evaluation and maintenance of nursing standards, policies, protocols and guidelines. They act as the clinical skills facilitator for partner programmes with higher institutes of education to ensure the quality of clinical placements as well as developing and delivering education programmes locally. Their function is to ensure that the staff have the required and appropriate clinical care skills and competencies to effect timely patient care and intervention (NCCP 2022).

Community infusion clinic	Community clinics providing SACT infusions and other services. They offer the opportunity to alleviate over-stretched hospital day wards and provide step down facilities for different patient groups (NCCP 2022).
Competencies	The knowledge, skills, values, and attitudes that are required for cancer nurses to carry out their work safely and effectively. (EONS, 2022)
Direct Care	To include clinical activities or interventions performed by the nurse, in the presence of the patient, associated with patient care including assessment, planning implementation, or evaluation.
Grade Mix	"The mix of individual grades within the workforce. For example, the mix of staff nurses, clinical nurse managers and healthcare assistants" (Department of Health 2018).
Grey Literature	Grey literature is defined as follows: "That which is produced on all levels of government, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers." The Fourth International Conference on Grey Literature (GL '99).
Health Care Assistant (HCA) Ireland	Health Care Assistant is an unregistered healthcare worker, providing patient care under the direct guidance and supervision of a registered nurse (Department of Health 2018). HCA are known as Cancer Support workers in other countries.
Indirect care	Activities performed for (but not in direct contact with) the patient (deSouza et al., 2014). To include discharge planning, coordination of care, referrals, organising prescriptions, liaising with pharmacy and other departments etc.
Nurse Co-ordinator (Israel)	A Nurse Coordinator (in Israel) has an accredited undergraduate degree in nursing with three years' experience. They must have a certificate of registration confirming completion of an accredited training program in a relevant clinical field. In clinical fields where no accredited training program exists, said certificate of registration is not required (Monas et al. 2017).
Outreach/ Community activities	Refers to nurses working in the AHODU setting conducting activities related to or providing expert advice and consultation with staff in community/ outreach settings.
Regimen	SACT drugs (single or multiple) and supportive medication, administered in a program of treatment for cancer.

Scheduler	A person responsible for scheduling patients for their AHODU appointments.
Skill-mix	"The mix of education, training, skills and experience within the nursing care team that includes both registered nurses and healthcare assistants" (Department of Health 2018). The composition of the nursing team in terms of qualification and experience. This is expressed as a percentage of registered nurses to healthcare assistants. Nursing skill mix should also encompass individual clinical competencies and different areas of expertise and grades of registered nurses.
Systemic Anti-Cancer Therapy (SACT)	SACT is defined as all drugs with direct anti-tumour activity that are administered for the treatment of cancer, including but not limited to chemotherapy, targeted therapies and immunotherapies. This includes SACT used in clinical trials and in compassionate use programmes and excludes hormonal therapy used to treat cancer SACT is dispensed in acute hospitals and administered either as an in-patient or as a day care patient or in the home (NCCP2022).
SACT outreach services	SACT outreach is a model used by health services to both enable care closer to the patient's home and to devolve certain aspects of lower complexity SACT service away from the SACT hospitals. SACT outreach services remain governed and staffed by the SACT hospital while being in an off-site location (NCCP 2022).
Supportive care	Includes e.g. management of central venous access devices, blood transfusions, intravenous support, and venesections.
Telephone triage	Telephone triage is defined as an interactive process between the healthcare worker and caller (patient or caregiver) that occurs over the telephone and involves identifying the nature and urgency of the health care needs and determining an appropriate plan of care and disposition of the call (NCCP 2022).

1. Introduction

The World Health Organisation (WHO, 2020) estimated that 18 million people were diagnosed with cancer in 2018 and predict that this number will increase to between 29 and 37 million in 2040. Pilleron et al. (2019) identified that 47.5% of all new cancer cases (6.7 million) were diagnosed in 2012 among adults aged 65 years and older. They further estimate that by 2035, 60% of all new cancer cases (14 million) will be among older adults worldwide. In Ireland, 45,000 patients are diagnosed with cancer annually and this number is predicted to double by 2045 (NCRI, 2021). This predicted increase in the incidence of cancer is attributed to an ageing population and increased levels of obesity.

Demand for cancer treatments is increasing due to higher numbers of cancer cases, an aging population, and extended cancer survival rates (Rodriguez et al., 2020). Systemic anti-cancer therapy (SACT) is a collective term to describe the growing number of differing therapies used in the treatment of solid tumour and haematological cancers. SACT includes, but is not limited to, chemotherapy, targeted therapies and immunotherapies and can be used on its own or in combination with other cancer treatment modalities such as surgery and radiotherapy (Department of Health, 2017). In Ireland, the NCRI recorded a fifty percent increase in the proportion of patients treated with chemotherapy between 1996 and 2013 (NCRI, 2017). It is also predicted that the number of patients requiring chemotherapy in Ireland will increase by 42% - 48% by 2025 (NCRI, 2014). SACT may be oral or parenteral and the focus of this review is on nursing configuration in AHODUs where parenteral SACT is administered.[1]

SACT is predominantly dispensed in acute hospitals and administered to patients in the inpatient, day- patient, or home setting. Changes in the delivery of SACT, as well as the ability to better manage toxicities, have resulted in a shift of cancer care from the inpatient to the outpatient setting (Cooper & de Lord, 2018). Outpatient haematology oncology day units are known as ambulatory oncology care units (AOCU) in the UK, as day oncology units in Australia (Department of Health and Human Services Victoria, 2020), as systemic therapy ambulatory care units in Canada (Knox, 2022), or infusion rooms in the USA (Edwards et al. 2017). The focus of this scoping review is on haematology, oncology day units and not radiotherapy day units as these are recognised as distinct settings (Blay et al., 2002). The term Ambulatory Haematology Oncology Day Units (AHODU) will be used for this review.

In terms of outpatient services, AHODU is a relatively unique context considering the complexity of services that are delivered in this setting. For example, outpatient services typically schedule two types of patient visit, new or return, while SACT delivery settings require multiple appointment types depending on prescribed chemotherapy protocol, type of treatment required, as well as the amount of nursing care that is required (Rodriguez et al.,

1. SACT in this review implies parenteral SACT and does not include Oral Anti-cancer Medicines (OAM).

2020). SACT may include infusions of three to four hours duration, or a five-day infusion which in some cases is commenced in AHODU and the patient continues to receive this treatment via a portable infusion pump at home (Sabbagh Dit Hawasli et al., 2021).

The National Cancer Control Programme (NCCP 2022) outlined the guiding principles of its model of SACT care which includes person-centred care, equity of access, and the provision of resources to deliver evidence based safe SACT care by the right person, in the right place and at the right time (House of the Oireachtas 2017). The NCCP (2022) states that there are 26 public hospitals in Ireland delivering SACT services. There are 8 adult cancer centres and one paediatric cancer centre designated type 1 centres, delivering all levels of complexities of SACT, including specialist referrals and certain centralised services. A further five hospitals are classified as type 2 centers and provide low, medium and some high complexity SACT therapies. Both type 1 and type 2 provide in-patient care. A further 12 hospitals provide ambulatory and outreach care only and low to medium SACT therapies. The type four service is community based and provides low and some medium complexity SACT therapies and supportive SACT therapies, including central venous line management (NCCP 2022).

The majority of SACT is delivered in the AHODU setting. Currently in Ireland some of these units are open Monday to Friday between 8am and 6pm. Some of the AHODU have organised that the delivery of services such as disconnection of SACT infusions, management of Central Venous Access Devices (CVAD) and pre-chemotherapy phlebotomy are delivered in the community (O'Connor Power et al., 2022; O'Mahony et al., 2021; O'Mahony et al., 2020). Furthermore, some AHODU organise for patients to receive low risk SACT in community infusion clinics.

The Department of Health (2017) in its national cancer strategy and the NCCP (2022) identified the need for workforce planning to maintain the current staffing needs and to facilitate the future expansion of AHODU in order to meet the predicted demand for SACT in the future The importance of determining appropriate nurse staffing levels for efficient and quality care is widely recognised (Saville et al., 2019). Methods to determine nurse staffing levels have included volume-based nurse to patient ratio approaches and patient classification systems based on care needs, however previously developed systems have predominantly focused on the inpatient setting (Griffiths et al., 2020).

The Department of Health (2018) published a Framework for Safe Staffing and Skill Mix in General and Specialist medical and surgical wards in 2018 and one for emergency departments in 2022 (Department of Health 2022). Staffing requirements are determined utilising the acuity and dependency requirements of the patients. This phase of the Framework is applicable to inpatient care settings in acute hospitals for oncology/ haematology patients.

One of the four assumptions of the framework is that patients care needs differ and thus they recommended that all hospitals identify an evidence based, validated tool to measure patient dependency and acuity. The framework does not identify a specific tool for medical or surgical wards (Department of Health 2018).

The second assumption is that the number, profile and skill mix of the nursing team have an important impact on the provision of safe, high quality patient care. One recommendation is that all health care assistants (HCA) are required to have a minimum QQI (Quality and Qualifications Ireland) level 5 qualification. The ratio of Registered Nurses (RN) to HCA is 80: 20 in medical and surgical wards and 85:15 in Emergency Departments (ED) once a safe nurse

staffing level exists (Department of Health 2018; Department of Health 2022). The framework does not identify a safe nurse to patient ratio but advises each ward should determine their individual "Tipping Point" which indicates the nurse staffing point at which there is a known increased risk of unsafe patient care.

The third assumption is that the organisational environment has an impact on nursing staff's ability to provide safe patient care. One of the recommendations is that the Clinical Nurse Manager 2 (CNM2) should not be allocated a caseload. Factors such as ward layout, number of single rooms should be considered when determining staffing numbers (Department of Health 2018).

The final assumption of the safe staffing framework is that "positive patient and staff outcomes are important indicators of the safety and quality of patient care" (Department of Health 2018, p32). One of the key recommendations was the introduction of a national workforce planning and workforce management information technology (IT) system to assist in decision making about staffing levels and skill mix. This system also needs to include the monitoring of nursing and midwifery quality care metrics which will inform decisions about safe staffing levels (Department of Health 2018).

The Oncology Nursing Society have previously recommended several interrelated variables to be considered in determining staffing levels in the ambulatory treatment setting such as AHODU. These include needs-based variables such as population mix and care needs, treatment-based variables such as treatment regimen and observation period, personnel based variables such as education, level of experience and presence of support staff, as well as institution-based variables such as number of chairs, number of single rooms, location, and type of services provided (Oncology Nursing Society (ONS), 2020).

A key consideration for staffing in AHODUs is the issue of nursing acuity and workload, quantification of which is understood to be complex due to the unpredictable nature of patients in the AHODUs (Cusack et al., 2004). Acuity refers to the intensity of patient care requirements and involves identifying what an individual patient represents in terms of workload (Nguyen, 2015). Fesler & Toms (2020) recently highlighted that at present, there is no systematic way to assign nurse workload in the ambulatory setting and that there is a need to define an acuity level system that adequately reflects experiences in this setting in order to inform staffing levels.

Scoping reviews are recognised as a valuable methodology for mapping available evidence from a variety of sources allowing examination of practice, research, and identification of knowledge gaps (Pollock et al., 2021). Therefore, conducting a scoping review to describe the available evidence related to nursing configuration in AHODU setting where SACT is delivered will provide insights to inform future staffing strategies as well as guide future research and developments related to this topic. A preliminary search of the JBI Database of Systematic Reviews and Implementation Reports, the Cochrane Database of Systematic Reviews, and PROSPERO was completed in February 2022 and there were no completed or ongoing systematic or scoping reviews on this topic.

1.1. Outline of Report

In the following section, the aims and objectives of this scoping review are presented. Next, Section 3 outlines the methodology used in this scoping review while section 4 describes the results of the search strategy. Section 5 presents the findings of this scoping review, detailed under a number of headings including the use of acuity tools to inform staffing, staff ratios in SACT delivery settings, scheduling and nurse staffing, skill mix, nursing roles, and nursing activities. Finally, Section 6 presents a discussion of the review findings.

2. Aims & Objectives

2.1. Study Aim

The aim of this scoping review was to systematically search the literature and describe the role of the nurse, the appropriate skill mix, and to identify models or tools used to determine appropriate nurse staffing within Ambulatory Haematology/Oncology Day Units (AHODU) where Systemic Anti-Cancer Therapy (SACT) is delivered.

2.2. Review Objectives

- To identify how patient acuity (including patient dependency and complexity of SACT) is measured in AHODUs
- To identify existing approaches for determining appropriate staffing AHODUs settings (e.g., acuity tools, scheduling systems, nurse-patient ratios, skill mix).
- To specify the role and activities of the nurse in AHODUs.

3. Methodology

This scoping review was conducted in accordance with the JBI methodology for scoping reviews (Peters et al., 2020) and the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) extension for Scoping Reviews (Tricco et al., 2018). The research team comprised academic researchers, a subject librarian specialist, and nursing professionals working in an ambulatory oncology day service where SACT is delivered and was supported by the NCCP Nursing team. This is in line with best practice as it is recommended that key stakeholders are included in the development of scoping reviews (Pollock et al., 2021).

3.1. Search Strategy

The search strategy was designed to identify published literature and grey literature relevant to the review aim and research questions. Two separate searches were conducted to capture the breadth of literature required for this review. One search focused on the concept of patient acuity, scheduling, and staffing systems, (henceforth referred to as the 'Acuity/ Scheduling search') while the other search focused on the role of the nurse in day ward settings where SACT is delivered (referred to as the 'Role of the Nurse search'). Both search strategies were developed by the research team and validated by a health sciences research librarian using the Peer Review of Electronic Search Strategies (PRESS) checklist (McGowan et al., 2016).

3.1.1. Search String Development

To develop the search string, an initial limited scoping search of MEDLINE (EBSCO), EMBASE (Elsevier), PsycINFO (EBSCO) and CINAHL (EBSCO) was undertaken to identify the relevant index terms for each of the databases. The full index term records were screened for additional keywords. In addition, a collaborative meeting was held with the Librarian and the research team to seek any additional relevant keywords for the strategy. The full search string for both the Acuity/Scheduling search and the Role of the Nurse search as applied to the MEDLINE database are presented in Appendix A. This was adapted for application to each of the other databases to ensure consistency.

3.1.1.1. Acuity/ Scheduling Search

The Acuity/ Scheduling search comprised two main concepts. The first concept looked at acuity, skill mix and staffing efficiencies. The second concept required the use of a proximity operator to increase the focus of keywords and the results. This specifically looked at the setting, specifying day oncology, outpatient, and ambulatory care. Each concept was searched independently using the OR operator for index and keyword searches, and then each concept search was combined using the AND operator to return the final article numbers.

3.1.1.2. Role of the Nurse search

The Role of the Nurse search also combined two main concepts. The first concept focused on the oncology/haematology nurse's role. A sub search was run looking at the health care worker to ensure that any nursing roles referred to under that title would be captured also. The second concept focused on day oncology/ haematology services. Keywords focused on ambulatory care, day oncology, outreach and outpatient environments. The keywords were limited to title and abstract. Each concept was comprised of an index search and a keyword search with the third strand combining them with the OR operator. Each complete concept search was then combined with the AND operator.

3.1.2. Literature Sources

The systematic search strategies were applied to seven electronic databases EMBASE (Elsevier), MEDLINE (EBSCO), CINAHL (EBSCO), ASSIA (ProQuest), Web of Science – Core Collection (Clarivate), Cochrane Library and Global Index Medicus (WHO). This combination of databases was chosen to comprehensively capture the available literature relevant to the research topic and the nursing discipline (Bramer et al., 2017). To identify grey literature sources and unpublished studies a simplified search methodology was applied to ProQuest Dissertations and Theses, LENUS, RIAN OpenAIRE, Scopus, Google Scholar. OpenGrey, Oalster, TRIP, BASE and GRAFT (jurn.org). Search Engines duckduckgo and Google were also searched with simple keywords to look for white papers and government documents. Furthermore, a search of nursing and government websites was conducted and scanned by hand (see Appendix B for a list of resources).

For a number of records identified, follow-up with relevant authors and cancer centres was required to obtain further information (e.g., to request information on a specific acuity tool referred to in their publication, or to clarify applicability of the clinical context). A call out was also posted on the UK Oncology Nursing Society (UKONS) website requesting information on staffing configuration in ambulatory oncology/ haematology day units where SACT is delivered.

3.1.2.1. Limits Applied

All searches were conducted in November 2021 and no date restrictions were imposed. All language records were included for the initial article screening. Google translate was used to assess the title and abstracts of non-English records to determine relevance and if required, a full translation was obtained. This scoping review did not exclude based on study design and considered quantitative, qualitative, and mixed methods study designs for inclusion. In addition, review papers, text and opinion papers, and national/international reports were also considered for inclusion.

3.2. Literature Screening and Selection

All identified records were collated and imported into Endnote 20 (Clarivate Analytics, PA, USA) where duplicates were removed. Covidence systematic review software was then used to screen records and determine eligibility for inclusion in the review. The title and abstract for each record were screened for relevance by two independent reviewers who were part of the research team. Records deemed eligible for full-text review were again screened by two independent reviewers to determine inclusion or exclusion. Two reviewers met to resolve any conflicts that arose in determining eligibility for inclusion.

3.2.1. Eligibility Criteria

3.2.1.1. Participants

This review includes studies that report on nursing configuration within medical oncology and haematology day unit settings where SACT is delivered. Studies with participants who are oncology or haematology nurses of different grades such as staff nurses, CNS, Co-Ordinators, ANP, Clinical Nurse mangers, Cancer Clinical Trial/Research Nurses and HCAs who work in or provide services to patients in this setting were included. Studies of oncology nurses who provide home nursing or who work in inpatient hospital settings were not included. This review focused on adult services and therefore did not include studies reporting on paediatric services.

3.2.1.2. Concepts

The key concepts are patient acuity, how to measure nursing workload in AHODU settings, models to determine appropriate staffing configuration, the role of the nurse, skill mix, and quality of nursing care. Articles on how care is scheduled were included as scheduling impacts upon the workload of nurses at peak times within AHODU.

3.2.1.3. Context

The context is SACT and supportive care delivered in AHODU. This included scheduled and unscheduled care. Supportive care includes management of central venous access devices, blood transfusions, intravenous support, and venesections. Haemopoietic, Stem Cell, and Transplant Services (HSCT) which are also delivered in AHODU. It also included any investigations that are conducted within AHODU. Notably, this review focused on haematology oncology day nursing and not radiation oncology nursing which are recognised as distinct contexts (Blay et al., 2002). Studies conducted in other settings including the inpatient context or paediatric services were not included. Studies specific to ambulatory oncology outpatient settings that make no reference to the delivery of SACT were excluded. Studies referring to outreach or community settings were included only if they referred to the impact of these services on the role or workload of the nurse in the AHODU setting (e.g., arranging or liaising with such services).

3.3. Data Extraction

Data extraction was conducted with Covidence systematic review software using customised extraction templates. Given the variability of the literature included between the two separate searches, two data extraction templates were developed; one for the articles obtained through the Acuity/ Scheduling search, and one specific to the articles obtained through the Role of the Nurse search. The data extraction templates were initially piloted by two reviewers with five studies to assess feasibility for the review, and this was followed by a collaborative process of template refinement. The final extraction templates are presented in Table 1 and Table 2. Please refer to Appendix C for a detailed description of the extraction templates and the accompanying guide. Data extraction for 20% of the articles was cross-checked by a second independent reviewer to ensure consensus on the data extraction process and the remainder were extracted by one reviewer.

Table 1. Summary of the Data Extraction Template for Acuity/Scheduling Search

Data Extraction Template for Sources Acquired in Acuity/ Scheduling Search	
Author(s)	
Year of publication	
Country of origin	
Aim/ purpose	
Focus of paper	
Population and setting where source conducted	
Methodology employed	
Outcomes assessed	
Name of system or tool used to determine workload and inform staffing configuration	
Description of system related to acuity	
Definition of acuity	
Description of system related to scheduling	
Staff to patient ratio recommendations or reported	
Recommendations for scheduling	
Recommendations for skill mix	
Description or recommendations for role of the nurse	
Findings for impact on quality of care or patient or staff outcomes	
Other key outcomes or findings	
Validity or reliability properties	

3.4. Data Analysis & Presentation

Included studies were described in a narrative summary relative to the review questions. Given the heterogeneity of the literature, included studies were grouped into common themes relevant to the review aim. Tables presenting the charted data and figures were developed to illustrate the key findings resulting from the extracted data. In line with the objectives of a scoping review, a quality appraisal of the included studies was not conducted as the aim was to descriptively map the available literature in relation to the review aim (Peters et al., 2022).

Table 2. Summary of the Data Extraction Template for Role of the Nurse Search

Data Extraction Template for Sources Acquired in Role of the Nurse Search	
Author(s)	
Year of publication	
Country of origin	
Aim/ purpose of the source	
Type of nurse or support staff	
Population and setting where source conducted	
Methodology employed	
Findings for education or (core) competencies	
Findings for functional roles of the nurse	
Allocation of roles (i.e., roles that could be conducted by staff other than nursing)	
Details for skills mix/ configuration	
Staff to patient ratio recommendations or reported	
Findings for impact of type of nursing staff (staff mix/configuration) on outcomes (quality of care, staff, or patient outcomes)	
Enablers and barriers to development of nursing role within SACT day settings	
Other key findings	

4. Search Strategy Results

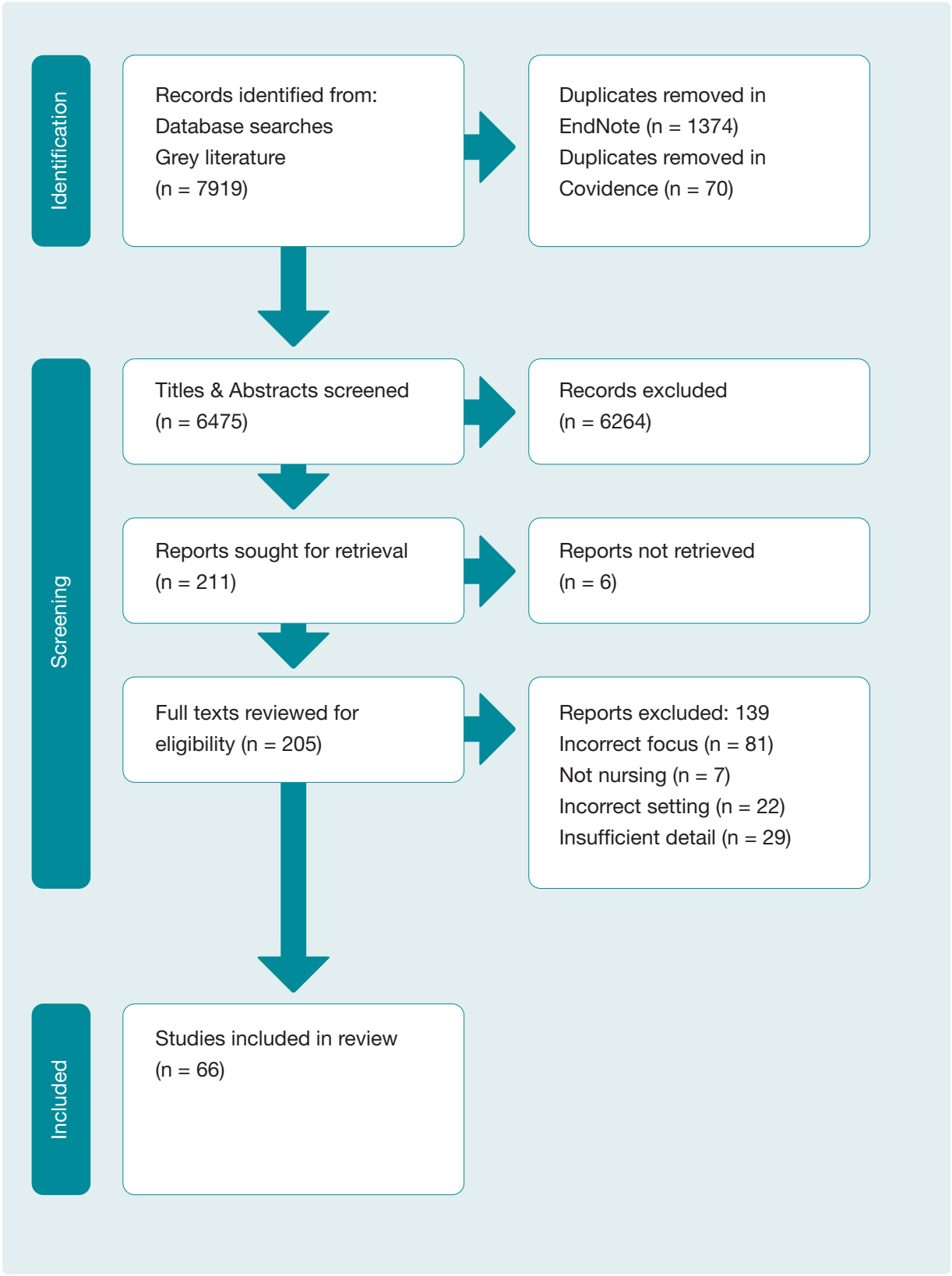
A total of 116 studies were deemed eligible for inclusion in this scoping review. Of these, 66 were obtained through the Acuity/ Scheduling search and 50 were obtained through the Role of the Nurse search. The following section outlines the results of the two search strategies and provides detail on the study selection process for each.

