2016

Intensive Care in Oncology: Admission and Outcomes in Adult Patients with Cancer

Surya John
University of Central Florida

INTENSIVE CARE IN ONCOLOGY: ADMISSION AND OUTCOMES IN ADULT PATIENTS WITH CANCER

by

SURYA JOHN

This thesis submitted in partial fulfillment of the requirements
for the Honors in the Major Program in Nursing
in the College of Nursing
and in The Burnett Honors College
at the University of Central Florida
Orlando, Florida

Summer Term, 2016

Thesis Chair: Dr. Victoria Loerzel

ABSTRACT

Background: Historically, patients with cancer have been perceived as poor candidates for ICU admission. General ICU admission criteria lists cancer patients as low priority in ICU admission depriving them of the care they rightfully deserve. The purpose of this literary synthesis was to examine ICU admission criteria, risk factors, and outcomes of ICU admission in relation to hematological and solid tumor cancers and discuss ways that practitioners and nurses can educate patients with cancer and their families on appropriateness of ICU care.

Methods: A total of 768 articles were found in a literature search including all literature from 2005 to 2016 from all countries using the databases CINAHL Plus, MEDLINE, PsycINFO, and Academic Search Premier. These were further narrowed down based on relevancy by topic or reading abstracts. A total of 13 articles utilizing the inclusion and exclusion criteria of the literature search were included in the final literature synthesis.

Results: In addition to general ICU admission criteria several other criteria and scores can be helpful in admitting patients with cancer to the ICU including cancer specific criteria, mortality predictor tools, performance status, and ICU trials. Mortality predictors, in combination with other patient characteristics, demonstrated effectiveness to predict outcomes in patients with cancer. Survival rates in hematological and solid tumor cancers have improved from the past, and lower prognostic scores can predict who will have better outcomes.

Conclusion: Cancer specific criteria, mortality predictor tools, performance status, and ICU trials in addition to general ICU criteria should be used for admission of cancer patients into ICU. Practitioners and nurses should become familiar with the newest outcomes in patients with cancer to make collaborative informed decisions about ICU admission.

DEDICATION

To my beloved family, John K. John, Suja K. John, Subin John, and Sooraj John. Thank you for your full support and encouragement in everything I do. You inspire me to become better with each new day and to reach for the stars. This is for you!

To Diane Rodríguez, thank you for always being with me every step of the way. Thanks for the endless supply of chocolate, ice cream, and encouragement. Best friends for eternity! P.S. You still owe me a lightsaber.

To God, thank you for your unwavering faith and love. May I go forward to do your work every day of my life.

To all patients with cancer, you are the inspiration for this work. Your strength and determination never fails to amaze me.

ACKNOWLEDGEMENTS

Thank you to Dr. Victoria Loerzel, my thesis chair, for supporting and guiding me throughout this process. I truly appreciate all you have done to develop this paper into what it is today.
Thank you to my other committee members, Dr. Paul Desmarais, Dr. Patty Geddie, and Dr. Mary Ann Burg. Your expert knowledgeable input and encouragement has given me the opportunity to produce this thesis.
Thank you to Dr. Paul Reich, Mr. Andrew Todd, Ms. Denise Crisafi, and Ms. Vanessa McRae for your contribution to the literature search and formatting of this thesis.
Thank you to the University of Central Florida, UCF College of Nursing, and Burnett Honors College for your support of this topic.

TABLE OF CONTENTS

INTRODUCTION

Background and Significance

Intensive care units (ICU) were developed in the 1960s and flourished in the 1970s with the implementation of trauma management techniques and resuscitation standards. These units served severe physiologically unstable patients who needed technical or artificial life support (Egol et al., 1999). Originally, intensive care was limited to specific populations and focused solely on care for cardiac, surgical, and trauma patients and care available only in ICU included endotracheal mechanical ventilation, noninvasive mechanical ventilation, vasopressive agents, and dialysis (Darmon et al., 2005). However, many other patients with chronic medical disorders needed the medical resources available only in ICU settings (Shelton, 2010).

ICU care is more frequent and intense, focusing on monitoring and treating hemodynamic instability that cannot be provided on the general medical, surgical, or progressive units. The availability of ICU specified care led to increased demand for these resources. The increased demand for ICU services posed a financial challenge to hospital administrators who were tasked with effectively and efficiently managing operations. Administrators met this challenge by establishing strict admission criteria for the ICU so that the limited ICU resources could be allocated effectively (Egol et al., 1999).

There is a growing need for intensive care support in the cancer population due to complications from cancer and aggressive cancer treatments (Caruso et al., 2010; McCaughey, Blackwood, Glackin, Brady, & McMullin et al., 2013). Today, patients with cancer are surviving longer due to major advances in screening, early diagnosis, and treatment options. The American Cancer Society (ACS) estimates that there will be 1.7 million new cancer diagnoses in the United

States in 2016 and that 595,690 people will die from cancer that same year (American Cancer Society, 2016). However, the overall mortality rate for cancer has declined over the past 2 decades and this consistent decline has averted more than 1.7 million deaths from cancer. These statistics highlight that, today, people are surviving longer with cancer, and some of them may benefit from advanced support during this time (American Cancer Society, 2016).