4.1. Acuity/ Scheduling Search

The Acuity/ Scheduling search identified a total of 6,475 unique records following removal of 1,444 duplicates in EndNote and Covidence. Two independent reviewers screened the title and abstracts, and following exclusion of 6,264 records, 211 records were selected for full text review. A full translation was required for one article only (Di Giulio, 1988). For records that were not open access or available in the College Library, an inter-library loan was sought. A small number of articles remained unattainable following interlibrary loan orders and requests sent to authors (n = 6).

Full text examination was conducted for 205 records by two independent reviewers to determine eligibility and 139 records were excluded. Records excluded for the reason of "incorrect focus" (n = 81) did not investigate or provide detail on aspects of nursing workload, patient acuity or scheduling. Those excluded for the reason of "not nursing" (n = 7) made no reference to nursing staff or focused on medical or pharmacy, or patient navigators which were considered outside the scope of this review (e.g., Johnston et al. (2019)). Records excluded due to "incorrect setting" (n = 22) either were not specific to oncology or related to paediatric services, inpatient services, or general ambulatory or outpatient care where SACT was not delivered (e.g., Dickson et al. (2010)). Finally, 29 records were excluded for the reason of "insufficient detail." These records were mainly conference abstracts or brief opinion pieces that did not include sufficient information for extraction. In the case of conference abstracts where author contact details were available, two attempts were made to request further information and those that did not receive replies were subsequently excluded for reason of insufficient detail. Following full-text examination, a total of 66 records were deemed eligible for inclusion in the scoping review. The study screening and full text review process is illustrated in a PRISMA-ScR flow chart in Figure 1.

Figure 1. Study Selection Process for the Acuity/Scheduling Search



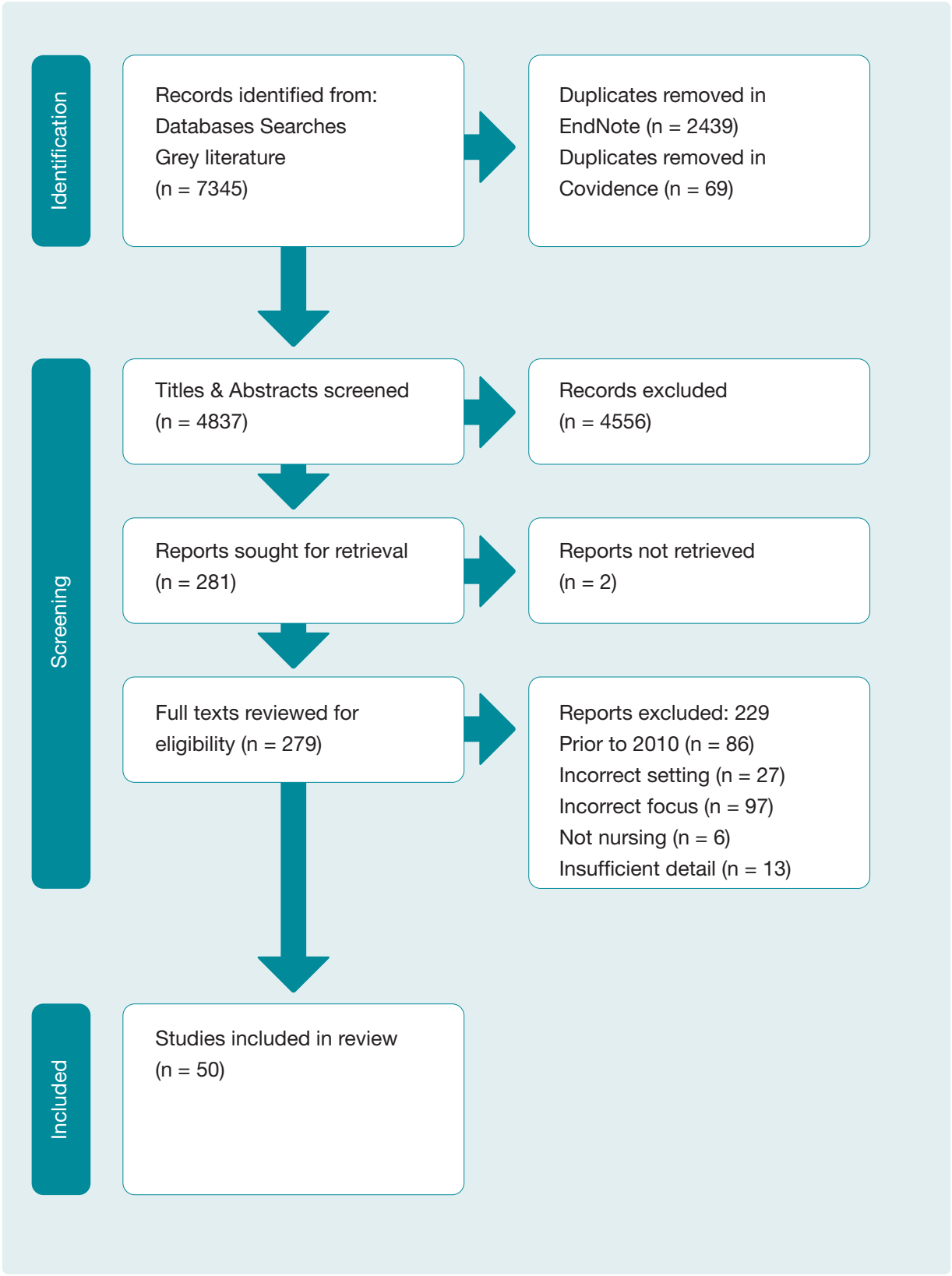
4.2. Role of the Nurse Search

After removal of 2,508 duplicates, the Role of the Nurse search identified 4,837 unique records. 4,837 title and abstracts were reviewed by two independent reviewers and 4,556 were deemed ineligible via screening. Of 281 records chosen for full text review, two could not be obtained through inter-library loan. Therefore, 279 full-text records were assessed by two independent reviewers. Reasons for exclusion at the full text review stage included "incorrect setting" (n = 27) whereby studies related to inpatients, paediatrics, settings where SACT was not delivered, or community/ homecare settings with no reference to the day ward (e.g., Breteau et al. (2016)). 97 records were excluded due to "incorrect focus" as they did not relate to any aspect of the role of the nurse. Those deemed as "not nursing" (n = 6) related specifically to the role of patient navigator, which as previously described was outside of the scope of this review. Reports were also excluded due to "insufficient detail" (n = 13) represented short records with insufficient information for extraction or conference abstracts which did not receive responses when relevant authors were contacted for further information.

4.2.1. Post-hoc Limit

Upon beginning full-text review of the Role of the Nurse search output, it was evident that many records were dated and not reflective of current nursing practice. Following consultation with the steering committee, it was decided to impose an additional exclusion criterion at the full-text review stage and exclude any 'Role of the Nurse' records published prior to the year 2010. This resulted in exclusion of 86 records dated prior to 2010 and ensured that the review more accurately reflected current nursing practice and healthcare services. A total of 50 records were included in the final review. The result of the study screening process is shown in a PRISMA-ScR flow chart in Figure 2.

Figure 2. Study Selection Process for the Role of the Nurse Search



4.3. Overall Characteristics of Included Studies

The publication dates of the included records ranged from 1988 to 2022. The majority of included records were articles published in academic research journals (n = 80) while the remainder of sources included conference abstracts, proceedings or presentations (n = 15), nursing standards (n = 5), theses (n = 3), clinical tools (n = 6), project reports (n = 2), online articles (n = 2), policy documents (n = 2), and a book chapter (n = 1). A diverse range of methodologies were represented, including service improvement initiatives, workload analysis, descriptions of tool development, literature reviews, commentary/discussion pieces, qualitative research, operations research including simulation modelling, and surveys. An overview of the individual study methodologies is provided in tables in Section 7.

The following section will detail the review findings under a number of categories which were identified within the literature, including: Use of acuity tools to inform staffing, staff ratios in SACT delivery settings, scheduling and nurse staffing, skill mix, nursing roles, and nursing activities. Section 7 includes tables outlining the studies that were selected for inclusion in the scoping review as well as the results categories that they contributed to.

5. Review Findings

While the 116 records included in this scoping review are all related to nursing within the SACT delivery AHODU setting, the literature demonstrated heterogeneity with respect to study focus and design. For the following descriptive summary, records were clustered into groups which represented key themes or topics identified by the research team.

5.1. Use of Acuity Tools to Inform Staffing

The general approach of nurse staffing according to patient acuity is longstanding practice in the healthcare setting since the 1960s (Brennan & Daly, 2009; Rodriguez et al., 2020). Patient acuity is defined as a "measure of the severity of illness of the patient and the intensity of nursing care that patient requires" (p.1119) (Brennan & Daly, 2009). Across the studies identified in this review, patient acuity in settings where systemic anti-cancer therapy (SACT) is delivered is characterised using various approaches, with some studies determining acuity based on the degree of patient illness and complexity of nursing care required (Cusack et al., 2004) or the length of treatment time and the type of medication being administered (Edwards et al., 2017). Acuity can also be characterised by the patient's level of stability, complexity, and predictability (Cordon et al., 2021). For the purpose of this scoping review, an "Acuity Tool" refers to a system that has been developed to classify or categorise oncology/ haematology patients in AHODU where SACT is delivered, according to their nursing care needs, dependency, or treatment.

The use of an acuity tool can provide an accurate and realistic reflection of the nursing time needed to provide safe and quality care (Fesler & Toms, 2020).

5.1.1. Characteristics of Included Studies

In this scoping review, a total of thirteen studies describing acuity tools relevant to SACT delivery in AHODU were identified: Many of these were research studies outlining how the acuity tools were developed (Delaney et al. 2002; Cusack et al. 2004; Green et al. 2012; Moore and Hastings 2006; Vortherms et al. 2015), other articles focused on the evaluation of acuity tools (Chabot and Fox 2005; DeLisle 2009); or implementation of acuity tools (Edwards et al. 2017; Hawley and Carter 2009; Tuna et al. (2015). Three acuity tools were obtained from authors of abstracts (Huntsman Cancer Institute 2018; Knox 2022; Noel 2019). The tools are dated between 2002 and 2019 and have been developed in the USA (n = 9), Canada (n = 2), Australia (n = 1) and Turkey (n = 1).

The Framework on Safe Staffing outlined factors that should be considered to support decision making around the use of specific acuity tools (Department of Health, 2018).. These include the process of tool development (e.g., by who, in what setting) and whether it is appropriate for the setting in which it is intended for use. Further considerations include the relevance and currency of the tool, the resource implications in using the tool (e.g., complexity of use, investment required) and evidence endorsing the validity and reliability of the tool (i.e., has the tool been tested for evidence of reliability or validity in the applicable setting). An example of various acuity levels and the activities or treatments corresponding to each level is presented in Table 3.

Table 3. Examples of activities and treatments included in various patient acuity levels (Cusack et al. 2004); Moore & Hastings (2006).

Acuity Level	Examples
Level 1	• Timings were approximately 0 to 30 minutes • Relatively low complexity care (e.g., CVAD management, phlebotomy) • Short coordination of care activities
Levels 2 - 3	• Treatment regimens of 1 to 2 hours duration • Hydration • Patient education/ new patient visit
Levels 4 - 6	• Treatment regimens of 3 to 5 hours duration • Complex SACT regimens (including 3 – 4 drugs) • Fever neutropenia workup • Complex interventions (e.g., intraperitoneal chemotherapy) • Blood transfusions

5.1.2. Overview of Existing Acuity Tools

While the approach of staffing by acuity has existed for many years, the Magnuson model published in 2004 was an influential introduction to developing a system of patient acuity that captures some of the complexities evident within the AHODU setting where SACT is delivered (Cusack et al., 2004). A summary of the key characteristics of the acuity tools identified in this review is presented in Table 4. The Magnuson model classifies patient acuity into 6 levels as determined by the time taken for direct and indirect nursing care activities. Since then, a number of acuity tools have been developed by different authors with a similar approach but to suit the needs of their own ambulatory oncology infusion settings. For example, DeLisle (2009), Moore and Hastings (2006), and Hawley and Carter (2009) each developed a patient acuity tool with a similar format to Cusack et al. (2004) based on the duration of the treatment and the complexity of the medication being administered to SACT patients, with consideration for supportive nursing activities. Across the tools, acuity levels have assigned timings which are typically the nursing time, chair time, or infusion time. While nursing time refers to the time that the nurse is directly involved in patient care activities the infusion or chair time refers to the time that a patient is under the care of a nurse but does not require direct intervention. For example, a patient may require 30 minutes of nursing time but a chair time of 3 hours (Langhorn & Morrison, 2001a, 2001b). In clinical practice, the assigned acuity levels can be used to inform patient scheduling and balanced nurse assignments during shifts.

While most tools use a similar system of defining acuity levels (e.g., 1-4, 1-6), a smaller number of tools use a points-based system (BC Cancer, 2018; Green et al., 2012; Vortherms et al., 2015). The BC Cancer tool (2018) was closely based on the original tool published by Green et al., (2012) for Cancer Care Ontario in Canada. Rather than basing the acuity tool on specific drug regimens, the tool includes specific “workload items” such as prep time, patient education, assessment, documentation, regimen nursing time, and infection control practices. Each workload item corresponds to a specific length of time required for nursing care. For each patient, the workload items required for the patient are entered into a formula which calculates the total nursing time required for the patient.

Table 4. Summary Characteristics of the Acuity Tools

Reference	Purpose of tool	Format	Setting where tool designed	Process of development	Developers of tool	Validity/ reliability testing
Delaney et al. 2002 AUS	Provide chemo treatment time in CBTE (relative complexity rankings)	CBTE values in multiples of 30 mins assigned to each chemo regimen	Liverpool Hospital Cancer Therapy Centre; haematology/ oncology	Time in motion study	Independent project officer	None reported
Cusack et al. 2004 USA	Classify patients by severity of illness & complexity of service, calculate nurse FTE required	Each patient is assigned an acuity level (1 – 6)	Magnuson Clinical Centre Outpatient haematology/ oncology	Literature review and benchmarking, nursing staff input	Nurse manager, CNS, & two senior nurses on the unit	Face validity, interrater reliability assessed throughout pilot
Chabot & Fox, 2005 USA	Estimate nursing time based on chemo complexity, balances total acuity per nurse in daily schedule	Each patient is assigned an acuity level (1 – 3)	Tower Haematology Oncology Medical Group outpatient infusion centre	Nursing staff input	Nurse manager and nursing team	Face validity
Moore & Hastings, 2006 USA	Categorise patients by amount of nursing care required, calculates nurse FTE required	Each patient is assigned an acuity level (1 – 6)	NIH Clinical Centre, haematology/oncology day hospital	Adapted from Cusack et al. 2004	Nurse managers, clinical nurse specialists, senior clinical research nurses	Face validity and interrater reliability
DeLisle, 2009 USA	Estimates nursing time based on complexity of chemo, balances total acuity per nurse	Each patient is assigned an acuity level (1 – 5)	Private oncology practice infusion rooms	Literature review, nurse input	Administrative director of operations, nurse practitioner, infusion room nurse	Face validity
Hawley & Carter, 2009 USA	Determines patient acuity level based on time of treatment, builds patient acuity into scheduling template	Each patient is assigned an acuity level (1 – 5)	Cleveland Clinic Canter Centre infusion rooms	Lit. review, time in motion study, informed by Cusack et al. 2004, Moore & Hastings 2006	Registered nurses, secretaries, and medical assistants	Not reported
Green et al., 2012 CAN	Determines nursing care requirements for chemotherapy regimens, informs workforce planning	Workload elements for each patient are added to a formula to calculate nurse intensity time	Cancer Care Ontario, ambulatory oncology	Consensus approach to define nursing activities and timings	Health economist, pharmacists, nursing leaders, oncology nurses, managers experienced in SACT	Not reported

Table 4. Summary Characteristics of the Acuity Tools (continued)

Reference	Purpose of tool	Format	Setting where tool designed	Process of development	Developers of tool	Validity/ reliability testing
Tuna et al., 2015 TUR	Classify patients by severity of illness & complexity of service, calculate nurse FTE required	Each treatment is assigned an acuity level (1 – 6)	Cerrahpasa Faculty of Medicine, outpatient chemotherapy unit.	Adapted Cusack et al. (2004), time in motion study	Chemotherapy nurses	Interrater reliability
Vortherms et al., 2015 USA	Equally distribute workload, assign maximum acuity points per nurse per shift	Each patient is assigned an acuity by adding points (maximum 5 points per patient)	Coborn Cancer Centre chemo infusion department	Literature review, nursing staff input	Nurses, physicians, schedulers, patients, and the cancer centre executive director	Validated with pilot (face validity)
Edwards et al., 2017 USA	Assign patient acuity levels by length and type of treatment, equally distribute workload	Each treatment is assigned an acuity level (1 – 6)	Regional MD Anderson Cancer Centre infusion room	Informed by Vortherms et al. (2015)	Nurses, administrators, and pharmacists	Not reported
Huntsman Cancer Institute, 2018 USA	Equally distribute nursing assignments	Each treatment is assigned an acuity level (2 – 6)	Huntsman Cancer Institute infusion rooms	Literature review, nursing staff input	Nurse manager, clinical nurse coordinator, infusion room staff	Not yet
Knox (BC Cancer), 2022 CAN	Determines nursing care requirements for chemotherapy regimens, informs workforce planning	Workload elements for each patient are added to a formula to calculate nurse intensity time	British Columbia Cancer Centre SACT Unit	Adapted from Green et al., (2012)	See Green et al., (2012)	Face validity
Noel, 2019 USA	Equally distribute workload based on patient acuity levels	Each patient is assigned an acuity level (1 – 5)	Baylor Scott & White McClinton Cancer Centre infusion room	Replicated acuity tool from outpatient oncology setting	Infusion room nurses	Not reported

Abbreviations. Chemo: Chemotherapy; CBTE: Chemotherapy Basic Treatment Equivalent. FTE: Full Time Equivalent; CNS: Clinical Nurse Specialist; OCC: Outpatient Cancer Centre; NIH: National Institutes of Health; SACT: Systemic Anti-Cancer Therapy. Note. For "Developers of Tool" this data was extracted from articles as the individuals involved in the project, specific details on who contributed to specific elements of the tool is not available. a Face validity and content validity are used to judge whether an instrument appears to assess what it claims to, providing an indication of the appropriateness and relevance on the surface level (Streiner et al., 2015) e.g., nursing experts review acuity levels and associated descriptors.

A stakeholder consultation was held in April 2022 to review the acuity tools with the purpose of identifying key features of the tools, characteristics that were considered useful, as well as overall advantages or disadvantages of the tools. Participants involved in the consultation were a subgroup of the overall research team and included clinical staff from the collaborating hospital (the Assistant Director of Nursing for Haematology/ Oncology, the Haematology/ Oncology Nurse Manager, and the Hospital Lead Cancer Nurse) as well as the Principal Investigator, a Professor of Nursing, and the Research Fellow.

5.1.3. Content of Acuity Tools

Table 5 provides a comprehensive summary of the various elements that are included across the thirteen acuity tools identified in this scoping review. The subsequent Table 6 includes operational definitions defining each of the elements within the acuity tools. Common nursing activities across the tools included patient assessment, phlebotomy, blood products, IV fluids, central venous access device management, and cannulation. de Raad et al. (2010) highlight the need for cannulation to be included in an acuity tool as the time taken for cannulation may vary for some patients due to difficulties sourcing suitable veins.

Many oncology and haematology patients require blood transfusions and some of these patients receive these in AHODUs. Nine of the acuity tools contained blood transfusions. Many patients require intravenous fluids as well as administration of pre-medications as part of their SACT regime and this requires additional nursing time (Wilkes & Barton-Burke 2019). Seven acuity tools incorporated intravenous fluids and five included pre-medications. Assessment of toxicity due to SACT is a key role of the nurse in AOHDU and only three acuity tools contained this and a further four acuity tools refer to monitoring for side-effects and reactions. Many SACT patients are at high risk of infection due to neutropenia (Wilkes & Barton-Burke 2019) and four acuity tools referred to febrile neutropenia workup while only three SACT tools included infection control. Seven acuity tools included patient education and only three contained psychosocial support.

5.1.4. Implementing Patient Acuity Tools

The patient acuity systems developed by Moore & Hastings (2006) and Knox (2022) (based on Green et al. (2012)) were identified by the clinical team as having the most potential in terms of their comprehensiveness, relevance to practice, and usability. It is important to note however that the tools identified in this review have been developed by researchers and clinical staff to be used in their specific settings. Furthermore, the limited level of reliability or validity testing reported for the identified tools is notable. As is displayed in Table 4, six report no reliability or validity testing, three report conducting inter-rater reliability testing, while six confirmed face validity in their clinical setting. As such, the literature concerning the use of acuity tools in AHODU settings is mostly reflective of individual service improvement initiatives and expert opinions that are not necessarily transferable to comparable settings (Fesler & Toms, 2020). Therefore, it is expected that such tools may require adaptation or need to undergo a process of validation in order to transfer to other clinical practice settings. Importantly, it is advised that development of acuity tools takes considerable time, effort, and continual monitoring (West & Sherer, 2009). West & Sherer also highlight the importance of involving AHODU staff in the design of such acuity tools to foster commitment to service improvement.

Table 5. Overview of Elements Included in the Acuity Tools

	Delaney et al. 2002	Cusack et al. 2004	Chabot & Fox, 2005	Moore & Hastings, 2006	DeLisle, 2009	Hawley & Carter, 2009	Green et al., 2012	Tuna et al., 2015	Vortherms et al., 2015	Edwards et al., 2017	Huntsman Cancer Institute, 2018	Noel, 2019	Knox (BC Cancer), 2022
Chair time	No	No	Yes	No	No	Yes	No	No	No	No	No	Yes	No
Nursing time	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	Yes
Drug infusion time	Yes	No	Yes	No	Yes	Yes	No	No	No	Yes	Yes[a]	Yes	No
Infection control	No	No	No	No	No	No	Yes	No	Yes	No	No	No	Yes
Additional patient needs	No	No	No	No	No	Yes	No	No	Yes	No	No	Yes	No
Cannulation	No	Yes	No	Yes	Yes	?	Yes	Yes*	Yes	No	No	?	Yes
Central venous access device management	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Coordination of care	No	Yes	No	Yes	Yes	No	Yes	Yes*	No	No	No	No	Yes
Documentation	No	No	No	?	No	No	Yes	No	Yes*	No	No	No	Yes
Fever neutropenia work up	No	Yes	No	Yes	No	Yes	?	No	No	No	No	Yes	?
Haematology (blood products)	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Intrathecal or intraperitoneal chemo	No	Yes	No	?	Yes	No	Yes	?	Yes	No	No	No	Yes
IV fluids	No	Yes	No	Yes	Yes	No	Yes	No	No	Yes	Yes	?	Yes
New patient	No	No	Yes	?	?	No	Yes	No	Yes	No	No	No	Yes
Patient assessment	No	Yes	?	Yes	Yes	?	Yes	No	Yes	No	Yes	No	Yes
Patient education	No	Yes	?	Yes	Yes	Yes	Yes	Yes*	No	No	No	Yes	Yes
Phlebotomy	No	Yes	No	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Pre-meds	No	?	No	Yes	Yes*	Yes*	Yes	No	No	?	No	?	Yes
Psychosocial support	No	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
Side effects/ reactions	No	No	Yes	Yes	?	No	Yes	Yes	No	No	Yes	Yes	Yes
Telephone triage	No	Yes	No	?	No	No	No	No	No	No	No	No	No
Toxicity assessment	No	No	No	Yes	No	No	Yes	No	No	No	No	No	Yes

Note. “Yes” indicates the element is explicitly included or accounted for in the acuity tool. “Yes*” indicates element is accounted for in the instructions accompanying the tool. “?” indicates element is unclear in the tool. aPresented as full appointment length.

Table 6. Operational Definitions for Table 5

Nursing time	The nursing time indicates an approximation of time required for nursing interventions or activities (direct and indirect to patient care).
Chair time	The chair time indicates the period that the patient may still be under the care of a nurse (i.e., requiring monitoring) but does not necessarily require nursing interventions (see Chabot & Fox, 2005).
Drug infusion time	The length of chemotherapy infusion for specific drug regimens is provided as the drug infusion time.
Phlebotomy	Time required for taking blood samples.
Central venous access device management	Time required for insertion, removal, or dressing change for peripherally inserted central catheter (PICC) line.
Cannulation	Time required for peripheral line cannulation, a.k.a. intravenous catheter placement, IV placement.
Haematology (blood products)	Allocation of time for packed red blood cells and platelets, blood transfusion.
Patient assessment	Assessment of patient vitals, admission assessment, emergency workup, screening, health assessments etc.
Toxicity assessment	Time for completing a standard toxicity assessment per patient (e.g., common terminology criteria for adverse events).
Patient education	Allowing time for patient and/or family teaching about treatment and related side effects.
Psychosocial support	Provision of support to patient and/or family member is acknowledged.
Telephone triage	Time allocation for conduct of telephone triage (e.g., patient assessment over phone including symptoms, level of risk risk).
New patient	Allowing for additional time required for a new patient (i.e., first appointment) including activities such as checking for consent, education time, patient, and family support.
Risk of side effects	More time is allowed for higher risk of side effects. A patient may be allocated more time or a higher acuity level on the basis of the drug regimen and history of allergic reactions.
Fever neutropenia work up	IV fluids, antibiotics, extra tests, query sepsis (additional patient review and nursing care required in relation to fever neutropenia).
IV fluids	Hydration
Pre-meds	Specific time allocated for administration of pre-medications.
Coordination of care	Time for activities such as management of prescriptions, reviewing laboratory tests, coordinating care with other departments, and ordering supplies for patients (see Moore & Hastings, 2006).
Infection control	Additional infection control required, including patients requiring isolation, patients with MRSA, C. diff., COVID-19, or requirement for personal protective equipment.
Documentation	Time to complete patient documentation including status, details of treatment, response to treatment (Green et al., 2012).
Additional patient needs	Accounting for patient needs that may require additional time such as frailty, mobility, and cognitive issues, or the requirement for an interpreter (Vortherms et al., 2015).
Intrathecal or intraperitoneal chemo	Allowing extra time for different requirements for intrathecal or intraperitoneal chemotherapy (e.g., lumbar puncture, specific setting).

Note. Definitions are informed by the descriptions provided in the acuity tool publications and by clinical experience of the research team.

5.1.5. Additional Staffing Tools

This scoping review identified three further tools used to assess nursing workload and determine appropriate nurse staffing. These include the Sussex Cancer Network Tool (Sussex Cancer Network, 2006), a Systemic Anti-Cancer Treatment (SACT) Modelling Tool developed in Scotland (Southeast Scotland Cancer Network, 2021) and an Audit Tool with Staffing Escalation Guidance developed in Oxford (Oxford University Hospitals NHS Foundation Trust, 2021).

5.1.5.1. Longer Term Audit Tools

The Sussex Cancer Network tool (2006) and Scottish SACT Modelling tool (2021) are not categorised as patient acuity tools but as audit tools. These audit tools record the number of patients on the different SACT regimes as well as the number of patients requiring blood transfusions, cannulations infusions etc.

The Sussex Cancer Network (2006) tool, is formatted as a modifiable excel spreadsheet. One Irish audit located in this scoping review reported on using the tool to evaluate their AHODU service (Gill & Dillon, 2010). This study involved a retrospective audit of patient time required for chemotherapy treatment. Specifically, the tool was used to assess the risk of demand saturating and exceeding capacity. The Sussex Cancer Network tool incorporates safe working limit factors, patient volumes, and chair/nurse capacity to display levels of efficiency. Authors described the ability to use the tool to calculate the number of nurse hours required for differing volumes of patients which was useful for staff planning (Gill & Dillon, 2010).

The SACT modelling tool developed in Scotland is not yet publicly available but provides a sophisticated tool combining nursing and pharmacy time to measure resource capacity in SACT day units and plan future workforce requirements (Southeast Scotland Cancer Network, 2021). Similar to the Sussex Cancer Network Tool (2006), the SACT Modelling tool is built using an Excel spreadsheet to allow analysis and manipulation of the data in order to model different clinical scenarios. The tool incorporates SACT regimen timings based on regional time and motion studies. Functionally, it can demonstrate the resources required to deliver individual regimens and treatments and give overviews of specific unit capacity (suggested that units should operate at 85% capacity). Notable elements of the tool include nursing staff “capacity modifiers” which are duties conducted by nurses that can impact workload and therefore reduce unit capacity. Examples include daily safety briefings for all nurses (30 minutes) and staff in training or staff mentors. The tool recognises that some staff may not be fully trained in the administration of SACT and a deduction of 0.4 whole time equivalent (WTE) is made. Meanwhile, for staff undertaking a mentoring role, a 0.2 WTE is made to cover the responsibility of supervising a trainee. Capacity modifiers are likely to be unique to specific units and can include duties such as telephone triage responsibilities (Southeast Scotland Cancer Network, 2021).

5.1.5.2. Shorter Term Audit Tool

The audit tool and staffing escalation guidance developed within the Oxford University Hospitals NHS Foundation Trust (2021) represents an audit tool more suitable for day-to-day use, and that is separate to the patient acuity tools described in the previous section. The tool is simple to complete, and involves recording the predicted overall acuity numbers for a day (patients are categorised as high, moderate, low complexity), the number of patients in the department at various times and their waiting times, the number of staff on duty and their grade, overtime completed, the actual acuity numbers for the day, cancellations or additions to the schedule, and a professional judgement of the day. The staffing escalation guidance includes a three-tier system (green, amber, and red) that corresponds to increasing level of staffing concerns and how to respond to them. Sample actions include use of agency nurses, cancellation of study leave and non-essential meetings, and increased staffing

reviews. The guidance is intended to support decision making on staffing day-to-day and assist with articulating staffing concerns when escalating to senior staff.

5.1.6. Summary of Acuity Tools

Summary Points Acuity Tools
• Acuity tools have been developed based on complexity of treatment and nursing care required.
• Acuity tools can be used to provide an accurate and realistic reflection of nursing time required to provide safe and quality care.
• 13 acuity tools relevant to SACT delivery in AHODU were identified.
• Most tools use a similar system of defining acuity levels for example, Levels 1-4, 1-6; whilst a smaller number of tools use a points-based system.
• Within these tools, acuity levels have assigned timings commonly nursing time, chair time and infusion time.
• Implementing an acuity tool is likely to require adaptation along with staff involvement to promote commitment to service improvement.
• 3 further tools identified from the UK were not categorised as patient acuity tools but considered more suitable for audit of services and workforce planning.

5.2. Staffing Ratios in AHODU

The use of nursing staff ratios (e.g., nurse-to-patient ratios) to determine staffing requirements is a debated approach. While ratios provide a simplistic and transparent method to determine staffing levels, they are also inflexible and unsophisticated (Buchan, 2005). Implementation of mandatory ratios to maintain staffing levels at a predetermined level is a common approach. For example, Queensland, Australia has mandated nurse to patient ratios of 1:4 on morning and afternoon shifts, and 1:7 on night shifts on medical and surgical wards (Queensland Health, 2016). However, they have not specified a nurse-to-patient ratio for AHODU.

5.2.1. Characteristics of Included Studies

A total of 26 studies identified in this scoping review referred to the topic of a nurse-to-patient ratio within day ward settings where SACT is delivered. Of the 26 studies, 23 specified a ratio that is used or considered optimal in their SACT delivery settings, whether this was nurse-to patient ratio (Baril et al., 2020; Baril et al., 2016; Blay et al., 2002; Bouras et al., 2017; Bouras et al., 2021; Di Giulio, 1988; Heshmat et al., 2017, 2018; Huang et al., 2019; Huang et al., 2018; Lingaratnam et al., 2013; Nevidjon, 2018; Rodgers, 2016; Santibáñez et al., 2012; Santos & Gaidzinski, 2019; Vortherms et al., 2015; Woodall et al., 2013) or a nurse-to-chair ratio (Alvarado & Ntaimo, 2018; Bourbeau et al., 2020; Edwards et al., 2017; Gul, 2021; Hahn-Goldberg et al., 2014; Haswell, 2018; Noel, 2019). A summary of the clinical context and staff ratio details provided in these studies is presented in Table 7.

5.2.2. Considerations for Staff Ratios

Authors of a literature review (Brisley et al., 2003) and a narrative commentary (Gaits, 2005) have previously indicated that there was no evidence base to identify an appropriate nurse-to-patient ratio for ambulatory oncology settings and no evidence linking particular ratios to care quality outcomes (Gaits, 2005). The Oncology Nursing Society (2020) do not recommend a specific nurse to patient ratio in ambulatory care settings. Both Briseley et al. (2003) and the Oncology Nursing Society (2020) outline the following issues to be considered when implementing nursing staff ratios in chemotherapy settings:

- Patient-based needs: population mix, patient acuity, average patient turnover, need for translator, education needs
- Treatment-based: treatment regimen, premedications, observation period
- Ward architecture: number of chairs, beds, availability of single rooms, physical location (e.g., freestanding centre, attached to a hospital, located in a rural setting), operating hours, services provided, accreditation requirements
- Technology and support staff available to nurses
- Expertise of staff: education, qualifications, level of experience, presence of assistive staff, role delineation, scope of practice, other resources (e.g., volunteers, pharmacists,) (Brisley et al., 2003; Oncology Nursing Society 2020).

More recently, a position statement from the Oncology Nursing Society (ONS) advised that as many factors contribute to efficient nurse-patient ratios and ambulatory infusion and chemotherapy centres, they do not recommend specific ratios for practice (Nevidjon, 2018). Australian policy on chemotherapy recommends that staff-to-patient ratios should be reduced for specific groups such as older adults and patients requiring stem cell transplants (Cancer Therapy Medication Safety Working Group, 2018).

Table 7. Staffing Ratios Reported in SACT Delivery Settings

Reference	Reference Clinical Context	Staff Ratio Details
Nurse to Patient		
Di Giulio (1988) ITA	Oncology day hospital.	For an average 35 patients per day, 14 nursing staff required (including head nurse and 4 auxiliaries).
Blay et al. (2002) AUS	Outpatient haematology-oncology day unit.	For an average of 18 patients per day, average number registered nurses were 5.6 FTE including the nursing unit manager.
Santibáñez et al. (2012) CAN	British Columbia Cancer Agency ambulatory care chemotherapy unit.	Each nurse can deliver care to 1 patient at a time and oversee care of 4 patients simultaneously.
Woodall et al. (2013) USA	Duke Cancer Institute (simulation).	1 nurse to 4 patients, but a nurse can only set up 1 patient at a time while remainder are monitored.

Table 7. Staffing Ratios Reported in SACT Delivery Settings (Continued)

Reference	Reference Clinical Context	Staff Ratio Details
Nurse to Patient		
Lingaratnam et al. (2013) AUS	Chemotherapy day unit with 19 chairs.	Close to 1 nurse to 3 patients.
Vortherms et al. (2015) USA	Outpatient chemotherapy infusion department.	1 RN for every 6-8 patients receiving chemotherapy, 1 RN for every 9-11 patients receiving infusions, and 1 RN for every 12-15 patient receiving injections.
Baril et al. (2016) CAN	Haematology-oncology clinic with 16 chairs and 4 stretchers.	Each nurse usually responsible for maximum 4 patients at any one time.
Rodgers (2016) USA	Cleveland Clinic Taussig Cancer Institute.	Straight ratio of 1 RN for every 6 infusion/injection patients per day, with a maximum of 1 RN to 9 patients per day. At any one time, each RN will have 3-4 patients in chairs.
Bouras et al. (2017) TUN	Outpatient oncology clinic administering chemotherapy. 10 chairs and 5 nurses per day.	Nurse can monitor up to 4 patients at any one time and set up 1 patient at any one time.
Heshmat and Eltawil (2017); (2018) EGY	Generic chemotherapy scheduling (simulation).	In the simulation model, a cluster of 15 patients would be distributed among 5 nurses.
Heshmat and Eltawil (2017); (2018) EGY	Generic chemotherapy scheduling (simulation).	In the simulation model, a cluster of 15 patients would be distributed among 5 nurses.
Nevidjon (2018) USA	Position statement of the Oncology Nursing Society focused on ambulatory infusion and chemotherapy centres.	Most common ratio is 1 nurse to 3 or 4 patients concurrently, with a total of 8-10 patients per nurse per day.
Huang et al. (2018) USA	Mayo Clinic Outpatient Haematology-Oncology practice chemotherapy infusion unit with 19 chairs.	1 nurse to 3 patients at any given time, and 1:1 for first 30 minutes and last 15 minutes of treatment. Nurse is chemotherapy trained nurse.
Huang et al. (2019) USA	Chemotherapy unit with 41 chemo chairs/beds (simulation).	1 nurse to 2.5 patients at any time of day, but 1 to 1 ratio for first and last 15 minutes of treatment.
Santos and Gaidzinski (2019) BRA	Chemotherapy outpatient clinic.	1 nursing professional to every 5 patients. This included specialized nurses and nursing technicians.

Table 7. Staffing Ratios Reported in SACT Delivery Settings (Continued)

Reference	Reference Clinical Context	Staff Ratio Details
Nurse to Patient		
Baril et al. (2020) CAN	Haematology-Oncology clinic delivering chemotherapy protocols.	Usually 1 nurse to 4 patients, meaning the nurse administers treatments to 4 patients simultaneously.
Bouras et al. (2021) TUN	Generic chemotherapy scheduling (simulation).	1 nurse to 4 patients when patients are in the "monitoring phase."
Nurse to Chair		
Hahn-Goldberg et al. (2014) CAN	Cancer centre in Toronto delivering chemotherapy.	13-15 nurses for 29 treatment chairs.
Edwards et al. (2017) USA	University of Texas MD Anderson Cancer Centre, infusion setting.	Main infusion suite has 14 chairs staffed by 6 nurses (aim 98 infusion hours per day). 1 level 1 nurse to 10- 15 level 1 patients per day and 1 level 2 nurse to 6- 8 level 2 patients or higher per day plus level 1 add-ons, walk-ins, and overflow.
Alvarado and Ntaimo (2018) USA	Outpatient Oncology Clinic Texas	1 charge nurse and 4-8 RN on duty for 17 chemo chairs and average 23.5 patients per day.
Haswell (2018) USA	Cancer centre	A nurse to chair ratio of 1:3 is used meaning each nurse treats 3 patients simultaneously.
Noel (2019); (2016) USA	Baylor Scott & White McClinton Cancer Centre infusion room.	20 infusion chairs with 5 nurses, one rapid service chair with 1 nurse, and 8 medical infusion chairs with 2 nurses.
Bourbeau et al. (2020) USA	Benchmarking data from the Survey of Oncology Practice Operations.	Average 0.5 FTE Drug Administrators (i.e., nurses, pharmacists and technicians, others) per chair.
(Gul, 2021) TUR	Chemotherapy clinic attended by 9 nurses and one head nurse. 28 chairs in clinic	Each nurse is assigned at most 4 patients at any time, but they suggest a 1:2 nurse to chair ratio for high patient satisfaction and less overtime.

RN: Registered Nurse

Notably, a number of articles refer to a "patient start" which describes the time that the nurse is responsible for setting up a patient to receive their chemotherapy (e.g., assessing the patient, checking dosages, starting treatment) (Turkcan et al., 2010). Within the nurse-to-patient ratio, it is recommended that a nurse can only be scheduled to set up one patient at any one time, while any other patients under their care should require monitoring only (Bouras et al. (2017); Turkcan et al. (2010); Woodall et al. (2013); Huang et al. (2019); Huang et al. (2018). Furthermore, nurse-to-patient ratios in the ambulatory oncology setting must consider that while a nurse is performing activities and interventions with one particular patient, they are simultaneously monitoring other patients who are undergoing an infusion (Gul, 2021). Baril et al., (2020) suggest that the nurse-to-patient ratio may need to be reduced for chemotherapy treatment protocols that cause a higher mental workload for nurses. While physical workload refers to the time that a nurse spends providing care, mental workload increases when a nurse is conducting and remembering multiple tasks in parallel (i.e., cognitive stacking). Therefore, the mental workload associated with chemotherapy schedules should be considered in determining staffing and ratios to enable nurses to provide safe quality care (Baril et al., 2020).

It is of note that many of the nurse-to-patient or nurse-to-chair ratios reported in the literature do not provide detail on the grade of nurses that they are referring to within their ratios, the competencies or skill level of the nurse, or the complexity of treatment that is administered. Many of these articles did not specifically outline the skill mix of the nurses in the nurse-to-patient or nurse-to-chair ratio. Edwards et al. (2017) did differentiate between level 1 and level 2 nurses, who were matched to the skills required to address the corresponding acuity levels of patients according to their clinic acuity tool. Level 1 nurses were responsible for patients with an acuity level of 1 (not requiring chemotherapy infusions but required routine vascular access maintenance) while level 2 nurses were caring for patients requiring chemotherapy infusions. Huang et al. (2018) clarified that their ratio of 1 nurse to 3 patients includes only nurses who are trained in the administration of chemotherapy.

5.2.3. Summary of Staff Ratios

Summary Points Staff Ratios
• Staffing ratios can provide a simplistic and transparent method to determine staffing levels, however they are also inflexible and unsophisticated.
• Staff ratios identified within the literature do not specify nursing grade, the competencies or skill level of the nurse or complexity of treatment being administered.
• There was no evidence base to identify an appropriate nurse-to-patient ratio for AHODU settings and no evidence linking ratios to care quality outcomes.
• Staffing in cancer care should be based on factors including patient acuity, nurse skills, other team members, the setting and available technology.
• Staffing ratios may need to be reduced for specific groups of patients.

5.3. Scheduling & Nurse Staffing

The scheduling of patients in the AHODU setting for delivery of SACT and supportive treatments is a complex process which must consider multiple factors including balanced nursing workload, laboratory testing, physician appointments, patient preferences, and nurse shift schedules (Santibáñez et al., 2012). When an appropriate staffing level has been determined utilising acuity and staffing tools, it is imperative that patients are then scheduled in a way that works with the staff employment structures (Rodriguez et al., 2020).

5.3.1. Characteristics of Included Studies

A total of 35 studies identified within the Acuity/Scheduling search investigated optimal patient scheduling in ambulatory oncology settings where SACT is delivered or provided guidance on scheduling practices in this setting. Of these, 24 described operational research studies that involved development of mathematical formulas and simulation modelling to identify optimal patient schedules that promoted improved efficiency and patient flow. A summary of some key findings and recommendations across these studies is provided in Table 7. While the mathematical models demonstrate some promising results such as improved schedules that reduce patient wait times and decrease staff overtime (Alvarado & Ntaimo, 2018; Bouras et al., 2017), it is noted that such models are not necessarily transferable to other SACT settings and require adaptation or rerunning in order to be implemented (Huang et al., 2018). The remaining studies provided some guidance for patient scheduling and these included service improvement initiatives (Kamimura et al., 2012; Langhorn & Morrison, 2001a, 2001b; van Lent et al., 2009; Vortherms et al., 2015; Wallis & Tyson, 2003), workload analysis (Gill & Dillon, 2010), a time in motion study (Hawley & Carter, 2009), qualitative research (Kamimura et al., 2012; Lafferty et al., 2020), survey research (Lau et al., 2014), a literature review (Rodriguez et al., 2020), and a commentary (Nevidjon, 2018). A summary of some key findings and recommendations across these studies is shown in Table 8. Table 9 presents other recommendations on scheduling from the other studies identified in this review.

Table 8. Operational Research Studies

Reference	Method	Findings and Recommendations for Scheduling
Turkcan et al. (2010) USA	Integer programming model	• Scheduling chemotherapy should consider acuity levels as well as minimization of treatment delay, staff overtime, and maximisation of staff utilization.
Santibáñez et al. (2012)	Integer programming model	• New scheduling system resulted in more balanced workload for nurses. • Appointments were scheduled one week in advance and 94% of patients were satisfied with amount of appointment notification time.

Table 8. Operational Research Studies (Continued)

Reference	Method	Findings and Recommendations for Scheduling
Woodall et al. (2013) USA	Mixed Integer Programme model	• Staggering nurses shift start times (with mix of 8- and 10-hour shifts) improved patient flow so that more nurses were on duty at peak times. • Scheduling (based on expert opinion) produced similar results to the schedules produced by the programme.
Claudio et al. (2014) USA	Time series forecasting	• Conducting patient forecasting specific to the demands of different days of the week can improve accuracy of scheduling.
Hahn-Goldberg et al. (2014) CAN	Dynamic template scheduling	• About 20% of appointments are cancelled due to blood results and changes to protocols. • "Shuffling" of appointments allows creation of new optimal template when appointments cancelled. Patients arrive 1 hour before appointments to allow for last minute changes to schedule.
Slocum (2014) USA	Monte Carlo method	• A common scheduling delay is nurses having to follow up with doctors to get chemotherapy orders after labs are processed. • Scheduling is designed to stagger patient arrival times and prioritize patients so that pharmacy can process longest infusions first.
Ansarifar et al. (2015) IRN	Integer programming model	• Model considers clinic resources (beds/chairs, medical room, nurses, pharmacists, oncologists, laboratory technician) limitation and patient flow in chemotherapy (laboratory, oncology clinic, pharmacy, and infusion clinic).
Baril et al. (2016) CAN	Discrete event simulation	• Discrepancies in nurse workload i.e. highest workload in the morning and lower in the afternoon. This can be reduced (creating a more balanced workload) by scheduling appointments according to nurse capacity.
Heshmat and Eltawil (2016) EGY	Mixed Integer Programme model	• Model minimized under or overutilization, treatment delay, and number of cancerous cells.
Liang and Turkcan (2016) USA	Optimization model	• Patient acuity level is matched to nurses' skill level when making nurse assignments in daily schedule. • A nurse can start at most one treatment per 30-minute slot. • Staggered nurse scheduling adjusts the availability of nurses according to changing demand throughout the day.

Table 8. Operational Research Studies (Continued)

Reference	Method	Findings and Recommendations for Scheduling
Bouras et al. (2017) TUN	Mixed Integer Programme model	• Improvement in patient waiting time up to 90% when using MIP scheduling compared to "first in first out" approach. • New patients require more time in schedule for consultation and set up with nurse.
Heshmat and Eltawil (2017) EGY	Mixed Integer Programme model	• Model schedules patients while considering key variables including drug availability and both nurse and pharmacist availability.
Heshmat et al. (2017); (2018) EGY	Clustering & mathematical programming	• Nurses are assigned to clusters of patients who share similar features (treatment duration, cancer type, acuity level). • A specific nurse is assigned to a patient for the duration of their treatment from start to finish.
Alvarado and Ntaimo (2018) USA	Model for scheduling individual chemotherapy patient appointments and resources	• Model increased throughput by 1%, decreased patient wait time by 41-42%, decreased system time by 6%, and decreased nurse overtime by 25-35% when compared to the current ASAP (as soon as possible) scheduling algorithm. • "Uncertainty" variables that impact scheduling include acuity level, appointment duration, and number of nurses. Side effects of chemotherapy may cause higher acuity and longer duration, delayed vascular access can lengthen duration, and sick days can impact nurse availability.
Haswell (2018) USA	Discrete event simulation (DES) of patient flow	• The start times of nurses are shifted depending on patient appointments - shifts start every half hour from 6am to 9.30am. • Model suggests having increased number of nurses before 8am to meet demand. • To avoid having major drop in nurses later in day (4.30pm), this needs to taper gradually to avoid a slowdown.
Huang et al. (2018) USA	Optimization model	• Scheduling should prioritize staffing constraints (i.e., nurse to patient ratio of 1:3) rather than patient preferences. • New model reduced ratio violations by 27% and patient wait times decreased from 40 mins to 5 mins on average.
Hesaraki et al. (2019) NLD	Binary integer programming for scheduling chemotherapy appointments	• Some patients may be asked to have their lab and oncologist appointments on the day before infusion to optimise patient flow time (i.e., split day scheduling)

Table 8. Operational Research Studies (Continued)

Reference	Method	Findings and Recommendations for Scheduling
Huang et al. (2019) USA	Optimization model	• As well as infusion time, treatment time in scheduling should consider pre- and post-infusion activities such as drug preparation and nurse education.
Benzaid et al. (2020) CAN	Mixed Integer Programme model	• By overbooking patients, the clinic would make better use of its resources (due to last minute cancellations). • Using a flexible patient start time improves productivity but the feasibility of this for patients needs to be considered.
Hesaraki et al. (2020) NLD	Multi-criterion Mixed Integer Programme model	• Clinics could adopt a mixed policy of same day and day before visits for patients (i.e., split day scheduling). • For reliable scheduling, appointment durations should be based on real-time infusion data rather than protocols. • Buffer time could be added to end of each appointment. • Patients likely to have allergic reactions (that may prolong infusion) can be scheduled for last appointments at stations.
Bouras et al. (2021) TUN	Mixed Integer Programme model	• Suggest that giving each patient a specific appointment start time will reduce waiting time at clinic in comparison to current practice where all patients arrive at start of day.
Gul (2021) TUR	Mixed Integer Programme model	• Length of pre-medication and infusion durations causes uncertainty in scheduling.
Heshmat and Eltawil (2021) EGY	Mixed Integer Programme model	• Model incorporates factors such as drug availability, nurse and pharmacist availability, and can create optimal schedule that minimizes patient wait time and staff idle time.
Issabakhsh et al. (2021) USA	Mixed Integer Programme model	• Real infusion times of patients were found to take longer than scheduled infusion times for at least 50% of infusion appointments and schedules should account for this.