While cancer treatment was once limited to the surgical removal of tumors in the early stages of the disease, antineoplastic drug therapy demonstrated major response rates in the late 1970s, especially in Hodgkin's disease, testicular cancer, and childhood leukemia. However, complications from hematologic and solid tumor malignancies may require admission into ICU prior to cancer therapy initiation (Darmon et al., 2005). Today, the main reasons for ICU admission in this population are infections and organ failure involvement, frequently occurring in combination (Darmon et al., 2005; Hull & O'Rourke, 2007). Additionally, the organ dysfunction and myelosuppression that result from therapies like blood and bone marrow transplantation have increased the need for intensive care beds (Shelton, 2010).

And yet, a cancer diagnosis was once considered a contraindication for an ICU admission (Egol et al., 1999; Shelton, 2010). Historical and preexisting views by internists concerning patients with cancer needing ICU treatment had long been "What is the point?" (Smith & Wigmore, 2008, p. 91). In the 1980s and 1990s, published studies demonstrated very poor survival rates, especially in patients with neutropenic hematology cancer in the ICU (Smith & Wigmore, 2008). Similarly, for patients with cancer, outcomes of treatment in the ICU was difficult to determine at time of admission. Paz, Crilly, Weiner, & Brodsky (1993) studied post bone marrow transplant patient admissions into a medical ICU and found that adults with cancer

who required mechanical ventilation while in the ICU had a discharge rate of only 3.7% compared to 81.3% in patients with cancer who did not need this therapy.

While the need for specific ICU admission criteria for patients with cancer is known, there is only minimal evidence of actual cancer specific criteria and outcomes. In 1983, the National Institutes of Health (NIH) led the first consensus conference on critical care medicine. At this conference, NIH first advocated for the need to expand ICU admission criteria from the ICU concept first defined in the 1960s. Recommendations for predetermined admission criteria is one way to allocate scarce resources when triaging patients (Egol et al., 1999).

In ideal conditions, ICU admission would rely solely on the factor of the patient's benefit from its care. In a less than ideal world, individual patient benefit is hard to define, especially at time of admission for patients with cancer. The concepts of "too well to benefit" and "too sick to benefit" are two conditions where ICU care was once considered to provide no greater benefit than conventional care. However, determining ICU care benefit in these two populations is difficult because severely ill and unstable patients have also been shown to improve after ICU care (Egol et al., 1999; McCaughey et al., 2013). Admission into ICU should be based on clinical judgement in combination with standardized tools assessing severity of illness and prognosis in the critically ill (Egol et al., 1999).

Prioritization is one model currently used to decide who is appropriate for admission into the general ICU. The Prioritization model triages based on highest patient benefit from ICU admission. The Prioritization model guidelines may be used as the initial triage for ICU admission in combination with Diagnosis and Objective Parameter models. Triaging is important when the need for ICU beds outnumber the availability of ICU beds (Egol et al., 1999).

The prioritization model of ICU admission guidelines also includes patients who are generally inappropriate for ICU admission. A limitation of this model is that patients with terminal and irreversible illness facing imminent death, such as patients with advanced cancer unresponsive to chemotherapy/radiation therapy, are denied ICU admission (Egol et al., 1999). This is unfortunate because mortality in patients with cancer is chiefly due to the number and nature of organ failures, not stage or nature of malignancy itself (Azoulay et al., 2011). These organ failures have the potential to be reversed or managed with appropriate and early ICU care.

Purpose of Paper

The lack of concrete evidence about who is appropriate for admission to the ICU, especially in patients with cancer, highlights the need for further exploration of this topic. The goal of this thesis is to examine the literature related to ICU admission and outcomes for patients with cancer. The specific aims of this literature synthesis are to: 1) Evaluate current ICU admission criteria and examine how patients with cancer fit into this criteria. 2) Examine risk factors and outcomes of ICU admission in relation to hematological cancer and solid tumor cancers. 3) Discuss ways that practitioners can educate patients with cancer and their families on appropriateness of ICU care.

Currently, the high cost of ICU resources has been a major determinant that, in general, the ICU should be reserved for reversible medical conditions in which patients have a chance for substantial recovery. This policy has the potential to exclude patients with cancer who may benefit from ICU care. A better understanding of current ICU outcomes in relation to cancer admission risk factors and ICU treatments could help guide appropriate ICU admission and restriction criteria for patients with cancer (Egol et al., 1999). Understanding post ICU care

survival rates, may provide practitioners and nurses to help their patients with cancer make informed medical care decisions.

Methods

A review of current literature was conducted using 4 databases: CINAHL Plus, MEDLINE, PsycINFO, and Academic Search Premier. Key words used in the search were intensive care unit, ICU, critical care, intensive care, patient admission, admission care, admission, criteria, triage, standards, decision making, outcomes, prognosis, neoplasms, and cancer.