MIP: mixed integer programming; BIP: binary integer programming; SIP: stochastic integer programming; DES: Discrete event simulation

Table 9. Scheduling Studies

Reference	Method	Findings and Recommendations for Scheduling
(Langhorn & Morrison, 2001a)	Service improvement	• Same day chemo and doctor visit reserved for emergencies or patients who live >100km from centre.
(Hawley & Carter, 2009) USA	Time-in-motion	• Charge nurse prepares the patient to nurse assignment schedule for the following day. • When determining time needed in schedule, consider if first treatment, if teaching is required, if patient needs special assistance, and if patient needs to be seen by physician.
(Gill & Dillon, 2010) IRL	Workload analysis	• Unplanned admissions can have significant impact on services as these patients often require greater input on nursing staff. • Nurse availability strongest in morning and decreases 12-2pm when centre is at its' busiest.
(Kamimura et al., 2012) USA	Qualitative interview	• When nurses provide input on patient scheduling, nurses reported more manageable and equitable workloads.
(Lau et al., 2014) AUS	Survey	• 85% patients preferred to receive chemotherapy on the same day as their medical oncology outpatient appointment. • 99% preferred chemotherapy to be delivered before 2pm and 80% preferred before 11am. No patients selected chemotherapy delivery after 5pm.
(Rodriguez et al., 2020)	Literature review	• Patients should be scheduled according to staff capacity and patient acuity. • Number of patients starts per time slot cannot exceed number of nurses on duty.
(Nevidjon, 2018) USA	Commentary	• If schedulers are non-clinical staff, developing descriptions of infusion types helps them to make better scheduling decisions.
(Wallis & Tyson, 2003) AUS	Service improvement	• Accurate measurements of length of nursing activity and chemotherapy administration time should be built into patient scheduling systems. • Each patient assigned a nurse who was their primary caregiver, with matching of patient needs to nurse capabilities.

Table 9. Scheduling Studies (Continued)

Reference	Method	Findings and Recommendations for Scheduling
(van Lent et al., 2009) NLD	Service improvement	• Scheduling system should match up with nurse and chair availability. • Patients were assigned a "primary nurse." • Occupy all beds before lunch to increase bed utilization during limited staff levels.
(Vortherms et al., 2015) USA	Service improvement	• No patients assigned to an individual nurse should have the same start time (patient start times staggered). • Staffing reviewed one day prior to accommodate schedule changes including add-ons and cancellations. • Nurses scheduled for 15 mins prep time at start of shift, 30 mins documentation at end of shift. • Open time slots left available to accommodation additional patients.
(Lafferty et al., 2020) USA	Qualitative	• Chemotherapy schedule delays can occur if prescribing physician not available to clarify care plans, if there are day of treatment order changes, if orders are not signed in advance by physicians, or if waiting for laboratory test results. • Two-day scheduling can avoid long delays for patients but can also be challenging depending on proximity and availability.

5.3.2. Scheduling within Ambulatory Oncology Settings

Staff in ambulatory oncology settings are tasked with scheduling large volumes of patients often with limited clinic resources. A first come-first-serve approach is not feasible considering the varied nursing input and treatments regimens that patients require (Rodriguez et al., 2020), as well as issues of crowding and waiting times. Giving patients specific start times to arrive for their appointment reduces waiting times at the clinical setting (Bouras et al., 2021). In a description of their service in the infusion room at Cleveland Clinic Cancer Centre, Hawley and Carter (2009) provide the following list of considerations which can assist in determining the time needed when scheduling a patient for treatment:

- Is this the person's first treatment?
- What is the length of treatment? (e.g., infusion time)
- Is teaching needed?
- Is assistance needed? (e.g., mobility issues)
- Does the patient need to be seen by the physician prior to treatment?

The issue of planning patient schedules for chemotherapy delivery is recognised as a complex task given the variability in patient needs and treatments, the increasing demands on chemotherapy services, and the unpredictable nature of the ambulatory setting (Heshmat & Eltawil, 2016). There are many "uncertainty" variables in the ambulatory oncology setting that are shown to impact upon effective scheduling such as walk-ins, no-shows, emergencies, lab delays, and uncertain pre-medication and infusion durations (Ansarifar et al., 2015; Gul, 2021; Heshmat & Eltawil, 2016). Unplanned admissions can have a significant impact on services as these patients typically require more input from nursing staff (Gill & Dillon, 2010), and conversely, short notice treatment changes or cancellations due to blood results for example can disrupt daily schedules in place.

5.3.2.1 Same-Day vs. Next-Day Scheduling

One particular scheduling consideration in chemotherapy delivery is "next-day" versus "same day" chemotherapy. Next day chemotherapy, also referred to as "split day scheduling," or 'two-day treatment model', is when a patient arrives one day for phlebotomy, nursing assessment and medical consultations and returns the next day to receive their chemotherapy treatment (Alvarado & Ntaimo, 2018; Hesaraki et al., 2020; Santibáñez et al., 2012; NCCP 2014; NCCP 2022). Split day scheduling can help to reduce delays or cancellations decreasing in-clinic waiting times for patients and can improve the efficiency of nurses and pharmacists (Benzaid et al., 2020; Dobish, 2003; Santibáñez et al., 2012). For same day chemotherapy, patients undergo all their procedures (e.g., blood tests, assessment, infusion) on the same day (Benzaid et al., 2020). This can lead to drug wastage if chemotherapy is cancelled on a same day schedule. Delays can also occur due to laboratory testing procedures, or if there are same day changes to treatment orders or delays in physician signing of on treatment orders (Lafferty et al., 2020). However, a 2014 patient survey reported that the majority of patients (85%) preferred to receive their chemotherapy on the same day as their medical oncology outpatient appointment (Lau et al., 2014). A person centred approach should be considered when allocating patients to either a one day our two-day treatment model. This means that the scheduler should consider factors such as the patients' proximity to the clinical site, transportation, work schedules, and caregiver schedules (Lafferty et al., 2020; Lau et al., 2014). For example, authors at a chemotherapy unit in Canada describe that they reserve same-day chemotherapy for emergencies and patients who live further than 100km from the hospital (Langhorn & Morrison, 2001a, 2001b). Patients receiving high-cost drugs with short shelf-lives could be considered for next day chemotherapy in order to limit drug wastage (Lau et al., 2014).

5.3.2.2. Staggered Scheduling

In the ambulatory oncology setting, schedules should aim to balance workload across the day, so that there are not periods of nurse overutilisation and correspondingly, periods of underutilisation (Baril et al., 2016). A number of articles highlighted the value of having staggered nurse start times within the daily schedule (Haswell, 2018; Liang & Turkcan, 2016; Woodall et al., 2013) in order to have more nurses available at peak clinic times and create a more balanced workload across the day. It is recognised that despite limited resources, many chemotherapy units are having to extend their capacity in order to meet increasing demand for treatments and accommodate the additional numbers of new patients (Heshmat & Eltawil, 2021). Flexible approaches such as staggering nurse start times could facilitate longer opening hours to increase unit capacity in the future. Furthermore, given that it is common for treatment cancellations to occur (Hahn-Goldberg et al., 2014), it is imperative to monitor reasons for treatment cancellations and identify measures to reduce patient cancellations.

5.3.3. Scheduling and Nursing

Scheduling patients for AHODU visits is a complex process and is dependent of the length of the treatment regime, resources available and availability of nurses with the required expertise and competencies. Vortherms et al., (2015) recommend that nurses are not allocated a patient at specific times. This includes 15 minutes nursing preparation time at the start of shift, and thirty minutes documentation at end of shift. It is recommended that nurses provide input and their expertise in patient scheduling within AHODU to facilitate manageable and equitable workloads (Kamimura et al., 2012).

5.3.4. Summary of Scheduling

Summary Points Scheduling
• Scheduling patients for AHODU is a complex process.
• The 'two-day treatment model' is recommended as the most efficient method for scheduling patients as it is associated with less cancellations and a more efficient use of resources.
• Staggered start times can increase nurse availability across the work day and could facilitate longer opening hours to increase capacity for the administration of SACT therapies.

5.4. Role of the Nurse

The role of the nurse in AHODU is to care for the patients receiving SACT or requiring other interventions such as blood transfusions. Prior to discussing the findings from the literature on this aspect of the scoping review, a brief outline of the Irish policy on SACT competencies, the role of the staff nurse and other grades within AHODU will be presented.

5.4.1 SACT Competency

The Irish NCCP has recently launched the National SACT Competency Programme for Nurses Working in Cancer Care (NCCP, 2021). This is for all nurses new to administering SACT. Participants on this programme complete a 2-day education programme, and then must complete the theoretical and the clinical component of the UKONS SACT Competency Passport which is based on their UKONS SACT Competency Learning Outcomes Framework (2019). The UKONS Competency Passport is then marked by an accredited SACT assessor. To complete this programme, Irish nurses must have a minimum of three months clinical experience in cancer nursing and be registered with NMBI for at least 12 months. Pre-requisite learning for this programme include peripheral venous cannulation and venepuncture, intravenous therapy, management of CVAD, national anaphylaxis education programme, medication management and introduction to chemical safety in the workplace. Following successful completion of the programme, Irish nurses are then registered as an accredited SACT administrator via HSELand and are then required to complete an annual re-accreditation SACT competency certificate (also via HSELand). In the UK, nurses complete a similar competency programme (NCCP 2021). Australian nurses are required to complete EviQ Antieneoplastic Drug Administration Course every two years (Government of Western Australia 2021). Canadian nurses are also required to maintain their competencies and complete the required Chemotherapy Competency Maintenance Course and the ONS/ONCC Chemotherapy Immunotherapy Certificate Renewal Course every two years (Ontario Health Cancer Care Ontario 2021). Nurses are required to adhere to their scope of practice (NMBI, 2015) and thus need to maintain their competencies to deliver evidence-based person-centred care.

5.4.2. Different Nursing Grades

Different grades of nurses exist in Ireland, and these include staff nurse, Clinical Nurse Specialists (CNS), Advanced Nurse Practitioners (ANPs) and Clinical Nurse Managers (CNM). Staff nurse is the entry level grade into the nursing profession. The majority of nurses working in AHODU are staff nurses who have attained competence in administering SACT (NCCP 2021).

In Ireland, CNS and ANPs are not predominantly employed in AHODU but may consult with patients who are attending AHODU for SACT therapy. The following table summarises the nursing grades working in AHODU in Ireland.

Table 10. Summary of Nursing Grades who support patient care in AHODU (NCCP 2022)

Nursing Grade/Title	Role in provision of SACT
Staff nurse	The majority of staff nurses provide direct patient care involving the delivery of complex SACT regimens and the management of the side effects of treatment or disease. This incorporates telephone triage, patient assessment, education and requires in-depth knowledge of treatment regimens to ensure SACT is administered safely and side effects are managed promptly. Staff nurses are challenged on a daily basis to deal with the numerous symptoms patients may experience as a result of their SACT or disease. They triage patient problems and assist in the evaluation of symptoms and the initiation of interventions. A staff nurse working in this specialist area is required to expand skills and competencies to perform venepuncture, cannulation, care and management of central venous access devices, SACT administration and deliver nurse led services. There is an expectation that the staff nurse completes local, national and postgraduate specialist programmes to enhance their clinical skills. All staff nurses who are naïve in the administration of SACT are expected to undertake the National SACT Competency Programme having worked in the area of cancer care for a minimum of three months.
Clinical facilitators	Assists staff by providing support and guidance in the orientation of new staff, working with experienced staff in further developing the necessary skills and competencies needed to care for and manage cancer patients. Clinical Facilitators work alongside front line staff. They contribute to the development, evaluation and maintenance of nursing standards, policies, protocols and guidelines. They act as the clinical facilitator for partner programmes with higher institutes of education to ensure the quality of clinical placements as well as developing and delivering education programmes locally. Their function is to ensure that the staff have the required and appropriate clinical care skills and competencies to effect timely patient care and intervention. Clinical Facilitators support new staff in the achievements of their SACT competencies.
Clinical Nurse Manager (CNM)	The post of CNM is a pivotal role in service planning, co-ordinating, and managing activity and resources within the clinical area. The main responsibilities are quality assurance, resource management, staff and practise development, performance management, facilitating communication, professional / clinical leadership. The role exists in all SACT services.

Table 10. Summary of Nursing Grades who support patient care in AHODU (NCCP 2022)

Nursing Grade/Title	Role in provision of SACT
Acute Oncology Service (AOS) CNS	The AOS CNS is employed in AHODU to manage patients who require telephone triage. The purpose of these specialist nursing roles is to provide a non ED direct access route for Oncology/Haematology patients who are experiencing a disease or treatment related complication. Patients are triaged assessed and managed using a validated tool, they are reviewed in hospital if necessary and discharged home in a timely manner, where possible.
Clinical Nurse Specialist (CNS)	CNS are categorised as either oncology or hematology, allocated to patients according to a tumor site and provide care to patients who are inpatients, outpatients or attending AHODU. CNSs have key responsibilities to include assisting patients navigate the healthcare system, patient education, psychological support and patient advocacy.
Advanced Nurse Practitioner (ANP)	ANPs in Oncology and Haematology provide care to patients who are inpatients, outpatients or attending AHODU. ANPs are also registered nurse prescribers and prescribe medications specific to their scope of practice.

5.4.3 Nurse-led Clinics

In this review, seven papers focused on specific nursing roles within nurse-led chemotherapy/ ambulatory settings from Australia (Cox et al. 2013), Canada (Lee & Fitzgerald 2013), USA (Culmone et al. 2019) and UK (Farrell et al. 2011; Farrell and Lennan 2013; Farrell et al. 2017),. These included the role of Nurse Practitioner (NP) (Cox et al. 2013), Advanced Practice Providers (APP) and Nurse Coordinator (Wu et al. 2022), Advanced Nurse Practitioner (ANP) (Lee and Fitzgerald, 2013), Clinical Resource Nurse (CRN) (Culmone et al. 2019) and other specialist nursing roles (Farrell et al. 2011; Farrell and Lennan 2013; Farrell et al. 2017, Lee and Fitzgerald 2013). These papers indicate that more nurse-led treatment clinics are emerging (Farrell & Lennan, 2013), however, there appears to be variability in nurses' titles, roles, responsibilities, and scope of practice in nurse-led chemotherapy clinics (Farrell et al. 2011; Farrell et al. 2017). In fact, Farrell et al. (2017) identified four different levels of nurse-led chemotherapy clinics in the UK and each level differed in the level of autonomy experienced by the nurses and patient care provided. Farrell et al. (2017) describes level 1 as nurse-led chemotherapy administration, while level 2 is nurse-led pre-assessment where the nurse assesses patient's symptoms and refers the patient who require alteration of their chemotherapy regimen to the medical practitioner. Nurses alternate clinic appointments with medical staff in level 3 nurse-led chemotherapy review for episodes of care during chemotherapy. In contrast, the nurse is completely responsible for the care of their patients in level 4 nurse–led chemotherapy led clinics. Within level 4, the nurses (ANPs) had more autonomy to make decisions about amending chemotherapy prescriptions in the UK.

Lee and Fitzgerald (2013) set out the roles and responsibilities of ambulatory nurses and advanced nurse practitioners in Canada and indicate that ANP-led clinics have reduced the waiting times for outpatient services. Other challenges faced in nurse-led clinics in the UK include seeking secretarial/admin support (Farrell et al. 2011) and nurse-doctor relationships (Farrell et al. 2017). Nonetheless, these specific nursing roles in Singapore and Australia were seen to impact the patients' 'journey' with cancer (Wu et al. 2022) and have a positive impact on the cancer care provided, as well as on the hospital, with fewer hospital admissions and emergency department presentations (Cox et al. 2013).

Table 11. Summary Characteristics of Specific Nursing Roles

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Cox et al. 2013 AUS	Evaluate the oncology nurse practitioner (NP) role in a chemotherapy unit in a public metropolitan hospital.	Service Evaluation (Nurse Practitioner (NP) recorded all unscheduled occasions of service for a six-month period).	The oncology NP had a positive impact in cancer care, particularly regarding the medical and hospital workload. The NP is a valuable asset to a busy department and the role has potential for minimising hospital admissions and emergency department presentations.
Culmone et al. 2019 USA	To create a clinical resource nurse (CRN) role to enhance the knowledge of the nurses at the bedside at ambulatory oncology infusion sites.	Service improvement initiative.	The CRN role improves consistency in clinical practice by teaching and monitoring evidence-based nursing practice with the bedside nurses. The continual interactions between the CRN and the bedside nurses helps to identify the learning needs among the nurses resulting in a successful teaching plan.
Farrell & Lennan 2013 UK	To discusses the evidence for nurse-led chemotherapy clinics and outline practice and the assessments tools used to inform cancer services across the UK.	Commentary/ Discussion piece	National policy supports nurse-led chemotherapy clinics, and non-medical prescribing initiative provides the professional tool for autonomous practice. Many models exist to provide nurse-led chemotherapy review but most important is to ensure the nurse works as part of a multidisciplinary team and never in isolation.
Farrell et al. 2011 UK	To explore the scope of practice of oncology specialist nurses in the UK, with emphasis on nurse-led clinics.	Quantitative Survey	The development and standardisation of advanced roles and associated educational preparation is important when taking forward the survivorship agenda and developing appropriate pathways for follow up care given the current shift to nurse-led follow up in many areas. Nurses in advanced practice face challenges in seeking secretarial/ administrative support to support their practice; and resources are often limited for such “extras” in nursing budgets, therefore careful negotiations must be undertaken to enhance efficiency.

Table 11. Summary Characteristics of Specific Nursing Roles (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Farrell et al. 2017 UK	This study aimed to explore nurses' roles within nurse-led chemotherapy clinics and understand how the clinics operated in practice across four (urban and rural) nurse-led chemotherapy units.	Non-participant observation of nurse-patient consultations. Qualitative interviews with nurses (Ethnographic study)	Nurses' relationships with medical consultants appeared to have a clear impact on nurses' roles, their scope of practice and autonomy within nurse-led clinics. Despite similarities in clinical skills training and prescribing, there were great disparities between clinics run by chemotherapy nurses and those run by ANPs. ANPs had a higher level of knowledge, autonomy, and decision than chemotherapy nurses. Thus, ANPs were able to make independent decisions about modification of chemotherapy prescriptions.
Lee & Fitzgerald 2013 CAN	To review existing models of ambulatory care employed by key national and international cancer centres in Australia, Canada, and the US.	Qualitative interview	Roles and responsibilities of Registered nurses in ambulatory care included patient education, support, symptom management, care coordination, telephone triage, primary contact point for patients, obtain insurance authorization, assist physicians during clinics. While primary nurses are the main patient contact for almost all centres, many of them employ centralized telephone help lines to ensure a) patients will always be able to speak with a nurse during office hours; and b) nurses can focus on nursing issues through the elimination of calls for administrative purposes.
Wu I.Q. et al. 2022 TWN	Book chapter to address aspects critical in the design of a comprehensive cancer centre, especially as these are developed in low- to middle-income countries.	N/A	Re: role of Advanced Practice Providers (APP) and Nurse Coordinator: The ASCO advisory Group has recommended improved integration of APPs into the oncology workforce. Advanced Practice Providers make significant contributions throughout a patient journey with cancer from detection and diagnosis, through treatment, survivorship, surveillance and even end-of-life care. Nurses also play an important role in their function as oncology nurse coordinators. Key elements of a nurse coordinators role involve emotional support, guidance to patients, and coordination of the multifaceted aspects of the patients' care.

5.4.4 Nursing Activities

In this scoping review, 23 papers reported on nursing activities related to the delivery of cancer care. De Souza et al. (2013) identified 48 nursing activities in Brazil under five broad 'domains', physiological basic (9) and complex (13), behavioural (1), safety (6) and health systems (19). These activities ranged from delivering medication, listening to the patient and various administrative tasks. Santos and Gaidzinski (2019) identified 23 interventions that were performed by registered nurses in Brazil and highlighted three (consultation, chemotherapy administration and chemotherapy prescription) that accounted for almost half of the nurses (48.9%) working time with support interventions (e.g., vital signs monitoring, medication administration, documentation etc.) accounting for 51.1% of the nurses' time.

Other studies report nurse activities within the context of delivering alternative cancer protocols (de Raad et al. 2010) or safe delivery of SACT (Neuss et al. 2016, NHS West of Scotland Cancer Network 2018). From an Australian perspective, activities such as patient education and assessment, administrative activities and communication are discussed in de Raad et al. (2010). Neuss et al. (2016) highlight the updated American Society of Clinical Oncology (ASCO)/ Oncology Nursing Society (ONS) Chemotherapy Administration Safety Standards. The new standards aim to underpin policies and procedures used to support and promote a safe environment for patients. The NHS West of Scotland Cancer Network (2018) paper sets out five recommendations to expand activity to include non-medical prescribing, repatriation of less common cancers, outreach service, the further development of shared care models for prescribing and community dispensing of oral SACT.

Also, included in this review are several discussion/commentary papers (Cooper and de Lord 2018, Harrold and Martin 2017, Price 2021, Reynolds 2021, Srithumsuk & Wangnum 2021) and a newsletter (Pirschel 2019). Cooper and de Lord (2018) provide a review of national UK guidelines in the context of patients being treated closer to home and highlight the key role played by nurses. Harold & Martin (2017) discussed the roles undertaken by cancer nurses in the UK which include receiving telephone calls, teaching nurses and medical staff, patient care, education and support. Price (2021) discusses the importance of US best practice guidelines and multi-disciplinary team communication in dealing with acute infusion-related reactions. Reynolds (2021) addressed the challenges faced in adequately staffing an outpatient oncology unit in the USA and concludes that several important factors need to be considered. These include appropriate RN expertise for the type of care they provide, the number of nurses with SACT competencies scheduled daily, the ability to make adjustments to the schedule as needed and how to balance volume with the amount of time needed to provide the ordered treatments. Pirschel (2019) indicate that nurses in ambulatory care in the USA are seen as caregivers, educators, advocates and patient champions from diagnosis to survivorship and the current landscape is changing as a result of new technologies and new treatments.

The unique value and skills of 'expert' nursing practice is addressed in Morrison (2010), where five attributes of expert American ambulatory care practice are identified. The nurse is seen as being a content expert, creates positive relationships, have an attuned skill of listening, advocate for the patient and develop long-term patient and family relationship (Morrison 2010). Similar to Morrison (2010), Brisley (2003) identifies the advocate role that chemotherapy

nurses play along with providing education, emotional support and direct care. More recently Srithumsuk & Wangnum (2021) summarise the lessons learned from the implementation of home chemotherapy service in Taiwan during the Covid-19 Pandemic. They conclude that more flexibility is required for the safe delivery of chemotherapy at home for cancer patients (Srithumsuk & Wangnum 2021).

While nursing in the AHODU setting where SACT is delivered is recognised as a complex and specialised role, de Souza et al. (2014) highlight that in their workload analysis, 11.6% of nursing time in their outpatient oncology service in Brazil was spent on "associated activities" which included phone calls, requesting patient records and medications from pharmacy, and escorting patients. The authors highlight that these tasks could be completed by nursing assistants in order to protect nursing time for more specialised activities. Cordon et al. (2021) focusses only on the medical nursing activities provided in the ambulatory treatment setting with chemotherapy administration accounting for 61% of the activity. They refer to the additional support that some patients may need but do not elaborate on what this might involve. The concept of 'indirect' care provision is reported by Gill & Dillon (2010) who indicate that staff nurses in Ireland spend 19% of their time on such care. This 'indirect' care includes activities such as staff management, reactive phone calls, proactive phone calls, direct administration, indirect administration, personnel management, away from unit, breaks, multidisciplinary team DT communication, domestic. They make no specific reference to psychological or educational activities, but they do include patient queries in their 'direct' care category.

Relevant to the discussion of nursing activities is the concept of "care left undone." This was considered by Cheevers et al. (2020) who adapted a nurse survey for use in the ambulatory chemotherapy setting in the UK. They explored 13 care activities that could be left undone due to lack of time. These included medical and administrative activities as well as educating and providing emotional support to patients and families. The only non-medical or administrative care left undone was education of patients on symptom management.

The remaining papers address a variety of topics. Vortherms et al. (2015) report on development of an outpatient acuity-based staffing model in a USA outpatient chemotherapy infusion centre and conclude that developing and implementing an acuity-based staffing model is time-intensive but effective as it optimises efficiency. The role of ambulatory nurses in counselling patients with cancer is examined in two papers, one from Japan (Komatsu & Yagasaki 2014), and one from the USA (Rogers et al. 2021). They suggest that patient-centred care can be provided by counselling and support services in non-physical settings (Komatsu & Yagasaki 2014) and in fact oncology nurses, as part of their role, counsel cancer chemotherapy patients on many lifestyle/behaviour issues (Rogers et al. 2021). Roe & Lennan (2014) outline the UK nurses' role in dealing with chemotherapy-related side effects in cancer patients and Traeger et al. (2015) discuss symptom burden and management in the American context.

Table 12. Summary table of nursing activities literature

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Brisley et al. (2003) AUS	To discuss appropriate nurse staffing levels in outpatient chemotherapy settings.	Literature review	Key dimensions of practice for nurses working in chemotherapy settings include (1) information giving/ education, (2) emotional support, (3) advocacy, (4) direct care including managing technology, assessments, responding to side effects, and meeting personal/psychosocial care needs.
Cheevers et al. 2020 UK	To adapt the care specific components of the RN4CAST tool and make them relevant to the ambulatory chemotherapy setting in a London hospital.	Qualitative interview (tool development) Feasibility testing	The care items with highest rates of being left undone were those related to verbal communication with patients (checking comorbidity management; or ability to carry our daily activities). Just over half the nurses (54%) reported not asking patients about specific toxicities before starting their chemotherapy treatments at least once a month or more and 40% of patients also reported not being asked about toxicities in the PR-CISE patient experience survey.
Cooper & de Lord 2018 UK	To review national guidance and look at ambulatory SACT in terms of patients being treated closer to home.	Commentary/ Discussion piece	These nurses play a key role in patient education in terms of • Promoting open communication through thorough pre-SACT assessments with patients • Empowering patients to gain a greater understanding of their chemotherapeutic regimens • Teaching patients and nurses' recognition of side effects, safe management of complications and reporting these, including severe symptoms in a timely manner • Access to a 24-hour support service in case of emergencies • Management of SACT spills from their elastomeric pumps and providing them with the necessary spill kits together with easy-to-use instructions • Providing peer support and clinical supervision for other nurses.

Table 12. Summary table of nursing activities literature (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Cordon et al. 2021 CAN	To pilot the Synergy Model in an oncology ambulatory care setting.	Pilot study	Nursing activities in the ambulatory treatment environment were captured as chemotherapy administration (61%), nursing care of patients after procedures such as lumbar punctures and therapeutic thoracentesis (25%), blood transfusions (10%), and intravenous hydration for supportive care (4%).
de Raad et al. 2010 AUS	To examine the nursing workload of administering alternative chemotherapy protocols in Metropolitan chemotherapy treatment centres in Australia.	Mixed Methods -Focus Groups -Survey	Description of Nursing Activities Within a Chemotherapy Protocol: The broad categories of nursing activities within a chemotherapy protocol include Patient Education, Patient Assessment, Administration (drug), Patient Communication.
de Souza et al. 2013 BRA	To identify the interventions/ activities nurses developed at a Chemotherapy Centre, using standardized language and to validate their contents. A Chemotherapy Centre at a large hospital that predominantly attends to Unified Health System (SUS) users.	Mixed methods • Qualitative interview • Document analysis • Questionnaire	The authors identified the following broad domains: • Physiological: basic domain (9 activities) • Physiological: complex domain (13 activities) • Behavioural domain: Listen and provide therapeutic support to patient and family (1 activity) • Safety domain (6 activities) • Health System domain (16 activities)
de Souza et al. (2014) BRA	To measure the workload of registered nurses in an oncological outpatient service.	Workload analysis, observational study	Most common nurse interventions were Health care information exchange (12.2%), Documentation (11.5%), Endo venous medication administration (11.1%). Indirect care activities accounted for 40.2% of total interventions/activities, and direct care for 33.6%. Indirect care activities that required most time were staff supervision, emergency cart checking, and laboratory data interpretation.

Table 12. Summary table of nursing activities literature (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Gill and Dillon (2010) IRL	To measure day centre activity and highlight areas for improvement. St Anne's Oncology/ Haematology Day Centre service.	Workload analysis • staff shadowing • time-in-motion	Staff nurses spend 70% of their day on direct patient care, and 19% on indirect care. Clinical nurse manager spends 42% day on direct patient care and 49% on indirect care. 15 activity categories identified: DIRECT Care: patient queries, treating patients, co-signing medications, preparing medications. INDIRECT care: staff management, reactive phone calls, proactive phone calls, direct administration, indirect administration, personnel management, away from unit, breaks, MDT communication, domestic.
Harrold & Martin 2017 UK	Give an overview of the nursing roles in their cancer centre.	Commentary/ Discussion piece	Roles include receiving phone calls from cancer wards and chemotherapy units to assess patient suitability for central venous access device. Cannulating patients. Receiving calls from patients, community nurses, or local general hospitals for advice. Ad-hoc teaching sessions for nursing and medical staff. Placement of PICC's. Patient education and support.
Komatsu & Yagasaki 2014 JPN	To understand the experiences of oncology nurses in patient counselling and support services in the ambulatory care setting.	Grounded Theory Qualitative interview	The conceptual model of the power of nursing serves as a guide for nursing practice and helps empower patients to manage consequences of the disease and develop their potential across the cancer trajectory. It also can be used as an educational tool to build the professional identity of competent and caring nurses. Oncology nurses should guide patients through the uncertain cancer trajectory by identifying patients' true needs based on the established relationship, providing personalized coordination, and developing their potential. Patient-centred care can be provided in non-physical care settings such as counselling and support services.

Table 12. Summary table of nursing activities literature (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Morrison, S. 2010 USA	To describe the unique value and skills of expert nursing practice in ambulatory care settings. Ambulatory clinic in large cancer centre in USA.	Qualitative Focus groups	Paper sets out the role of nurse managers and ambulatory care nurses with 5 or more years of experience in ambulatory care). Five attributes of expert ambulatory care practice emerged to support the over-arching Theme, the nurse as Journeyer: these include (a) being a content expert, (b) creating positive relationships, (c) attuned skill of listening, (d) advocating for the patient, and (e) developing long-term patient and family relationship. They suggest structuring nurse (patient) assignments so that, where possible, nurses can see the same patients through their disease trajectory. This would facilitate long-term patient relationships and enhance the ambulatory care nurse's ability to advocate for patients.
Neuss et al. 2016 USA	To update the American Society of Clinical Oncology (ASCO)/ Oncology Nursing Society (ONS) Chemotherapy Administration Safety Standards and to highlight standards for paediatric oncology.	Strategic review and emerging future service model	Section 1 discusses the environment and routine procedures. Section 2 addresses treatment planning and patient education before the start of treatment. Section 3 of the paper details specific standards for ordering, preparing (including labelling), and administering chemotherapy. Section 4 discusses monitoring adherence to, and toxicity from, chemotherapy to promote safety both while on treatment and subsequent to therapy. These standards are ever evolving in response to advances in oncology and underpin policies and procedures used to support and promote a safe environment for patients.

Table 12. Summary table of nursing activities literature (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
NHS West of Scotland Cancer Network 2018 GB-SCT	Review resource requirements for safe delivery of SACT for the main tumour types (haemato-oncology, breast, lung, colorectal, prostate and bladder cancers), where treatment is delivered in outpatient or day-case settings.	Strategic review and emerging future service model	Recommendation 1: Non-Medical Registered Nurse Prescribers Implement Non-medical prescribing (NMP) led pre-assessment and prescribing of SACT across all relevant patient groups. Recommendation 2: Repatriation of Less Common Cancers a. Implement models of central assessment and local delivery for some rare cancers b. Assess feasibility of repatriation of some less common cancers Recommendation 3: Outreach Service Delivery Develop outreach services for all relevant treatments Recommendation 4: Shared Care Models Implement and further develop shared care models of monitoring and prescribing Recommendation 5: Shared Care Models Maximise use of community dispensing of oral SACT
Nilsson A., Lundkvist J., & Lindman H. 2016 SWE	To perform a time-motion study to compare time required for treatment administration. Oncology day care unit.	Quantitative Questionnaire	A 12-week treatment course of nab-paclitaxel (every three weeks), nab-paclitaxel (weekly) and paclitaxel (weekly) would require in total 2.8, 8.4 and 20.9 hours of infusion time, respectively. The corresponding patient time in hospital would be 5.5, 16.4 and 36.8 hours, respectively. There can be substantial differences in nurse and facility resources required for administration of chemotherapy. No details provided on team members.
Pirschel, C. 2019 USA	Discussion on the role of the oncology nurse in ambulatory care.	Newsletter	Authors state that in some settings, other nurses handle navigation and administrative duties. They acknowledge the impact of new technologies, new treatments and nurses' knowledge. Smaller ambulatory setting can result in fewer nurses for support. Ambulatory setting may not have resources of larger hospital.

Table 12. Summary table of nursing activities literature (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Price 2021 USA	To review potential signs and symptoms of infusion-related reactions, the pathophysiology behind these reactions, risk factors, and management strategies in inpatient oncology units.	Commentary/ Discussion piece	Importance of best practice guidelines and better outcomes for patients. Importance of good communication between members of MDT and importance of knowledge base for applicable nurse in terms of potential side effects of medications as applicable.
Reynolds, 2021 USA	Commenting on the challenges including how to appropriately staff in a "fluid environment". 16 chair short stay outpatient unit administering chemotherapy and supportive treatments.	Commentary	They used a shared governance model for practice that promotes teamwork, team decision making, and positive changes within our organization. Staff members were asked to provide input, which helped to foster an environment of autonomy and ownership that contributed to nursing satisfaction. Team building leads to autonomy, buy-in from team members, and ownership of the practice. Adequate nurse-patient ratios in an outpatient oncology unit can result in increased nurse and patient satisfaction.
Roe, H. & Lennan E. 2014 UK	A guide to assessment of chemotherapy patients, including the process of chemotherapy, key information needs, and consent.	Commentary	Paper listed the common side effects of chemotherapy and the nurses' role in their management. These included: neutropenic sepsis, chemotherapy-induced nausea and vomiting, chemotherapy-induced diarrhoea, alopecia, stomatitis, fatigue, hypersensitivity, peripheral neuropathy and extravasation.
Rogers et al. 2021 USA	An electronic survey was designed to determine current practice in nurse-patient counselling related to lifestyle and behaviour during chemotherapy treatment. Outpatient clinic/ infusion room.	Quantitative Survey	This survey found that most oncology nurses counsel chemotherapy patients on all sixteen behaviour/lifestyle questions asked. Nurses described multiple influences on their education practices including oncologists, senior nurses, peer nurses, and institutional protocols. This study identified an opportunity for quality improvement of the nurse-patient chemotherapy education with a description provided of current practice patterns related to patient lifestyle and behaviour topics.

Table 12. Summary table of nursing activities literature (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Santos, D.V. & Gaidzinski, R.R. 2019 BRA	To apply the Workload Indications of Staffing Need (WISN) method for dimensioning the nursing staff for the care of cancer patients in an antineoplastic chemotherapy (CT) outpatient clinic. A chemotherapy outpatient clinic of a public teaching institution of tertiary care specialized in adult oncology.	Workload analysis Quantitative observational, documentary, field study with an intentional sample.	Total of 25 activities listed Nurse Activities: 23 of the 25 - three were recorded: Consultation, Chemotherapy Management (CT administration) and Risk Identification (CT prescription analysis). Among the interventions, five were more representative in relation to the relative working time of nurses, namely: CT Management (CT administration); Consultation; Documentation; Health Care Information Exchange and Medication Administration. Nursing Technician Activities: 18 of the 25 - three recorded: Risk Identification (CT double checking), Medication Administration, Vita Signs/Anthropometric Monitoring. Among the 18 interventions, the five with the greatest relative working time of this professional category were Medication Administration, Vital Signs/Anthropometric Monitoring, Environmental Control, Documentation and Infection Control.
Srithumsuk & Wangnum 2021 THA	To describe the lessons learned for delivering home chemotherapy to cancer patients from oncology nurses during the COVID-19 pandemic.	Commentary/ Discussion piece	A summary provided of the lessons derived from the implementation of home chemotherapy from the perspectives of nurses' roles in Thailand. Conclude that oncology nurses will need to be flexible to facilitate the safe delivery of alternative models of care especially the delivery of chemotherapy at home for cancer patients.
Traeger et al. 2015 USA	To reduce patient-reported symptom burden by facilitating patient-nurse practitioner collaboration and the early management of symptoms Patients at the Massachusetts General Hospital.	Randomised Control Trial	The Intervention group received proactive telephone calls from their oncology team Nurse Practitioner during the week after each of the first 2 chemotherapy administration visits. The findings suggest that a pro-active intervention delivered by a patient's oncology team nurse practitioner provided reassurance but did not improve symptom burden, satisfaction with care, or the likelihood of anxiety and depression symptoms during the first two chemotherapy cycles.

Table 12. Summary table of nursing activities literature (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Vortherms, J., Spoden, B. & Wilcken, J. 2015 USA	To evaluate outpatient oncology staffing options and initiate development of an outpatient oncology staffing model. Outpatient chemotherapy infusion centre in community-based, not-for-profit hospital.	Pilot Study (incl. development of acuity-based staffing tool)	Despite evidence supporting 16- to 20-point assignments, some nurses struggled at 14 points. To cope, they requested assistance from the rapid response RN, limiting that RNs ability to respond to other patient situations. Decided not to reduce acuity points per nurse, and for nurses to strengthen communication with the charge nurse to proactively obtain assistance. Charge nurse coaching supported these nurses.

All of these papers highlight the many and varied activities undertaken by oncology nurses working in ambulatory and day wards. In the UK, Cheevers et al., (2020) reported that nurses in this setting worked, on average, one hour and 10 minutes over their contracted time and that 60% of nurse respondents reported a medium level and 33% reported a high level of emotional exhaustion.

5.4.5. Additional Nursing Activities

A number of articles included in the review relate to telephone triage (TT) (n = 10) and outreach/community activities (n = 5). These are summarised in Tables 12 and 13.

5.4.5.1 Telephone Triage

The majority of the staff nurse role in the provision of SACT includes delivering direct patient care involving the provision of complex treatments and the management of the side effects of therapy or disease. Telephone Triage (TT) is incorporated within this role, with staff nurses triaging patient problems and advising concerning symptom evaluation along with initiation of interventions (NCCP, 2022). TT is a significant aspect of oncology care that affords direct access to the oncology team to report side effects, assistance with symptom management, patient education, and detection of potentially life-threatening situations Pirschel (2018). Flannery et al. (2009) also identified that the workload associated with TT is complex and highly variable following their study to establish the telephone call volume and distribution in an active ambulatory oncology practice in the United States. Barrett et al. (2019) highlighted that calls from patients and families, their GPs, community care, palliative care teams or within the hospital itself is a substantive aspect of the nursing role in AHODU. In a large AHODU in Dublin, Ireland, Daly et al. (2013) recognise the need for protected time for TT within the nursing workload model along with a dedicated space and phone line.

Telephone triage services can have a number of applications. Jernigan et al. (2020) supported the application of a proactive nurse-led TT with their intervention to enhance the symptom experience of patients having their first line chemotherapy in the ambulatory setting in the United States. According to Gaubert (2020), TT should be used for patient symptom management with patients presenting with less problem visits. Kondo et al. (2015) investigated the use of a telephone triage service to assess adverse events with a standardised tool at an outpatient treatment centre in Japan. Finally, Moretto et al. (2019) reinforced the benefits of

a nurse-led telephone follow up interventions for patients (in Brazil) receiving chemotherapy in oncology outpatient's clinic in terms of management of symptoms and health related quality of life.

The success of TT depends upon a distinctive skill set for oncology nurses to converse and identify underlying issues with their patients Pirschel (2018). In the United States, Gleason et al. (2013) devised an initiative to highlight the educational needs of registered oncology nurses working in an ambulatory outpatient's clinic along with intended strategies to educate and enhance their TT skills.

The UK Oncology Nurses Society (UKONS) (2016) devised a 24-hour triage risk assessment tool using a red, amber and green system to categorise presenting problems of patients calling 24-hour advice lines. This tool is widely used within the UK, Ireland and internationally for the telephone assessment and triage of patients. Reports indicate that there should be procedures available to trace or follow up any activities that occur post the applicable call and calls should be audited regularly to assess the effectiveness of advice provided (UKONS, 2010; 2016; NCCP, 2022). There is an acute oncology CNSs allocated to each SACT service in Ireland and within one hospital this role is allocated to an ANP. Their role is TT, for patients within AHODU and they use the UKONS (2016) guidelines to assist in the triage of patients with acute symptoms as a result of their treatment or their disease (NCCP 2022).

5.4.5.2 Community Oncology

The NCCP (2011) developed an educational programme and learning resource in Ireland for community nurses (PHNs and CRGNs) to support and facilitate them providing community oncology nursing care to their patients. Subsequently Hanan et al. (2014) and O'Mahony et al., (2021) evaluated community oncology nursing programmes in Ireland for patients receiving systemic cancer therapy and established that this integrated care model of delivery was effective. They suggest that this integrated approach to patient care delivery has the potential to match the increased demands of oncology care in a patient-centred manner but that governance and agreed patient pathways are critical enablers. They found it is more cost effective to deliver care in a primary care facility in the community as opposed to in a patient's home. Srithumsuk & Wangnum (2021) identified the challenges of home chemotherapy in Thailand, as this service is in its infancy with only certain types of treatment deliverable in the home setting. The difficulties during the COVID-19 pandemic were also recognised as a mitigating factor in home chemotherapy delivery as well as role clarity for both oncology and home health care nurses. Penfold et al. (2016) discussed the benefits of a purpose-built nurse-led chemotherapy mobile service within the community in Manchester, UK. This service provides treatment closer to home for patients who would usually travel long distances to attend appointments at the Trust's main hospital site.

Table 13. Summary Characteristics of Telephone Triage (TT)

Reference	Aim of the study	Setting & Methodology	Specific grade of nurse	Key findings
Barrett et al. (2019) IRL	To assess the nature of calls to the day unit and broad advice given to callers so that a dedicated Acute Review Specialist Oncology Nurse Clinic could be developed.	Medical oncology day unit, large teaching hospital Call Log	Specialist oncology nurse, and staff nurse	The analysis of answered calls identifies the necessity for involvement of experienced oncology nurses in the triage of phone calls within a demanding oncology day unit along with the requirement to develop an Acute Review Clinic, directed by an experienced oncology nurse specialist. It was recognised that processing and responding to these calls from patients and families, their GP's, community care, palliative care teams or within the hospital itself is a substantive aspect of the nursing role in AODC. In addition to advising diagnostics, emergency department and wards seeking advice or consults can all be time consuming and undocumented in terms of the associated workload for the nurses in this day unit.
Compaci et al. (2011) FRA	To improve ambulatory care quality in aggressive B-cell lymphomas through use of a standardised telephone intervention.	Community setting linked to oncology centre Intervention feasibility testing	Oncology certified nurse	Ambulatory medical assistance (AMA), a telephone-based follow-up procedure, centred on scheduled calls to the patient's home by an expert oncology nurse who initiated a series of graduated interventions established from analysis of clinical and biological monitoring parameters and formerly established protocols. The efficiency of the AMA process was also reinforced by its triage function with the nurse managing a high volume of calls without direct participation of an oncologist. It is founded on the competency of specialised nurses. AMA aims to deliver health care quality, to encourage therapeutic adherence and education with patients along with maintaining patients at home, enhancing emotional support, and use of suitable medical resources.

Table 13. Summary Characteristics of Telephone Triage (TT) (Continued)

Reference	Aim of the study	Setting & Methodology	Specific grade of nurse	Key findings
Daly et al. (2013) IRL	To safeguard patient safety by standardising TT in the haematology/ oncology setting.	Haematology oncology services, large teaching hospital Service Evaluation	Staff nurses	Both nurses and patients completed a questionnaire concerning TT; it was recognised the necessity for protected time, space, and phone line along with standardised protocols, guidelines, e-documentation, and staff competency. Following a 3-month timeframe of implementation standards the process was then evaluated; this included a random analysis of the number and types of TT. Findings included that 90% of TT delivered both appropriate and immediate advice to patients, with governance and duties in following up patient concerns were processed. The standardisation of the TT system through nursing leadership enabled enhanced patient care. It enhanced staff nurses' recognition of the relevance of timely, quality intervention along with knowledge and skills in addressing patients' problems. There was also accurate documentation on the electronic patient records (EPR) which supported appropriate patient management, enhanced team communication and increased adherence with both professional and legal requirements.
Flannery et al. (2009) USA	To define telephone call volume and distribution in an active ambulatory oncology practice.	Ambulatory medical oncology and haematology adult practice. Descriptive study	There was a dedicated telephone line staffed by two registered nurses are assigned to manage calls during normal business hours	Telephone calls are a large component of ambulatory oncology practice. The workload involved in managing calls is significant, complex, and highly variable. Possible reasons for increasing call volumes could be increased complexity of oral chemotherapy management and an overall increase in ambulatory management of cancer. Considering large volume of repeat calls, telephone call management is seen as a mechanism for providing continuity of care, not just triage of urgent needs.

Table 13. Summary Characteristics of Telephone Triage (TT) (Continued)

Reference	Aim of the study	Setting & Methodology	Specific grade of nurse	Key findings
Gleason et al. (2013) USA	To identify the educational needs of registered nurses and design strategies to educate and improve their telephone triage skills.	Ambulatory outpatients' cancer centre Survey Service improvement initiative	Staff nurses	An initial online needs assessment tool was used to evaluate the nurse's comfort with telephone triage (TT) and its management, recognition of impediments to TT, understanding of disease process, and detection of oncologic emergencies. Educational presentations were organised bimonthly by members of the multidisciplinary team. Every presentation concentrated on improving disease-based knowledge along with reinforcing TT skills for symptom management relevant allied to a specific disease and/or therapy. Following a 3-month trial, the evaluation noted an increase knowledge concerning diseases, the management of side effects along with nurses being comfortable not referring patients to the emergency department. The educational presentations will continue along with the intention to standardise the triage practice.
Gaubert (2020) USA	To study the education practice.	Oncology outpatients centre Quality Improvement Study	Staff nurses or oncology outpatient infusion centre nurses	90% of nurses conveyed an inability to deliver comprehensive education to their patients. Barriers identified by nurses included a lack of knowledge and time with escalating patient loads and increased patient acuity. Patients experiencing their first chemotherapy should be educated and provided with necessary learning resources. Patients' safety should be evaluated for outcome measures through adherence with home care techniques along with reduced problem visits and TT concerning symptom management.

Table 13. Summary Characteristics of Telephone Triage (TT) (Continued)

Reference	Aim of the study	Setting & Methodology	Specific grade of nurse	Key findings
Jernigan et al (2020) USA	To determine the viability of a nurse driven TT intervention for patients receiving first-line chemo in the ambulatory setting.	National Cancer Institute–designated comprehensive cancer centre Feasibility study	Staff nurses and an advanced practice nurse	The findings reinforce involving nurses in the ambulatory setting to fully assess and deliver ample care to patients navigating their first course of chemotherapy. Applying a proactive nurse-driven TT intervention can potentially transform cancer care and patient outcomes during active treatment in the ambulatory setting.
Kondo et al. (2015) JPN	To investigate the potential for a TT service using CTCAE (common terminology criteria for adverse events) to predict severe adverse events in ambulatory chemotherapy.	Outpatient treatment centre Evaluation and testing a tool	Telephone consultation service is operated by rotation of staff members including nurses, pharmacists, and medical oncologists.	Using a telephone triage service to assess adverse events with a standardized tool is a useful method to predict changes in planned chemotherapy schedules. Changes in planned chemotherapy schedule were more likely to occur with grade 2 adverse events and with males. Overall, using phone triage to assess adverse events with the CTCAE tool was useful to predict severe events that may change clinical scheduling.
Moretto et al. (2019) BRA	To explore the evidence concerning nurse-led telephone follow up interventions with outpatient oncology patients receiving chemotherapy.	Oncology outpatients' clinics Literature review	N/A	This integrative review identified that the use of nurse-led telephone follow-up interventions were identified as a feasible and efficient strategy for patients receiving outpatient cancer chemotherapy, especially due to the evidence relevant to the management and control of symptoms, health-related quality of life, and self-efficacy.
United Kingdom Oncology Nursing Society (UKONS) (2016) UK	To highlight the UK oncology nurses society (UKONS) 24-hour triage tool	Oncology/ haematology units Nursing standards	Staff nurses	The UKONS Toolkit is a 24-hour triage risk assessment tool utilising a red, amber and green (RAG) scoring system to recognise and concentrate on the presenting problems of patients contacting advice lines 24/7 for assessment and advice. UKNOS Version 2 consists of information and a training manual with the premise that this essential reading should be conducted prior to using or instigating the UKNOS toolkit in clinical practice.

Table 14. Summary Characteristics of Community Services

Reference	Aim of the study	Setting & Methodology	Specific grade of nurse	Key findings
Bloodworth et al (2018) USA	To restructure the lymphoma service in the day unit in off-site oncology units.	Off-site oncology centres Patient stories and time and motion audits of pilot study.	N/A	The intervention freed up chair space for the administration of the rituximab biosimilars without additional costs to the lymphoma service.
Hanan et al (2014) IRL	To establish whether training and systems were put in place to equip community nurses participating in the programme with the competence and confidence to manage patients safely in the community	Selected cancer centres and units associated with centres of nurse education. Survey Qualitative interview Evaluation of the pilot programme	Community staff nurses who had attended the NCCP (2011) community oncology educational programme	The evaluation of the community oncology nurse education programme established that this integrated care model was effectively delivered. It has led to aspects of oncology care being provided safely to patients within their homes. It was also regarded as positive by staff in the community and hospital. In addition, it was identified by patients that it enhanced their quality of life. There began a partnership approach between the community nurses and the oncology day ward nurses in caring for these patients. The community nurses had the competence and confidence to safely provide cancer care in the community with the extension of their scope of practice. This integrated approach to patient care delivery has the potential to match the increased demands of oncology care in a patient-centred manner.
O'Mahony et al (2021) IRL	To establish the lived experiences of both patients and nurses participating in a community oncology nursing programme along with investigation its impact.	Oncology day ward and community services. Qualitative interview	Hospital and community based nurses	The community oncology nursing programme has been a positive experience by both nurses and patients with enhanced quality of care delivered in cancer services.

Table 14. Summary Characteristics of Community Services (Continued)

Reference	Aim of the study	Setting & Methodology	Specific grade of nurse	Key findings
Penfold et al (2016) UK	The primary aim of the mobile unit is to provide treatment closer to home for patients who would usually travel long distances to attend appointments at the trust's main hospital site.	The mobile unit treats patients five days a week from 9am to 4pm, travelling to a different community location each day. The trust selected these locations based on research that identified five areas where the service would be needed most. Commentary/ Discussion piece	Staff nurse (registered); Clinical nurse manager; Healthcare assistant/ nurse assistant (aka chemotherapy support worker)	The purpose-built nurse-led mobile service has four treatment chairs and the latest chemotherapy treatment equipment, as well as a separate consultation room to enable patients to speak to a nurse in private if they prefer. Up to 20 patients a day can be treated at the unit, but each day varies, based on the primary factor of length of treatment. Some treatment regimens may involve just a five-minute injection, while others can take up to three hours. The mobile unit provides standard treatments, such as boluses and short infusions for any solid tumour group.
Srithumsuk & Wangnum (2021) THA	To deliver a summary of the lessons learned for providing chemotherapy to cancer patients at home from the perspective of the oncology nurses during the COVID 19 pandemic and new normal in Thailand.	Initial hospital setting then community setting. Commentary/ Discussion piece	Oncology nurses, specialist chemotherapy nurse, home health care nurses (HHC), advanced practice nurse, oncology case manager	Home chemotherapy will continue to be challenging in Thailand as it is in its early stages; only certain types of cancer and chemotherapy can currently be conducted at home. There needs to be improvements in the roles of oncology and HHC nurses to enhance the quality of care for patients and their families. The obstacles to home chemotherapy delivery also need to be clarified along with the ongoing challenges with COVID-19.

5.4.6. Summary of Role of the Nurse

Summary Points Role of the Nurse
• Delivery of SACT is a highly specialised and complex role that requires specialised knowledge competence and skills.
• Recently published national SACT competency programme for every nurse administering SACT within Irish hospitals includes pre-requisite learning, annual re-accreditation SACT competency certificate and SACT certified provider.
• It is vital that nurses adhere to their scope of practice and maintain their competencies in this specialised role.
• Nurses working in AHODU undertake many and varied activities including administration of SACT, along with the provision of psycho-social and educational needs.
• Telephone Triage (TT) is an essential role of nurses working in AHODU, in supporting and triaging patients who are experiencing problems with their SACT treatment.
• Irish nurses use the UKONS (2016) guidelines when performing TT.

5.5. Skill Mix

As outlined by Brisley et al. (2003), nursing practice in delivery of SACT is a highly specialised and complex role that requires specialised knowledge and skills. To provide safe and effective care, a high skill level in precise drug administration is required, an understanding of toxicities and side effects associated with specific drugs, as well as an ability to attend to patients' psychosocial adjustment is also needed. Staff skill and experience must be taken into account when determining appropriate nurse staffing configuration. Gaits (2005) highlights that nurses who are assisted by other supportive staff (e.g., healthcare assistants, nurse practitioners, social workers, or triage nurses) will be able to devote most of their time to direct patient nursing care activities.

5.5.1. Administrators.

Many of the articles focusing on scheduling made specific recommendations about who should schedule patients. The role of the scheduler was to arrange appointments for diagnostic tests, consultations and future treatments, record details regarding insurance authorisations as needed and facilitate correspondence to the primary care team (Chabot & Fox, 2005). The majority of the articles recommended that administrative staff schedule patients for their chemotherapy (Langhorn & Morrison 2001; Santibanez et al.2012; Nevidjon 2018 Baril et al. 2020; Lafferty et al. 2020). Baril et al. (2020) identified that administrative staff would need information on the nursing workload required for individual treatment protocols in order to facilitate efficient scheduling of patients to nurses. In contrast, Reynolds (2021) stated that any staff within the oncology/ haematology day unit could schedule patients.

5.5.2. Health Care Assistants (HCA)

The term HCA is used in Ireland, England and Canada while the term 'Healthcare Support Worker' is used in Scotland and auxiliary is used in Italy (Conyard et al., 2020; Drennan et al., 2018). The term 'Certified Nursing Assistants' is used in the USA (Drennan et al. 2018). All HCAs in Ireland are expected to have a minimum of QQI level 5 qualification in healthcare. The HSE (2018) have adapted the International Standard Classification of Occupations (International Labour Office, 2012) in their definition of the role of the HCA, which is as follows:

"Healthcare assistants provide assistance, support and direct personal care to patients and residents in a variety of healthcare settings such as hospitals, clinics, nursing homes, aged care facilitates as well as community and domestic settings. They generally work in support, or under delegation, direction, and supervision, of health professionals. They support multi-disciplinary teams in the delivery of high-quality care" (HSE 2018, p28).

There is limited reference to the role of the HCA in the articles retrieved. Comerford & Shah (2019) identified that there was one HCA working with four RGNs in their ambulatory oncology unit in London, however they did not specify what was the role of the HCA. Penfold (2016) outlined the role of the HCA in assisting with line care, including flushing lines within an English mobile chemotherapy unit. Di Giullio (1988) outlined the role of the auxiliary included hospitality and infection control.

This review identified other roles operating in the AHODU setting, including nursing technician (Brazil) (Santos & Gaidzinski 2019), medical assistant (USA) (Chalbot & Fox 2005; Turkan et al. 2010) Kamimura et al. 2012; Nevidjon 2018) and associate nurse (UK). Conyard et al. (2020) outlined how the role of nurse technician in Croatia was equivalent to that of a HCA. There is little or no international literature identifying what is the equivalent grade of the nurse technician in Brazil.

The International Labour Office (2012) define medical assistant as an individual who works under the direct supervision of a medical practitioner or other healthcare professional, performing basic clinical and administrative tasks to support patient care. This scoping review identified some aspects of the role of the medical assistant within AHODU. A US based study (Turkcan et al., 2010) identified the role of medical assistants to prepare patient documentation, provide supportive care to help with patient needs and other work delegated by nurses (Nevidjon (2008). Both Chalbot & Fox (2005) and Kamimura et al. (2012) alluded to other skills and activities including vital signs monitoring, monitoring patient's weight and height, phlebotomy and transportation. Another task performed by medical assistants in one centre was administration of injections (Nevidjon 2018). However, nurses also reported lack of clarity in the role of medical assistants (Kaminura et al. 2012).

Associate Nurses in the UK are employed as band 4 and the role aims to bridge the gap between HCA and Registered Nurse's role (King et al., 2020; NHS Health Education England, 2020). UKONS (2022) does not support the practice of associate nurses administering SACT to adults with cancer. Within the Republic of Ireland, HCA's and Registered Nurses and midwives are employed in the Irish health services. There is no other grade of nurse recognised in Ireland.

5.5.3. Charge Nurse (Clinical Nurse Manager)

Both Gaubert (2020) and Cusack et al. (2004) recommend the employment of a charge nurse. Cusack et al. (2004) recommend that the charge nurse is not allocated a patient case load but is responsible for the smooth organisation of the services within oncology/haematology units. Some of the key roles of the charge nurse advocated by Cusack et al. (2004) are similar to the clinical co-ordinator role outlined

by De Raad et al. (2010). De Raad et al. (2010) identified that some oncology/haematology day wards employed a clinical co-ordinator whose remit included review of patients' medical notes and blood results prior to their arrival to the unit, answering calls from patients regarding appointments and management of adverse events. The Department of Health (2018 and 2022) recommends that the Clinical Nurse Manager (CNM2) grade is not allocated a patient case load as their role is as a supervisor for 100% of their time in general and specialist medical and surgical wards as well as in ED. Furthermore, In Ireland, the NCCP SACT Model of Care (NCCP 2022) advise that a CNM2 should be allocated the responsibility of the management of SACT outreach services.

5.5.4. Nurses administering SACT

The Canadian Association of Oncology Nurses (CANA) (2017) recognises that the models of cancer care delivery are changing and thus many patients now receive their cancer treatment in their own homes. Both CANA and UKONS recommend that RNs administer parenteral chemotherapy in any setting, be it at home or inpatient or day care setting.

Both Noel (2019) and Reynolds (2021) identified that in their American AHODU, all of the nurses had undertaken chemotherapy competency educational programme. Furthermore, Reynolds (2021) identified that two of their nurses had additional oncology expertise and were classified as "oncology certified nurses." National and international guidelines on the administration of SACT requires nurses to have certified competency in SACT (East Midlands Expert Clinical Advisory Group 2020; UKONS 2021; NCCP 2022). Furthermore, to minimise drug errors, two nurses are required to check patient details, prescriptions, dose calculations, and laboratory results and these nurses need to have knowledge of SACT and thus have a SACT passport. Both the UK and Canada recommend that a second healthcare professional with the appropriate knowledge and skills checks the drug prior to administration (East Midlands Expert Clinical Advisory Group 2020; Ontario Health 2021). The NCCP SACT Model of Care (2022, p78) recommended that all nursing staff involved in the administration of SACT must have completed the National SACT Competency Programme for Nurses Working in Cancer Care.

5.5.5. SACT assessors

SACT assessors are required to be senior nurses, who have completed the preceptorship programme or other teaching qualification and the UKONS SACT Assessor online 'Train the Trainer' programme (NCCP 2021). Each AOHCU needs to identify a senior nurse to act as a SACT assessor, to support nurses new to SACT administration and to support the implementation of the National Competency educational Programme for Nurses Working in Cancer Care (NCCP 2021). UKONS (2021) recommends that SACT assessors should be at least band 6[3] (UK) or higher, which is equivalent to a senior staff nurse in Ireland. Ontario Health (2021) states that the assessor is a 'nurse expert' who has obtained certification of competency, maintained competence to administer SACT, and demonstrate specialised knowledge, skills and critical thinking in SACT care. In addition to SACT assessors, many hospitals employ clinical facilitators, who are senior nurses who provides clinical education and support to oncology nurses in practice (Department of Health 2022).

3. Band 6 is nurse specialist or senior nurse.

Table 15. Summary Characteristics of Skill Mix

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Beaver et al. 2016 USA	To develop and implement processes for standardizing nursing practice across diverse ambulatory oncology settings in 17 distinct and independent cancer care venues.	Commentary/ Discussion piece	One program assessed competences needed to develop systems of care to detect and treat treatment-related side effects. Nine side effects of cancer treatment (chemotherapy and/or radiation therapy) were targeted A second program was developed to assess competencies needed to prevent harm to oncology patients.
Canadian Association of Nurses in Oncology (CANO) 2017 CAN	To provide standards for the practice, education, and continuing competence of Registered Nurses (RNs) and for the quality practice environment required to ensure optimal cancer chemotherapy nursing practice in Canada.	Nursing standards	Position Statement: “Cancer chemotherapy should be delivered by Registered Nurses and patients receiving chemotherapy for the treatment of cancer should receive care from Registered Nurses.”
Canadian Association of Nurses in Oncology (CANO) 2006 CAN	The document contains only those standards of oncology nursing practice for the specialized oncology nurse.	Nursing standards	Practice Domain 1: Comprehensive Health Assessment (competencies listed) Practice Domain 2: Supportive and Therapeutic Relationships Practice Domain 2: Management of Cancer Symptoms and Treatment of Side Effects Practice Domain 2: Teaching and Coaching Practice Domain 2: Facilitating Continuity of Care/Navigating the System Practice Domain 2: Decision Making and Advocacy Practice Domain 2: Professional Practice and Leadership

Table 15. Summary Characteristics of Skill Mix (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
East Midlands Expert Clinical Advisory Group 2020 UK	To support the delivery of Systemic Anti-Cancer Therapy (SACT) used to treat cancer in East Midlands.	Policy document	A nurse who has completed an agreed competency-based training course must always be one of the two practitioners responsible for checking, assigning and administering SACT. One of the two people checking any SACT must be the administering person. Nursing staff of any grade may only administer SACT under the supervision of an appropriately trained nurse until they have completed the necessary training and achieved competency.
Griffiths et al. 2012 ENG	To identify patient outcomes sensitive to the quality of nursing services in ambulatory cancer chemotherapy settings to guide the development of an outcomes-based quality measurement system.	Literature review	Recommend that any system developed to monitor or demonstrate the quality of nursing care incorporated measures and reports of structural factors including level and skill mix of nurse staffing, specialist qualifications of nurses and quality of the practice environment. The purpose of identifying a set of outcomes as specifically nurse-sensitive for quality measurement is to give clear responsibility and create an expectation of strong clinical leadership by nurses in terms of monitoring and acting on results.
NCCP 2014 IRL	National baseline assessment of systemic cancer therapy cancer services in day units from a patient safety perspective, from all hospitals in Ireland involved in the administration of SACT.	Service review	Recommendations for staffing: “There should be national agreement on the minimum key personnel required for an oncology/ haematology day unit in relation to scope of service and the essential qualifications/ experience of these key staff.” and “The NCCP should develop a capacity-planning model to support hospitals in their local service planning with regard to day ward activity and staffing requirements.”
Lennan et al. (UKONS) 2012 UK	The UKONS position statement sets out the core issues for nurse-led chemotherapy review clinics for adult patients.	Position statement	Nurses must never work in isolation. The chemotherapy nurse must always work as part of a team, with robust lines of support, e.g., from medical and pharmacy colleagues. UKONS recommends nurses to conduct and assume accountability for their own service audits.

Table 15. Summary Characteristics of Skill Mix (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
Melville & James 2016 USA	Introduction of certified medical assistants (CMAs) into outpatient clinics. (Conference Abstract)	Literature review	The new model appropriately reassigned duties related to patient care and administrative tasks to the appropriate medical personnel (i.e., RN, Certified Medical Assistant (CMA)) to allow each to work to their fullest scope. The delegation of tasks to CMA's will facilitate nurses to perform within their fullest scope allowing adequate time for thorough assessment, enhanced education and follow up phone calls post chemotherapy.
Rodriguez 2019 USA	To understand the self-reported time ambulatory oncology nurses spent on various tasks and activities in the outpatient setting.	Quantitative Survey	Multiple factors determine the appropriate skill mix and number of staff to effectively care for the cancer patient. Patient treatment, long-term chronic care needs, care coordination and management add to the complexity and acuity of the patients.
The Wales Cancer Network with UKONS Oncology Nursing Society 2019 UK	The aim of the National Systemic Anti-Cancer Therapy (SACT) Competency Programme for Nurses Working in Cancer Care is to standardise the education and assessment of SACT administration and patient care, ensuring consistently safe and high-quality SACT practice.	Nursing standards	Programme Overview: 1. Attending the two-day training programme to cover prerequisite theoretical learning (virtually, in the classroom or through blended learning). 2. Completion of the theoretical sections of the UKONS Passport. 3. Completion of the clinical practice competency sections of the UKONS Passport with an approved SACT administration assessor. 4. Completion of the UKONS SACT Safe Handling and Administration Certificate and then annual completion of the Re-accreditation Competency Certificate and submission to HSELand to ensure the nurse remains a competent SACT administrator.
	To publish the updated version (Version 4) of the Systemic Anti-Cancer Therapy (SACT) Competency Passport. This provides comprehensive standards for assessing SACT competence, which can be used throughout the UK.	Nursing standards	These standards set out: - Prerequisite competencies - Prerequisite theoretical learning - Professional responsibility

Table 15. Summary Characteristics of Skill Mix (Continued)

Reference	Study Aim & Setting	Methodology	Summary of Key findings
**UK Oncology Nursing Society 2016 UK	To provide a toolkit for staff manning 24-hour advice lines for patients who are receiving SACT, radiotherapy, bone marrow graft or may be suffering from related immunosuppression.	Nursing standards	Nurses operating telephone triage and assessment services should successfully complete the 24-hour triage training and competency assessment. The UKONS Toolkit Information and Instruction Manual should be read in detail at the start of training, followed by a process of formal classroom-based training with scenario practice, and then observed clinical practice and competency assessment.
UKONS Oncology Nursing Society 2021 UK	Position statement on recommendations for staff who administer SACT in the UK.	Position statement	The UKONS Board recommend that staff who administer SACT complete a university accredited SACT course accredited at HEI level 6 (BSc Hons) or level 7 (MSc) alongside the UKONS SACT Competency Passport. They should be employed in a role that is Band 5 or above. UKONS does not recommend this model of practice of SACT qualified nurses undertaking a restricted range of SACT-related activities. Investment needs to be made in educating, training and assessing SACT nurses, who will themselves be assessors in the future when they hold roles that are band 6 and above. "If a task-oriented approach to practice is to be used, a full risk assessment is needed to ensure safe care can be maintained, as the risk of incidents might increase if different personnel are responsible for administering different elements of SACT treatment and care."

5.5.6. Summary of skill mix

Summary Points Skill Mix
• Staff skills, competencies and experience must be considered when determining appropriate nurse staffing configuration.
• Some tasks/ activities can be undertaken by others such as administrators, health care assistants, associate nurses.
• National and international guidelines will determine who is responsible the administration of SACT in different jurisdictions.

6. Discussion

This scoping review aimed to map the available literature relevant to describe the role of the nurse, the appropriate skill mix, and to identify models or tools used to determine appropriate nurse staffing within AHODU where SACT is delivered. The review identified 13 acuity tools used in AHODU settings, reported nurse-to-patient or nurse-to-chair ratios evident in the literature, described the role of the nurse and skill mix within AHODU and looked at the challenges associated with scheduling patients in AHODU. In this final section, the use of an acuity tool will first be discussed, followed by the challenges associated with scheduling patients in AHODU, nurse to patient ratios, and skill mix. Finally, a discussion on the role of the nurse in AHODU follows, including the role in telephone triage for patients in receipt of SACT as well as a focus on the importance of person-centred care and patient safety in AHODU SACT delivery settings.

6.1 Acuity Tools in AHODU

This review identified thirteen acuity tools currently used in AHODU settings. While variation among the tools was evident in terms of the format and elements included, a common approach of categorising patient acuity according to the range of nursing activities required, rather than the SACT regimen alone, was observed. As may be expected, the key elements included in many of the acuity tools (Table 4) were found to broadly reflect the nursing activities outlined in Section 5.4.

Eight tools included a weighting or specific time allocation for patient education. Separately, De Raad et al. (2010) reported that the average time for patient education was 48 minutes for the first visit, and this reduced to 18.5 minutes for subsequent visits. The authors also identified that some Australian oncology/haematology day ward settings offer group educational sessions for patients on a specific day of the week rather than individual sessions for new patients which may be a time saving approach (De Raad et al. 2010). Relatedly, a small number of the tools acknowledge the extra time required with new patients (i.e., attending first treatment visit) as it is expected that such patients and their family/caregivers require additional time for education (e.g., symptoms management) and psychosocial support. The lack of time allocation for psychosocial support was notable as only three tools mentioned this.

It is important that additional needs and potential unplanned care requirements are also accounted for in acuity tools. Alvarado & Ntaimo (2018) outlined the impact that patients experiencing side-effects or hypersensitivity reactions can have on scheduling plans as they can require longer appointment times

and greater input from nurses. Management of adverse reactions may require calling the physician, monitoring vital signs, administration of medications, and involvement of a second nurse (BC Cancer, 2018). Seven acuity tools were shown to account for the risk of side-effects/ reactions. Furthermore, three of the acuity tools included a category of additional patient needs which required extra nursing time. These additional needs could include patient frailty, impaired mobility, cognitive issues, or language difficulties which required the use of an interpreter (Vortherms et al., 2015). De Raad et al. (2010) previously reported that Australian nurses required additional time for patient education if the individual had difficulties in speaking and understanding English.

Importantly, this review highlights the wide and complex range of activities conducted by nurses in the AHODU setting and an acuity tool needs to account for the complexity of services provided. It is worth noting that different units may provide varied services or activities, which should be accounted for in degree of customisation needed in individualised acuity tools. For example, scalp cooling (Shaw et al., 2018) is an optional service developed to reduce the hair loss caused by some chemotherapy drugs that was not identified within the existing acuity tools. This service can add up to an additional two and a half hours treatment time for the patient and represents additional nursing workload (e.g., staff education & training, fitting the cooling cap) (University of Melbourne & Peter MacCallum Cancer Centre, 2020).

It is important to highlight however, that the tools identified in this review have been developed by researchers and clinical staff to be used in their specific settings. Most of the acuity tools were developed in the USA while others were developed in Canada (Green et al. 2012; Knox 2022), Australia (Delaney et al. 2002) and Turkey (Tuna et al. 2015). Across different jurisdictions, the organisation of services, skill mix, and availability of staff can vary, and this should be considered when considering the transferability of acuity tools for use in other settings. Thus, acuity tools developed in one country may need to be modified and tested before implementation in a new jurisdiction.

Importantly, it is recognised that staffing in ambulatory infusion settings should not take a one-size-fits-all approach (Nevidjon, 2018). Given the unique characteristics of different clinical settings, Rodriguez et al. (2020) recommend selecting a pre-existing acuity tool from the literature that best suits the needs of the intended setting, followed by a process of customisation. As well as the variability in services across international jurisdictions, differences between services nationally must also be considered. Given the variation in staffing and nursing activities in AHODU settings and SACT delivery units in Ireland, one fixed tool may not meet the needs of multiple services. Some of the reviewed instruments (e.g., Edwards et al. 2017) reflect a task orientated approach to nursing activity and consequently underestimate the range of professional activities and related time commitment within nursing work. The majority of the acuity tools did not include psychosocial support. Patient acuity tools that account for indirect care have potential to be of greater utility within AHODU.

This review has uncovered the range of tools developed to assist with this complex scheduling activity which is reliant on standardised processes but must allow for flexibility and local adaptation to respond to the local constraints and considerations. Acuity tools require professional judgement to enable person centred and responsive care. (Department of Health, 2018). The available instruments have limited transferability due to limited testing of reliability and utility of instruments. Any tool proposed for adaption to the Irish context will require evaluation of

validity and reliability (Fesler & Toms 2020). Given the variation in staffing and nursing activities in SACT units nationally in Ireland, further research is required to develop a flexible patient acuity system that can be tailored to individual settings.

6.2. Scheduling challenges

The scheduling of patients in the ambulatory oncology setting for delivery of their SACT therapies and supportive treatments is a complex process. This scoping review identified 35 studies that used simulation and development of mathematical formulas to develop optimal scheduling. These studies have been used in developing software to assist in scheduling AHODU patients. The data extracted from these studies highlighted the complexity of scheduling AHODU patients. The precision in scheduling has considerable influence on the nurses' workload, workflow within AHODU, patients' waiting times and ultimately patients' experience within AHODU.

The prediction of workload in the AHODU is a multifactorial and contextual endeavour. The allocation of nursing resources in the AHODU will be influenced by the local health care organisational context, cancer care policy and guidance on chemotherapy administration in addition to the scope of practice of nursing staff in respective jurisdictions. One single workload tool did not emerge in this literature review as being responsive to all care environments. However, recurrent features were in evidence across the detected tools including consideration of anticipated chair time, and treatment complexity. It is clear that patient acuity and treatment scheduling should be considered simultaneously and synchronised closely. It is evident that the work of the AHODU, incorporates considerable indirect care activities in terms of planning for forthcoming admissions in addition to the managing an active case load of patients experiencing treatment related side effects. Managing complex care needs for the latter requires skilled registered nursing assessment and telephone triage to avoid unnecessary Emergency Department (ED) presentations.

A comprehensive acuity tool that captures the complexities of SACT delivery and the nursing activities performed in the AHODU should provide accurate nursing timings for treatment regimens that can be used to inform day-to-day scheduling of patients. There are some examples in the literature that may have relevance to the Irish heath care context but will require adaptation. For example, the acuity tool developed by Green et al. (2012), for Cancer Care Ontario in Canada[4] is a comprehensive resource, containing detailed information on cancer treatment regimens, specifying the nursing time required, the pharmacy's time required and the patient's visit time or chair time. In Ireland, the National Cancer Control Programme[5] provides guidance on chemotherapy regimen with infusion times outlined as a reference point. Table 16 presents two sample drug regimens and their associated timings as per the Cancer Care Ontario calculations and the infusion timings provided by the NCCP. As can be seen, there is common language but variance in the estimation of patient timing.

4. https://www.cancercareontario.ca/en/drugformulary/regimens
5. https://www.hse.ie/eng/services/list/5/cancer/profinfo/chemoprotocols/

Table 16. Sample Chemotherapy regimens with timings

Drug Regimen	Cancer Care Ontario, Canada	National Cancer Control Programme, Ireland
ABVD regime Drugs Used: Doxorubicin, bleomycin, Vinblastine, Dacarbazine	Patient Visit (Chair time) 1.5 to 2 hours Nursing Workload (Average time per visit) 62.417 minutes	Infusion times 2 IV boluses 1 infusion 10 minutes 1 infusion 30 minutes
CRBPDOCE+PERT+TRAS Drugs Used: DOCEtaxel, CARBOplatin, PERTuzumab Trastuzumab	Patient Visit (Chair time) First Cycle: 4.5 to 6 hours. Subsequent cycles: 2.5 to 4 hours Nursing Workload (Average time per visit) 67.500 minutes	Cycle 1 infusion time 4 hours Not including time for flushing of lines between medications or the recommended observation period required for a first dose of trastuzumab. Subsequent cycles 2.5 to 3 hours depending on the pertuzumab infusion time
NCCP If any reactions were to occur to these agents this would prolong the visit or maybe necessitate slowing of the infusion rates		

Sources: ABVD CCO https://www.cancercareontario.ca/en/drugformulary/regimens/monograph/45821 NCCP https://www.hse.ie/eng/services/list/5/cancer/profinfo/chemoprotocols/lymphoma-myeloma/290-abvd-therapy.pdf

CRBPDOCE+PERT+TRAS https://www.hse.ie/eng/services/list/5/cancer/profinfo/chemoprotocols/breast/722-docetaxel-carboplatin-trastuzumab-and-pertuzumab-tchp-therapy.pdf

The use of a customised acuity tool may assist the individual who is scheduling AHODU appointments in determining appropriate timings (i.e., nursing time, infusion time, chair time) in the Irish context so that scheduling may more accurately reflect all activities in the AHODU. A national audit of SACT regimen infusion times and related patient flow consideration will inform the identification of standardised appointment times for common drug regimens.

Some patients may have treatment regimens where they are required to attend weekly or monthly for a few months while others may be attending for longer. The length of the infusions may vary according to the treatment regimen and some patients may require intense monitoring after the regimen. There is considerable heterogeneity in the individual patient's care needs in response to treatment. Therefore, scheduling approaches need to provide flexibility to enable clinical judgement to respond to individual need. The person scheduling appointments must also consider the need to allow flexibility and to allow for some capacity rather than scheduling 100% of the time available. This would facilitate nurses to care for patients following up via telephone triage, and or who require urgent review in the AHODU for the treatment of sepsis as an example, or patients who require a longer visit (chair time) due to experiencing side effects of the treatment. It is clear that the nature of the AHODU service is demand led, and to some extent, not always predictable. In determining the distribution of nursing time and chair time in the AHODU, there is need to also plan for the acute unscheduled care arising from unforeseen patient needs when scheduling patients.

When an appropriate staffing level has been determined utilising acuity and staffing tools, as described in previous sections, it is imperative that patients are then scheduled in a way that makes sense within the available of resources (Rodriguez et al., 2020). The range of interventions and complexity of SACT regimens will vary across cancer care service and will be influenced by the local resources.

Internationally, patient scheduling practices in the SACT setting vary between hospitals and while some units may rely on scheduling by hand, others implement specific systems and Software packages (Altai Oncology Suite; MEDITECH Expanse Oncology). The ongoing implementation of the National Cancer Information System (NCIS) in Ireland has potential to help streamline the process of organising patient therapy plans. While any solution to the scheduling process and the technology used for this is outside the remit of this scoping review, it is worthwhile to consider the implications of scheduling practices for nurse staffing. Inefficient scheduling may result in missed care, nursing overtime, nursing burnout and patient dissatisfaction (Cheevers et al. 2020). It is important to manage the unplanned and unanticipated overtime of nursing staff as excessive overtime reduces the workplace satisfaction level of nurses (Gul, 2021). A critical consideration is optimisation of patient flow, and maximising use of available resources to avoid underutilisation of valuable nursing time and skills.

The NCCP recommends that patients, if appropriate, are offered a two-day treatment model whereby patient assessments and/or blood tests are conducted on the day prior to treatment to improve patient flow and decrease wait times (NCCP 2014). Allocation of scheduling with a next-day or same-day approach needs to consider factors such as the patients' proximity to the clinical site, transportation, work schedules, and caregiver schedules (Lafferty et al., 2020; Lau et al., 2014). Patients receiving high-cost drugs with short shelf-lives could be considered for next day chemotherapy in order to limit drug wastage (Lau et al., 2014). On the face of it, there appears to be merit in the two-day treatment model approach to optimise patient flow to maximise the effective use of organisational resources. However, a 2014 patient survey reported that the majority of patients (85%) preferred to receive their chemotherapy on the same day as their medical oncology outpatient appointment (Lau et al. 2014.). This finding does point to reticence among patients to the two-day treatment model. It is clear that some patient prefers same day treatment and appointment times due to demands associated with attending appointments. Adjustment of scheduling does require individualisation and assessment of an individuals needs to include transportation issues, carer support as well as consideration of potential effects of treatment and support that may be needed.

6.3. Staff ratios

This review mapped the data available on the nurse-to-patient ratio in this care setting. This issue is complex as some papers identified a nurse-to-patient ratio calculated as the whole day (max 1 RN to 9 patients per day) (Rodgers et al. 2016). Other studies identified a nurse-to-patient ratio at a particular time (a one nurse to one patient ratio for first 15 minutes and last 15 minutes of treatment in the US (Huang et al. 2018) or one RN to 4 patients at any one time in Tunisia (Bouras et al. 2017).

Some studies did not specify the statutory and required competencies in checking and administering SACT when determining nurse to patient ratio. Many of the patients who require less complex or a lower level of care only such as CVAD management, discontinuation of chemotherapy infusion pumps and phlebotomy prior to SACT are being advised to attend

community nursing services for this service (O'Mahony et al. 2021; O'Connor Power et al. 2022). Thus, patients attending AHODU require registered nurses to have SACT competencies to both administer and monitor during their complex regimes. If a patient is scheduled to a nurse without the required competencies in SACT, then that patient is required to wait until the nurse who is an accredited SACT administrator is available to administer SACT. This will impact on patient flow in AHODU and may result in longer patients' waiting time, and/ or nurses being required to work overtime to care for patients, whose treatment regimen was delayed. Ultimately, such factors will negatively impact the patient experience and contribute to job dissatisfaction among nurses. Skill mix is an integral component of allocation of staffing in AHODU. Scheduling must be cognisant of minimum threshold of staff and indeed ratios of SACT competent nurses to administer and manage treatment in this specialised care environment. It is recommended that the ratio of nurse to patient needs to allow capacity to respond to the indirect care activities that are inherent in this role and to allow for unscheduled care resulting from TT.

Seven studies identified a nurse to chair ratio. There are limits to using these ratios as it is not possible to determine whether there is one patient requiring a long SACT regimen in this chair or multiple patients receiving short regimes. This approach will ultimately be at risk of underestimating nursing workload associated with patient transitions. There are potential limitations to using nurse-to-patient/ nurse-to-chair ratios as they do not adequately consider the individual patients' needs/ acuity or unforeseen events (Gul 2021). Griffiths et al. (2020) outlines the benefits of using systems to determine patients' individual needs, such as a patient acuity tool in conjunction with a minimum nurse to patient ratio to determine the overall nursing staff requirements.

6.4. Role of the Nurse

This scoping review identified that the role of the nurse in AHODU is broader than just the administration of SACT. Nurses in AHODU provide a holistic person-centred care of patients who are receiving SACT. AHODU nurses were identified in this review as having a vital role in communicating with patients (de Raad et al. 2010: Farrell et al. 2011) and co-ordinating their care. The NCCP outlined the importance of the role of the designated contact person for patients to enhance the patient's experience while in receipt of SACT therapy and they identify that the nurse may take on this key role (NCCP 2022).

One of the key activities of the AHODU nurse is counselling and supporting patients with cancer (Komatsu & Yagasaki 2014: Rogers et al. 2021). Patients who require SACT need different levels of psychological support on their cancer journey. AHODU nurses need the necessary knowledge, skills, and peer support to assess patients to ascertain if they are anxious and distressed, and to identify those individuals who require referral for additional support. The implementation of the model of care for psycho-oncology will facilitate AHODU nurses with information on referral pathways for community-based psycho-oncology services (Greally et al. 2020; 2022).

Telephone triage has been identified as an important element of AHODU nurse's role in AHODU (Barrett et al., 2019; Daly et al., 2013; Flannery et al., 2009). Within some AHODU's, this activity was the sole responsibility of a CNS and in Ireland a CNS has been allocated to each AHODU to support this work. However, some studies identified that TT was the remit of all staff nurses within AHODU (Daly et al. 2013; Gaubert 2020). The NCCP (2022) SACT Model of Care recommended that a validated TT such as the UKONS 24-hour telephone triage system be used in all SACT hospitals in Ireland. It is suggested that this service is available 24 hours to patients (NHS England,

2011). Furthermore, healthcare professionals (including nurses) with expertise in SACT must provide advice and support to patients who call these TT helplines and should be able to actively manage the care pathway should an acute assessment be necessary. Adaptation of training is recommended to include the remote support of patients during ongoing treatment regimens is necessary to enhance knowledge and skills of nurses providing TT.

6.5. Skill mix

AHODU nurses, who administer SACT are required to demonstrate competency in SACT (NCCP & Office of the Nursing and Midwifery Service Director 2021). All new AHODU nurses should successfully complete the National SACT Competency Programme for Nurses Working in Cancer Care.

Patients who are in receipt of SACT therapies require oncology nursing assessment skills, to include assessment of toxicity associated with SACT as well as specialised nursing skills in the management of side-effects and psycho-social care of the patient. This scoping review identified that the only mandatory criteria required of AHODU nurses was to have certified SACT competencies.

This scoping review identified the need for AHODU nurses to have annual re-certification of SACT competencies (NCCP & Office of the Nursing and Midwifery Service Director 2021) as well as ongoing education and support to facilitate nurses providing telephone triage. SACT therapies are rapidly evolving and AHODU nurses require ongoing education and support to keep up to date with these changes. The employment of a dedicated clinical facilitator is needed to supervise, educate and support all nurses in AHODU to care for Oncology/ Haematology patients, including supporting nurses to achieve SACT competencies.

Little is articulated in the literature to specify the role of the HCA in AHODU settings. The Department of Health (2018) recommended a registered nurse (RN) to HCA ratio in medical surgical wards of 80% to 20% while the ratio for emergency departments is 85% to 15% (Drennan et al., 2020). The available literature does not specify an appropriate ratio of RN to HCA within AHODU. There are considerable supportive care interventions in the AHODU setting and the literature does not give clarity on specific activities that might be delegated to support personnel. Many studies recommended that an administrator, instead of a nurse could schedule patients for their AHODU appointments and other appointments such as pre-chemotherapy bloods, attendance at community nursing services for management of CVAD and discontinuation of chemotherapy infusions (Langhorn & Morrison 2001; Santibanez et al.2012; Nevidjon 2018 Baril et al. 2020; Lafferty et al. 2020). Before an appropriate ratio for nurse to HCA in AHODU can be determined, an investigation of the role of the HCA and supportive care activities in AHODU is needed to inform how the HCA role might be utilised most effectively.

The nurse manager in AHODU was key to the safe organisation and delivery of SACT. Many papers recommended that the nurse manager is not allocated a patient case load. The Department of Health (2018) also recommends that nurse managers in medical and surgical wards do not have an allocated patient caseload. Scheduling in the AHODU care environment is an organic process requiring skilled nursing assessment and professional judgement to manage patient flow and individualise care. Nursing manager or shift coordinator should not be included allocated daily case load so they are free to support department activities.

6.6. Role of the AHODU nurse in delivering person-centred care

Person-centred care is one of the key principles of SláinteCare (House of the Óireachtas 2017). The National Cancer Strategy 2017-2026 (Department of Health 2017) identified the main aim of all cancer services is to provide effective, safe, high quality and patient-centred care. One of the key aspects of person-centred care is the therapeutic relationship between patients and their care givers. Some patients due to their drug regimen may attend AHODU for long periods of time and thus the development of a therapeutic relationship will naturally contribute to enhance their care experience. One of the KPIs (Key Performance Indicators) for person-centred nursing is consistent delivery of nursing care against identified need (McCance et al. 2012, McCance et al. 2015, Lynch & McCance 2022). Allocating a patient to one nurse for the duration of the visit facilitates the development of patient's confidence in knowledge and skills of the nurse and sense of safety while under the nurse's care. The nurse also has the opportunity with consistent patient allocation to develop an understanding of what is important to the patient, facilitate the patient to self-care and to involve the patient in decision making about his/her own care. All of these are KPIs for person-centred nursing care (Lynch & McCance 2022). Allocating patients to an individual nurse is only feasible if the nurse has the required skills and competencies to deliver SACT care, in other words has the SACT competencies.

6.7. Quality and Safety

Chemotherapy is viewed by Health Information and Quality Authority (HIQA) as a high-risk medication, due to the elevated risk of causing injury or death to patients when used in error (HIQA 2019). UKONS (2021) discusses the challenge of having staff who undertake a restricted range of SACT-related activities, due to lack of competency in SACT administration (no SACT passport). They identified that this is not congruent with the model of patient-centred, holistic, safe SACT care, advocated by the NCCP (2022). UKONS (2021) identifies the patient safety risks associated with this practice. UKONS (2021; p2) state:

"If a task-orientated approach to practice is to be used, a full risk-assessment is needed to ensure safe care can be maintained, as the risk of incidents might increase if different personnel are responsible for administering different elements of SACT treatment and care"

The allocation of different nurses to do different tasks for an individual patient may increase the risk of missed care. Cheevers et al. (2020) small study of twelve AHODU nurses in the UK highlighted the issue of care left undone (due to lack of time) and the most frequent reported items were assessment of toxicity and asking patients about their co-morbidities. A study of oncology nurses working in an inpatient setting identified that when they were working under time pressure, they prioritised the technical aspects of their role, for example medication management and patient hygiene. In contrast, time pressure adversely affected nurses communicating with their patients and ultimately the psycho-social aspects of care are neglected (Vinckx et al. 2018). Care left undone by nurses is associated with poor nurse patient ratios, poor skill mix and ultimately high workload (Department of Health 2018).

The Key Performance Indicator (KPI)[6] for AHODU patients focuses on waiting time to first treatment (NCCP 2022). Adherence to this KPI is an indicator of the quality of access to SACT. There is no KPI associated with waiting times for SACT on the day of treatment in AHODU. Schedulers need to balance the need to schedule patients to meet this KPI with the need to maintain patient safety.

This scoping review highlighted the complexity associated with scheduling patients within AHODU, identifying acuity tools, recommended nurse-patient ratios, and skill mix considerations. Research is required to ascertain the impact of changes to patient scheduling within AHODU, acuity tools, revised nurse-patient ratio and skill mix in its entirety. The key outcome measurements would include patient flow, adherence to the 15-working day KPI, nurses' perceptions of care left undone, patients' satisfaction with their experience in AHODU (including waiting times), unplanned nursing overtime and AHODU nurses' job satisfaction and stress.

6.8 Framework for Safe Staffing and AHODU

The Department of Health (2018; 2020) identified that determining safe and appropriate staffing levels and skill mix in medical and surgical wards, which include Haematology/ Oncology inpatient wards, as well as in ED, is a complex process. This is also true for AHODU. The four assumptions of the safe staffing framework can be applied to AHODU settings.

Patient care needs differ, and the individual care needs as well as the complexity of the SACT treatment will influence the amount of nursing input required and the amount of time the patient needs to stay in AHODU, or the care required in the community to be provided by community nurses. Further research is required to determine the validity and reliability of a modified tool in identifying patients' needs in AHODU.

Within Ireland, Nursing Hours per Patient Day (NHPPD) is calculated using acuity variables designed for medical and surgical patients to calculate nursing hours per patient day (Department of Health 2018; Drennan et al. 2018). Nurses in ED use the patient triage assessment category as a dependency and acuity measure to calculate Nursing Hours per Patient Presentation (NHpPP). To illustrate, the average number of hours required for patients triaged as 'immediate' is 6.13 hours while those categorised as 'urgent' is 2.33 hours and lowest category or 'non-urgent' require an estimated 0.58 hours (Drennan et al. 2020). Further research is required to determine how nursing hours are calculated in AHODU. Some patients contact AHODU for advice and support while they are in receipt of SACT therapy. The telephone triage aspect of the role of the AHODU nurse needs to be considered when determining a suitable acuity tool and number of nursing hours

Determining skill mix and number of nurses required is key to maintaining high quality care in AHODU. The number of AHODU nurses with the required SACT competencies needs to be continuously monitored. Each AHODU should identify a target for the minimum number and percentage of nurses with required SACT competencies ("Tipping Point) required in order to deliver a safe high-quality service. Further consideration is required to determine the role of the HCA within AHODU before a recommended ratio of RGN to HCA is decided.

6.9. Recommendations

The following are proposed recommendations arising from this scoping review.

Summary Points Skill Mix
1. All AHODU nurses, new to the administration of SACT, should be facilitated to complete the NCCP (2021) National SACT Competency Programme. Annual reaccreditation, as per the National SACT Competency programme, is recommended to ensure all AHODU nurses, who administer SACT maintain current competence. SACT competencies is a key determinant of appropriate skill mix within AHODU. Each AHODU should determine the minimum number of nurses with SACT competencies required
2. Employment of a dedicated clinical facilitator to supervise, educate and support all nurses to care for Oncology/ Haematology patients including supporting nurses to achieve SACT competencies in type 1 and type 2 SACT model of services. Type 3 SACT model of services should receive support from a clinical facilitator in hospitals with type 1 or type 2 SACT model of services.
3. Review the scheduling process of SACT services nationally.
4. Review the scope and define the role of the HCA within AHODU to determine the appropriate RGN to HCA ratio within this setting.
5. Any acuity tool for AHODU will need to be appropriately configured to effectively measure nursing services as delivered in Ireland. Further research is required to determine the validity and reliability of any acuity tool used.

6. KPI For patients receiving a new parenteral systemic therapy in the day ward setting, the timeline between the date that it is agreed that the patient is deemed ready to treat and the administration of the new parenteral systemic therapy will not exceed 15 working days. This includes haemato-oncology patients.

7. Conclusion

The aim of this scoping review was to systematically search the literature and describe the role of the nurse, the appropriate skill mix, and to identify models or tools used to determine appropriate nurse staffing within AHODU where Systemic Anti-Cancer Therapy (SACT) is delivered. Thirteen patient acuity tools used to assess nursing workload in AHODU were identified and studies examining the challenges of scheduling patients for SACT in AHODU were also described. Some studies identified nurse-led chemotherapy clinics while others focused on the role of the nurse within AHODU and their role in telephone triage (TT) of patients who are currently on SACT therapy. Overall, this review demonstrates the breadth of literature relevant to determining appropriate staffing configuration in AHODU settings. Staff planning for day-to-day in the clinical setting, as well as longer term workforce planning will be a complex process that considers the various aspects reviewed in this report.

The JBI methodology for scoping reviews was followed in the conduct of this scoping review, from formulating the search strategy to data extraction. Two key members of the research team were senior nurses currently working in AHODU. They provided valuable insight into the challenges associated with scheduling patients for SACT therapy. They participated in all stages of the review, from search strategy design, screening of abstracts and full text, and they worked in collaboration with the academic staff to resolve conflicts with the screening process. Their input to the review of the acuity tools and their assessment of the findings of the review was a major strength of this scoping review. The steering committee for this review were representatives from the NCCP. They provided valuable advice throughout the process and provided key documents to assist the review.

8. Record of studies included in review

Table 17. General Characteristics of Studies Included in the Acuity/Scheduling Search

	Reference	Source type	Methodology	Topics Covered
1	(Di Giulio, 1988) ITA	Journal article	Workload analysis	Ratio, skill mix
2	(Langhorn & Morrison, 2001a, 2001b) CAN	Journal article	Service improvement	Scheduling, skill mix
3	(Blay et al., 2002) AUS	Journal article	Workload analysis	Ratio
4	Delaney et al. 2002 AUS	Journal article	Tool development	Acuity tool
5	(Brisley et al., 2003) AUS	Journal article	Literature review	Ratio, nursing activities
6	(Wallis & Tyson, 2003) AUS	Journal article	Service improvement	Scheduling
7	Cusack et al. 2004 (3 part) USA	Journal article	Tool development	Acuity tool, skill mix
8	Chabot & Fox, 2005 USA	Journal article	Tool development	Acuity tool, skill mix
9	(Gaits, 2005) USA	Journal article	Commentary	Ratio, skill mix
10	Moore & Hastings, 2006 USA	Journal article	Tool development	Acuity tool
11	Sussex Cancer Network, 2006	Clinical tool	Tool development	Audit tool
12	DeLisle, 2009 USA	Journal article	Tool development	Acuity tool
13	(Hawley & Carter, 2009) USA	Journal article	Time-in-motion, tool development	Acuity tool, scheduling
14	(Flannery et al., 2009) USA	Journal article	Workload analysis	Telephone triage
15	(van Lent et al., 2009) NLD	Journal article	Service improvement	Scheduling
16	(West & Sherer, 2009) USA	Journal article	Commentary	Acuity

Table 17. General Characteristics of Studies Included in the Acuity/Scheduling Search (Continued)

	Reference	Source type	Methodology	Topics Covered
17	(de Raad et al., 2010) AUS	Journal article	Qualitative interview	Skill mix, acuity, nursing activities
18	(Gill & Dillon, 2010) IRL	Project report	Workload analysis, service improvement	Scheduling, nursing activities, audit tool
19	Turkcan et al. (2010) USA	Journal article	Integer programming model	Scheduling, skill mix
20	Green et al., 2012 CAN	Journal article	Tool development	Acuity tool
21	(Santibáñez et al., 2012) CAN	Journal article	Integer programming mode	Scheduling, ratio, skill mix
22	(Kamimura et al., 2012) USA	Journal article	Qualitative interviews	Scheduling
23	(Woodall et al., 2013) USA	Journal article	MIP model	Scheduling, ratio
24	(Lingaratnam et al., 2013) AUS	Journal article	Service improvement	Ratio
25	Claudio et al. (2014) USA	Journal article	Time series forecasting	Scheduling
26	(de Souza et al., 2014) BRA	Journal article	Workload analysis	Nursing activities
27	(Hahn-Goldberg et al., 2014) CAN	Journal article	Dynamic template scheduling	Scheduling, ratio
28	Slocum (2014) USA	Thesis	Monte Carlo method	Scheduling
29	(Lau et al., 2014) AUS	Journal article	Survey	Scheduling
30	Ansarifar et al. (2015) IRN	Conference proceedings	Integer programming model	Scheduling
31	Tuna et al., 2015 TUR	Journal article	Tool development	Acuity tool
32	(Vortherms et al., 2015) USA	Journal article	Service improvement, tool development	Acuity tool, scheduling, ratios, nursing activities
33	(Kondo et al., 2015) JPN	Journal article	Service improvement	Telephone triage

Table 17. General Characteristics of Studies Included in the Acuity/Scheduling Search (Continued)

	Reference	Source type	Methodology	Topics Covered
34	(Baril et al., 2016) CAN	Journal article	Discrete event simulation	Scheduling, ratio
35	Heshmat and Eltawil (2016) EGY	Conference proceedings	MIP model	Scheduling
36	(Rodgers, 2016) USA	Conference presentation	Service improvement	Ratio
37	Liang and Turkcan (2016) USA	Journal article	Optimization model	Scheduling
38	(Bouras et al., 2017) TUN	Conference proceedings	MIP model	Scheduling, ratio
39	(Edwards et al., 2017) USA	Journal article	Tool development, service improvement	Acuity tool, ratio
40	Heshmat and Eltawil (2017) EGY	Conference proceedings	MIP model	Scheduling
41	(Heshmat & Eltawil, 2017; 2018) EGY	Conference proceedings	Clustering & mathematical programming	Scheduling, ratio
42	(Alvarado & Ntaimo, 2018) USA	Journal article	SIP model	Scheduling, ratio
43	Huntsman Cancer Institute, 2018 USA	Clinical Tool	Tool development	Acuity tool
44	(Nevidjon, 2018) USA	Journal article	Commentary	Scheduling, ratio, skill mix
45	Knox (BC Cancer), 2022 CAN	Clinical tool	Tool development	Acuity tool
46	(Haswell, 2018) USA	Thesis	DES model	Scheduling, ratio
47	(Huang et al., 2018) USA	Journal article	Optimization model	Scheduling, ratio
48	Hesaraki et al. (2019) NLD	Journal article	BIP model	Scheduling
49	(Huang et al., 2019) USA	Journal article	Optimization model	Scheduling, ratio
50	(Noel, 2019; 2016) USA	Conference presentation	Tool development	Acuity tool, ratio

Table 17. General Characteristics of Studies Included in the Acuity/Scheduling Search (Continued)

	Reference	Source type	Methodology	Topics Covered
51	(Baril et al., 2020) CAN	Journal article	DES model	Scheduling, ratio, skill mix
52	Benzaid et al. (2020) CAN	Journal article	MIP model	Scheduling
53	(Bourbeau et al., 2020) USA	Journal article	Survey	Ratio
54	(Cheevers et al., 2020) UK	Journal article	Feasibility testing, survey	Nursing activities
55	Hesaraki et al. (2020) NLD	Journal article	Multi-criterion MIP model	Scheduling
56	(Fesler & Toms, 2020) USA	Journal article	Literature review	Acuity tools
57	(Rodriguez et al., 2020) USA	Journal article	Literature review	Scheduling
58	(Lafferty et al., 2020) USA	Journal article	Qualitative interview	Scheduling, skill mix
59	(Oncology Nursing Society, 2020) USA	Journal article	Position statement	General
60	Southeast Scotland Cancer Network, 2020	Clinical tool	Tool development	Audit tool
61	(Bouras et al., 2021) TUN	Journal article	MIP model	Scheduling, ratio
62	(Gul, 2021) TUR	Journal article	MIP model	Scheduling, ratio
63	Heshmat and Eltawil (2021) EGY	Journal article	MIP model	Scheduling
64	Issabakhsh et al. (2021) USA	Journal article	MIP model	Scheduling
65	Oxford University Hospitals NHS Foundation Trust, 2021	Clinical tool	Tool development	Audit tool
66	(Cordon et al., 2021) CAN	Journal article	Service improvement	Nursing activities

Table 18. General Characteristics of Studies Included in the Role of the Nurse Search

	Reference	Source type	Methodology	Topics Covered
1	(CANO, 2006) CAN	Nursing standards	Nursing standards	Skill mix
2	(Morrison, 2010) USA	Thesis	Focus groups	Nursing activities
3	(Compaci et al., 2011) FRA	Journal article	Feasibility study	Telephone triage
4	(Farrell et al., 2011) UK	Journal article	Survey	Nursing roles
5	(Griffiths et al., 2012) UK	Journal article	Literature review	Skill mix
6	(Lennan et al., 2012) (UKONS) UK	Online article	Position statement	Skill mix
7	(Daly et al., 2013) IRL	Conference abstract	Service evaluation	Telephone triage
8	(de Souza et al., 2013) BRA	Journal article	Qualitative interviews	Nursing activities
9	(Cox et al., 2013) AUS	Journal article	Workload analysis	Nursing roles
10	(Farrell & Lennan, 2013) UK	Journal article	Commentary	Nursing roles
11	(Gleason et al., 2013) USA	Journal article	Survey	Telephone triage
12	(Lee & Fitzgerald, 2013) CAN	Journal article	Qualitative interview	Nursing roles
13	(Hanan et al., 2014) IRL	Journal article	Programme evaluation	Outreach/community
14	(Roe & Lennan, 2014) UK	Journal article	Commentary	Nursing activities
15	(National Cancer Control Programme, 2014) IRL	Project report	Service review	General
16	(Komatsu & Yagasaki, 2014) JPN	Journal article	Qualitative interview	Nursing activities
17	(Traeger et al., 2015) USA	Journal article	Randomized controlled trial	Nursing activities
18	(Beaver et al., 2016) USA	Journal article	Commentary	Skill mix

Table 18. General Characteristics of Studies Included in the Role of the Nurse Search (Continued)

	Reference	Source type	Methodology	Topics Covered
19	(Melville & James, 2016) USA	Conference abstract	Commentary	Skill mix
20	(Neuss et al., 2016) USA	Journal article	Nursing standards	Nursing activities
21	(Nilsson et al., 2016) SWE	Conference abstract	Survey	Nursing activities
22	(Penfold, 2016) UK	Journal article	Commentary	Skill mix, outreach/ community
23	(CANO, 2017) CAN	Nursing standards	Nursing standards	Skill mix
24	(UK Oncology Nursing Society, 2016)	Clinical tool	Nursing standards	Telephone triage
25	(Farrell et al., 2017) UK	Journal article	Qualitative interview	Nursing roles
26	(Harrold & Martin, 2017) UK	Journal article	Commentary	Nursing activities
27	(Bloodworth et al., 2018) UK	Conference abstract	Audit	Outreach/community
28	(Cooper & de Lord, 2018) UK	Journal article	Literature review	Nursing activities
29	(West of Scotland Cancer Network, 2018) SCT	Policy document	Policy document	Nursing activities
30	(Comerford & Shah, 2018, 2019a, 2019b) UK	Journal article	Service improvement	Skill mix
31	(Barrett et al., 2019) IRL	Conference abstract	Call log	Telephone triage
32	(Culmone et al., 2019) USA	Conference poster	Service improvement	Nursing roles
33	(Moretto et al., 2019) BRA	Journal article	Literature review	Telephone triage
34	(Pirschel, 2019) USA	Online article	Newsletter	Nursing activities
35	(Prip et al., 2019) DNK	Journal article	Qualitative interview	Nursing activities

Table 18. General Characteristics of Studies Included in the Role of the Nurse Search (Continued)

	Reference	Source type	Methodology	Topics Covered
36	(Santos & Gaidzinski, 2019) BRA	Journal article	Workload analysis	Ratio, nursing activities
37	(UK Oncology Nursing Society, 2019) IRL	Nursing standards	Nursing standards	Skill mix
38	(Gaubert, 2020) USA	Conference abstract	Survey	Skill mix
39	(Jernigan et al., 2020) USA	Journal article	Intervention feasibility testing	Telephone triage
40	(East Midlands Cancer Alliance, 2020) UK	Policy document	Policy document	Skill mix
41	(O'Mahony et al., 2021) IRL	Journal article	Qualitative interview	Outreach/community
42	(Price, 2021) USA	Journal article	Commentary	Nursing activities
43	(Reynolds, 2021) USA	Journal article	Commentary	Skill mix, nursing activities
44	(Rodriguez, 2019)	Conference abstract	Survey	Nursing activities
45	(Rogers et al., 2021) USA	Journal article	Survey	Nursing activities
46	(National Cancer Control Programme, 2021) IRL	Nursing standards	Nursing standards	Skill mix
47	(Srithumsuk & Wangnum, 2021) THA	Journal article	Commentary	Nursing activities, outreach/community
48	(UK Oncology Nursing Society, 2021) UK	Nursing standards	Position statement	Skill mix
49	(Wu et al., 2021) TWN	Journal article	Literature review	Skill mix
50	(Wu et al., 2022) SGP	Book chapter	Book chapter	Nursing roles

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Appendices

Appendix A: Search strings for databases

(i) Acuity/ Scheduling Search String

Medline (EBSCO) on 16.11.2021		
Search	**Query**	**Records retrieved**
#1	(MH "Patient Acuity") OR (MH "Workload") OR (MH "Personnel Staffing and Scheduling") OR (MH "Resource Allocation") OR (MH “Patient Navigation”)	48,940
#2	TI (“patient-acuity*” OR “patient* classif*” OR acuity* OR “safe staffing*” OR “trend* care*” OR “synergy model*” OR “patient* staff* ratio*” OR “staff* patient* ratio*” OR “patient* flow*” OR “patient* navigat* metric*” OR “patient metric*OR caseload* OR “effective staffing*” OR “work load*” OR workload* OR “case load*” OR “patient* severity” OR kpis OR KPI OR “patient* intensity” OR “treatment* complexit*” OR “patient* volume*” OR “staffing number*” OR “staff* volume*” OR teamwork* OR “nurse* patient*” OR “patient* hours per day*” OR “nurse–patient ratio*” OR “patient* analytic*” OR “patient safety*” OR “patient* depend*” OR “staffing metric*” OR “nurs* metric*” OR “cost effectiv*” OR “performance indicator*” OR skillmix* OR “nursing manpower*” OR “skill mix*” OR “staff* manpower*” OR “patient* schedul*” OR “nurs* schedul*”) OR AB (“patient-acuity*” OR “patient* classif*” OR acuity* OR “safe staffing*” OR “trend* care*” OR “synergy model*” OR “patient* staff* ratio*” OR “staff* patient* ratio*” OR “patient* flow*” OR “patient* navigat* metric*” OR “patient metric*OR caseload* OR “effective staffing*” OR “work load*” OR workload* OR “case load*” OR “patient* severity” OR kpis OR KPI OR “patient* intensity” OR “treatment* complexit*” OR “patient* volume*” OR “staffing number*” OR “staff* volume*” OR teamwork* OR “nurse* patient*” OR “patient* hours per day*” OR “nurse–patient ratio*” OR “patient* analytic*” OR “patient safety*” OR “patient* depend*” OR “staffing metric*” OR “nurs* metric*” OR “cost effectiv*” OR “performance indicator*” OR skillmix* OR “nursing manpower*” OR “skill mix*” OR “staff* manpower*” OR “patient* schedul*” OR “nurs* schedul*”)	91,953
#3	#1 OR #2	139,722
#4	(MH "Oncology Service, Hospital") OR (MH "Integrative Oncology") OR (MH "Ambulatory Care Facilities") OR (MH "Ambulatory Care") OR ((MH "Outpatient Clinics, Hospital") AND (MH "Neoplasms"))	66,678
#5	AB ((day N2 (oncol* OR hemotolog* OR haemotolog OR infusion* OR surg* OR service* OR unit* OR ward* OR support* OR transfusion* OR transplant* OR clinic* OR therap* OR treat* OR hospital* OR blood* OR care OR nursing OR infusion)) N2 (oncolog* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR “anticancer*” OR “precancer*” OR carcinoma* OR metastas* OR leukaemia* OR leukemia* OR myeloma* OR “haematooncolog*” OR “hematooncolog*” OR “neurotoxic drug*” OR cytotoxic OR immunotherap* OR “targeted therap*” OR apheresis OR plasmapheresis OR lymphoma* OR ocancer* OR sarcoma*)) OR TI ((day N2 (oncol* OR hemotolog* OR haemotolog OR infusion* OR surg* OR service* OR unit* OR ward* OR support* OR transfusion* OR transplant* OR clinic* OR therap* OR treat* OR hospital* OR blood* OR care OR nursing OR infusion)) N2 (oncolog* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR “anticancer*” OR “precancer*” OR carcinoma* OR metastas* OR leukaemia* OR leukemia* OR myeloma* OR “haematooncolog*” OR “hematooncolog*” OR “neurotoxic drug*” OR cytotoxic OR immunotherap* OR “targeted therap*” OR apheresis OR plasmapheresis OR lymphoma* OR ocancer* OR sarcoma*))	2,955

(i) Acuity/ Scheduling Search String (Continued)

Medline (EBSCO) on 16.11.2021		
Search	**Query**	**Records retrieved**
#6	TI ((outpatient* OR ambulat* OR outreach* OR “home based” OR “home base*” OR “day-base*” OR “out patient*” OR community* OR “systemic therapy ambulator*” OR “systematic anti-cancer unit*” OR “infusion centre*” OR “sact suite*” OR “infusion suite*” OR prehabilitat* OR sact OR sacts OR “stem cell harvest*” OR transplant*) N2 (oncolog* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR “anticancer*” OR “precancer*” OR carcinoma* OR metastas* OR leukaemia* OR leukemia* OR myeloma* OR “haematooncolog*” OR “hematooncolog*” OR “neurotoxic drug*” OR cytotoxic OR immunotherap* OR “targeted therap*” OR apheresis OR plasmapheresis OR lymphoma* OR ocancer* OR sarcoma*) OR sact OR “systematic anti-cancer*”) OR AB ((outpatient* OR ambulat* OR outreach* OR “home based” OR “home base*” OR “day-base*” OR “out patient*” OR community* OR “systemic therapy ambulator*” OR “systematic anti-cancer unit*” OR “infusion centre*” OR “sact suite*” OR “infusion suite*” OR prehabilitat* OR sact OR sacts OR “stem cell harvest*” OR transplant*) N2 (oncolog* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR “anticancer*” OR “precancer*” OR carcinoma* OR metastas* OR leukaemia* OR leukemia* OR myeloma* OR “haematooncolog*” OR “hematooncolog*” OR “neurotoxic drug*” OR cytotoxic OR immunotherap* OR “targeted therap*” OR apheresis OR plasmapheresis OR lymphoma* OR ocancer* OR sarcoma*) OR sact OR “systematic anti-cancer*”)	41,378
#7	#4 OR #5 OR #6	109,179
#8	#3 AND #7	1,046

(ii) Role of the Nurse Search String

Medline (EBSCO) on 12.11.2021		
Search	**Query**	**Records retrieved**
#1	((MH "Nurses+”) OR (MH "Nurse’s Role")) AND (MH "Neoplasms+")	4,319
#2	(MH "Oncology Nursing")	8,197
#3	AB ((nurs*) N3 (oncol* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR anticancer* OR pre-chemo* OR carcinoma* OR metastas* OR leukaemia* OR leukemia* OR myeloma* OR haematooncolog* OR hematooncolog* OR “Neurotoxic Drug*” OR psychooncolog* OR parenteral-chemo* OR cytotoxic* OR immunotherap* OR infusion* OR “targeted therap*” OR SACT OR “stem cell harvest*” OR apheres* OR plasmapheres* OR lymphoma* OR ocancer* OR sarcoma* OR prehabilitat* OR precancer*)) OR TI ((nurs*) N3 (oncol* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR anticancer* OR pre-chemo* OR carcinoma* OR metastas* OR leukaemia* OR leukemia* OR myeloma* OR haematooncolog* OR hematooncolog* OR “Neurotoxic Drug*” OR psychooncolog* OR parenteral-chemo* OR cytotoxic* OR immunotherap* OR infusion* OR “targeted therap*” OR SACT OR “stem cell harvest*” OR apheres* OR plasmapheres* OR lymphoma* OR ocancer* OR sarcoma* OR prehabilitat* OR precancer*))	10,033

(ii) Role of the Nurse Search String (Continued)

Medline (EBSCO) on 12.11.2021		
Search	**Query**	**Records retrieved**
#4	AB (health* N2 (assistant* OR attendant* OR worker* OR volunteer*) N3 (oncol* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR anticancer* OR "pre chemo*" OR carcinoma* OR metastas* OR leukaemia* OR leukemia* OR myeloma* OR "haemato oncolog*" OR "hemato oncolog*" OR "neurotoxic drug*" OR psychooncolog* OR "parenteral chemo*" OR cytotoxic* OR immunotherap* OR infusion* OR "targeted therap*" OR sact OR "stem cell harvest*" OR apheres* OR plasmapheres* OR lymphoma* OR ocancer* OR sarcoma* OR prehabilitat* OR precancer*)) OR TI (health* N2 (assistant* OR attendant* OR worker* OR volunteer*) N3 (oncol* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR anticancer* OR "pre chemo*" OR carcinoma* OR metastas* OR leukaemia* OR leukemia* OR myeloma* OR "haemato oncolog*" OR "hemato oncolog*" OR "neurotoxic drug*" OR psychooncolog* OR "parenteral chemo*" OR cytotoxic* OR immunotherap* OR infusion* OR "targeted therap*" OR sact OR "stem cell harvest*" OR apheres* OR plasmapheres* OR lymphoma* OR ocancer* OR sarcoma* OR prehabilitat* OR precancer*))	2,293
#5	#1 OR #2 OR #3 OR #4	19,412
#6	'ambulatory care nursing'/exp OR 'integrative oncology'/exp OR 'outpatient department'/exp	37,789
#7	((day NEAR/2 (oncol* OR hemotolog* OR haemotolog OR infusion* OR surg* OR service* OR unit* OR ward* OR support* OR transfusion* OR transplant* OR clinic* OR therap* OR treat* OR hospital* OR blood* OR care OR nursing OR infusion)) AND (oncol* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR anticancer* OR precancer* OR carcinoma* OR metastas* OR leukaemia* OR leukemia OR myeloma* OR haematooncolog* OR hematooncolog* OR neurotoxic drug* OR cytotoxic OR immunotherap* OR targeted therap* OR apheresis OR plasmapheresis OR lymphoma* OR ocancer* OR sarcoma*):ab,ti	44,454
#8	(((outpatient* OR ambulat* OR outreach* OR home* OR 'day-base*' OR 'out patient*' OR community* OR 'systemic therapy ambulator*' OR 'infusion centre*' OR 'infusion suite*' OR prehabilitat* OR 'stem cell harvest*' OR transplant*) NEAR/2 (oncol* OR cancer* OR malignan* OR tumour* OR tumor* OR neoplasm* OR carcinogen* OR chemo* OR antineoplastic* OR 'anticancer*' OR 'precancer*' OR carcinoma* OR metastas* OR leukaemia* OR leukemia* OR myeloma* OR 'haematooncolog*' OR 'hematooncolog*' OR 'neurotoxic drug*' OR cytotoxic OR immunotherap* OR 'targeted therap*' OR apheresis OR plasmapheresis OR lymphoma* OR ocancer* OR sarcoma*)):ab,ti) OR sact:ab,ti OR sacts:ab,ti OR 'systematic anti-cancer*':ab,ti	45,822
#9	#6 OR #7 OR #8	125,772
#10	#5 AND #9	1,410

Appendix B: Websites searched for grey literature

Australian Government – Department of Health	https://www.health.gov.au/
Rural and remote health	https://www.rrh.org.au/home/defaultnew.asp
Cancer Australia	https://www.canceraustralia.gov.au/
Clinical Oncology Society of Australia	https://www.cosa.org.au/
Cancer Nurses Society of Australia	https://www.cnsa.org.au/
Canadian Institute for Health Information (CIHI)	https://www.cihi.ca/en
Canadian Association of Nurses in Oncology (CANO/ACIO)	https://www.cano-acio.ca/
Canadian Institute for Health Information (CIHI)	https://www.cihi.ca/en/quick-stats?pageNumber=1&resultCount=10
Health Canada - Federal department	https://www.canada.ca/en/health-canada/corporate/about-health-canada.html
Institute of Health Economics (IHE). Database of Online Health Statistics	https://www.ihe.ca/publications/health-db/
Public Health Agency of Canada	https://www.canada.ca/en/public-health/services/reports-publications.html
Grey Literature Report (Health Research) New York Academy of Medicine Library	http://www.greylit.org//
World Health Organization. Global Health Observatory (GHO)	https://www.who.int/data/gho
Organisation for Economic Co-operation and Development (OECD). OECD	https://data.oecd.org/
Department of Health Ireland	https://www.gov.ie/en/organisation/department-of-health/?referrer=http://www.health.gov.ie/
Health Information and Quality Authority	https://www.hiqa.ie/healthcare https://www.hiqa.ie/healthcare/health-information/data-collections/online-catalogue
Health Service Executive	https://www.hse.ie/eng/
Irish Nurses and Midwives Organisation	https://www.inmo.ie/
Lenus, The Irish Health Repository	http://www.lenus.ie/hse/
Nursing and Midwifery Board of Ireland	http://www.nmbi.ie/Home
RIAN - Open Access Irish research publications	http://rian.ie/
Netherlands: Ministry of Education, Culture and Science	https://www.government.nl/ministries/ministry-of-education-culture-and-science
Netherlands: Ministry of Health, Welfare and Sport	https://www.government.nl/ministries/ministry-of-health-welfare-and-sport
De Gezondheidsraad (GR). Health Council of the Netherlands	http://www.gezondheidsraad.nl/en
Nursing Council of New Zealand	http://www.nursingcouncil.org.nz/
NZ – Ministry of Health	http://www.health.govt.nz/

Government UK – Department of Health	https://www.gov.uk/government/organisations/department-of-health
Health & Social Care Information Centre	http://www.hscic.gov.uk/
National Institute for Health and Care Excellence (NICE).	https://www.nice.org.uk/
Nursing and Midwifery Council (England, Wales, Scotland, Northern Ireland)	https://www.nmc.org.uk/
Office for National Statistics	https://www.ons.gov.uk/
GAIN - Guidelines and Audit Implementation Network / Regulation and Quality Improvement Authority (RQIA) [Belfast]	http://www.gain-ni.org/
Healthcare Improvement Scotland: the national healthcare improvement organisation for Scotland and part of NHS Scotland	http://www.healthcareimprovementscotland.org
Scotland's Health on the Web (SHOW)	http://www.scot.nhs.uk/
Scottish Government	http://www.gov.scot/Publications/Recent
Scottish Intercollegiate Guidelines Network / Health Improvement Scotland [Edinburgh]	http://www.sign.ac.uk/
National Health Service (NHS) Wales: Public Health Wales Observatory (ATTRACT)	http://www.attract.wales.nhs.uk/
United Kingdom Oncology Nursing Society (UKONS)	https://www.ukons.org/
International Society of Nurses in Cancer Care	https://www.isncc.org/
European Oncology Nursing Society	https://cancernurse.eu/
Irish Association for Nurses in Oncology	https://www.iano.ie/
Oncology Nursing Society (USA)	https://www.ons.org/
Oncology Nurse Advisor	https://www.oncologynurseadvisor.com/
National Centre for Health Statistics (CDC)	http://www.cdc.gov/nchs/
American Nurse	https://www.myamericannurse.com/
European Forum of National Nursing and Midwifery Associations (EFNNMA)	http://efnnma.org/
European Bone marrow Transplant	https://www.ebmt.org/

Appendix C: Templates with guide for data extraction

(i) Data Extraction Template for Sources Acquired in Acuity/ Scheduling Search	
Author(s)	Authors name (et al.)
Year of publication	YYYY
Country of origin (where source was published or conducted)	Where do authors report their hospital or clinic is located (if authors are from multiple countries ensure to report the hospital where the research was based)
Aim/ purpose of the source	What do authors report as their aim (e.g., improving a particular service)
Focus of paper	Can be more than one: ☐ Acuity ☐ Scheduling ☐ Role of nurse ☐ Workload
Population and setting where source conducted	>Nurses: specify is study about an interdisciplinary team that includes nurses, or is study focused solely on nurses, do they specify type of nursing staff >Setting: how do authors describe the setting and what type of treatments are done there (e.g., outpatient infusion centre). Can also include details such as opening times, number of patients seen if reported
Methodology employed	General method or design used. For example: • Tool development – developing or adapting a measure • Evaluation – testing a tool and reporting outcomes • Description – simply describing the use of a staffing system • Operational research including simulation modelling with mathematical models and formulas • Others could include workload analysis, qualitative interview study, survey
Outcomes assessed	What outcomes do the authors state they assessed in the study. E.g., patient or staff satisfaction, waiting times, infusion hours
Name of system or tool used to determine workload and inform staffing configuration	Record the name of the tool or system as reported in article. This can be one developed by the authors themselves or a previously developed tool or system that they are using in their study. If a previously developed tool, include the appropriate reference for this. • If no specific name, use authors own description. E.g., in Edwards 2017 they refer to their 'Acuity Based Scheduling (ABS) Template' • Insert N/A if there is no type of tool or system used in the study.
Description of system related to acuity (+) Definition of acuity	If the tool or system is related to acuity, provide description of it here. [Acuity refers to the intensity of patient care requirements and involves identifying what a patient represents in terms of workload]. Could include time requirements, treatment classifications, severity illness etc. • Insert N/A if not about acuity. How do authors define acuity in the ambulatory oncology setting? (Extract as stated if possible)
Description of system related to scheduling	If the tool or system is related to scheduling, provide description of it here. These tend to be the formula focused articles. State variables that are included in the formula/ scheduling tool. • Insert N/A if not about scheduling.

Appendix C: Templates with guide for data extraction

(i) Data Extraction Template for Sources Acquired in Acuity/ Scheduling Search	
Staff to patient ratio recommendations or reported	State whether authors recommend a specific ratio, or if they report a ratio that they use in their setting. *Distinguish between a ratio that is recommended based on their research or a ratio that is just stated descriptively for study purposes.
Recommendations for scheduling	Report if authors provide guidance on scheduling requirements for shifts in AOCU
Recommendations for skill mix	Report if authors provide guidance on combinations of different categories of staff within AOCU (e.g., registered nurses, CNM, HCA, other staff such as administrative or clerical)
Description or recommendations for role of the nurse	Include detail if the authors outline the role of the nurse in the AOCU setting (e.g., functional roles or required competencies/education) or provide guidance on this. For example, they may discuss direct and indirect patient care. • Insert N/A if nothing on this.
Findings for impact on quality of care or patient or staff outcomes	Impact of staffing or scheduling practice on quality of care (e.g., efficiency measures, number of hours etc.) or patient or staff outcomes (e.g., satisfaction)
Other key outcomes or findings	Report any key findings or outcomes not previously covered in the extraction document that may be important to know.
Validity or reliability properties	Do the authors state any findings regarding the reliability or validity properties of the tools or systems they used? Report this. E.g., content validity (e.g., reviewed by external experts), interrater reliability

(ii) Data Extraction Template for Sources Acquired in Role of the Nurse Search	
Author(s)	Authors name (et al.)
Year of publication	YYYY
Country of origin (where source was published or conducted)	Where do authors report their hospital or clinic is located (if authors are from multiple countries ensure to report the hospital where the research was based)
Aim/ purpose of the source	What do authors report as their aim
Type of nurse or support staff	Check description of nurse: ☐ Staff Nurse (registered) ☐ clinical nurse manager ☐ clinical nurse specialist ☐ Advanced Nurse Practitioner ☐ community/ outreach ☐ nurse-led service ☐ student nurse ☐ healthcare assistant ☐ non-registered nurse ☐ scheduler/ admin ☐ other
Population and setting where source conducted	>Nurses: specify is study about an interdisciplinary team that includes nurses, or is study focused solely on nurses, do they specify type of nursing staff >Setting: how do authors describe the setting and what type of treatments are done there (e.g., outpatient infusion centre). Can also include details such as opening times, number of patients seen if reported
Methodology employed	General method or design used. For example: • Nursing standards • Policy document • Commentary/ discussion piece • Literature review • Others could include workload analysis, qualitative interview study, survey

(ii) Data Extraction Template for Sources Acquired in Role of the Nurse Search	
Findings for education or (core) competencies	Competencies: knowledge, skills, values that are required to fulfil roles safely and effectively (EONS, 2018).
Findings for functional roles of the nurse	Include detail if the authors outline the role of the nurse in the SACT delivery setting (e.g., direct or indirect care roles).
Allocation of roles (i.e., roles that could be conducted by staff other than nursing)	e.g., Healthcare assistant, clerical staff
Details for skills mix configuration	Report if authors provide guidance on combinations of different categories of staff within AOCU (e.g., registered nurses, CNM, HCA, other staff such as administrative or clerical)
Staff to patient ratio recommendations or reported	State whether authors recommend a specific ratio, or if they report a ratio that they use in their setting. *Distinguish between a ratio that is recommended based on their research or a ratio that is just stated descriptively for study purposes.
Findings for impact of type of nursing staff on outcomes	Report if authors include findings for impact of type of nursing staff (i.e., staff mix/ configuration_ on outcomes (e.g., quality of care, staff, or patient outcomes).
Enablers and barriers to development of nursing role within SACT day settings	Include if the authors name any barriers or enablers to development or the nursing role (e.g., nurse-led services).
Other key findings	Report any key findings or outcomes not previously covered in the extraction document that may be important to know.

Oifig an Stiúrthóra Seirbhísí
Altranais & Cnáimhseachais

Office of the Nursing &
Midwifery Services Director

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

NURSING
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National Cancer
Control Programme

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