The inclusion criteria included publications of review articles, quantitative and qualitative research from 2005-2016. The search included peer reviewed articles from all countries focused on cancer admission and outcomes of adult oncology population (age greater than 18 years) in the ICU setting. Exclusion criteria: the pediatric oncology population (age less than 18 years), articles not in English, not human participants, no abstract available, no full text available.

A total of 768 articles were found at the conclusion of the full literature search process conducted on 3/10/16 (refer to appendix B for figure of literature search method). The total 768 articles included 383 Medline articles, 275 Academic Search Premier articles, 89 CINAHL Plus articles, and 21 Psych INFO articles. The articles in each of these databases were further narrowed down by discarding articles that were not relevant by title of article to the topics of ICU, cancer, admission, and outcomes.

This process reduced the total to 86 articles: 33 Medline articles, 23 Academic Search Premier articles, 25 CINAHL Plus articles, and 5 Psych INFO articles. Abstracts and articles were read and references of these articles were reviewed, further exclusion by hand was done to

limit to topics of general and cancer specific admission criteria, cancer outcomes with focus on hematological and solid tumors, ICU trial, and prognostic scores, resulting in a final count of 13 articles used in this literature analysis. Refer to appendix C table 4 for concise presentation of studies.

FINDINGS

ICU Admission Criteria for Patients with Cancer

Current admission into the ICU for patients with cancer is based on general ICU criteria, which includes the combination of Prioritization, Diagnosis, and Objective Parameters models. Clearly defined admission and triage criteria can provide access to effective treatment for critically ill patients in need of ICU resources (Egol et al., 1999).

General ICU admission criteria

Guidelines for ICU admission were developed and published by the Society of Critical Care Medicine (SCCM) in 1999. The SCCM recommends that an intensivist led multi-professional team should be involved in developing and implementing the unit-specific admission protocol from the existing guidelines; emphasis is placed on collaboration with nursing and ancillary staff. The SCCM recommends that admission to the intensive care unit be based on using models of Prioritization, Diagnosis, and Objective Parameters (Egol et al., 1999).

The Prioritization model, which practitioners should use as the initial triage decision making point for patients needing ICU support, is organized based on what type of patients would benefit most from an ICU admission. Patients are organized into one of four categories. The larger the priority number (1 to 4), the lower the probability of admission into ICU (Egol et al., 1999).

Priority 1, the highest probability of admission into ICU, includes critically ill and unstable patients that need treatments not available outside the ICU. Priority 2 includes patients requiring continuous intensive monitoring and may require ICU treatments. Priority 3 includes critically ill and unstable patients with reduced chances of survival due to underlying disease or

acute illness. In priority 3, therapeutic limits are placed on cardiopulmonary resuscitation(CPR) and intubation. Priority 4, the lowest probability of admission into the ICU, includes patients who are too well or too sick to benefit from ICU care (Egol et al., 1999).

Categories 1 and 2 are admitted to the ICU. Category 3 is assessed individually, and category 4 should not be admitted to the ICU (Egol et al., 1999). A more detailed explanation of the prioritization model can be found on Table 1 in appendix A.

The Diagnosis model, which practitioners should use to supplement the Prioritization model for patients needing ICU support, also guides practitioners by organizing conditions and diseases appropriate for ICU admission under individual organ specific and non-organ specific categories. Individual patient diagnoses are taken into account when prioritizing the patient for ICU admission (Egol et al., 1999).

The major organ systems addressed under the Diagnosis model are pulmonary, cardiovascular, neurologic, gastrointestinal, and endocrine. Surgical, drug overdose, and "miscellaneous" are non-organ specific categories (Egol et al., 1999). A comprehensive list of the Diagnosis model can be found on Table 2 in appendix A.

Using Objective Parameters model is the final recommendation for making decisions about ICU admission. Objective parameters include physical exam, vital signs, laboratory values, radiography, and electrocardiogram (EKG) findings. Even though these objective parameters were generated by consensus through a review process done by the Joint Commission on Accreditation of Healthcare Organizations, no data exists demonstrating improved outcomes from specific criteria levels alone (Egol et al., 1999). A comprehensive list of the Objective Parameters model can be found on Table 3 in the appendix A.

Cancer specific admission criteria

When following the general ICU admission criteria patients with cancer fall under priority 3 and 4 of the Prioritization model. However, they may periodically have an acute condition that puts them into a higher priority category. For example, a patient in acute respiratory failure needing ventilator support normally falls under priority one, but in patients with metastatic cancer, they automatically become priority 3 (Egol et al., 1999).

Falling into priority 3 limits the types of life saving treatments available in the ICU that patients with cancer can receive, for instance CPR and intubation. Falling into category 4 denies patients with cancer ICU care for the sole reason of having a metastatic disease unresponsive to treatments and only calls for individual patient review in exceptional cases (Egol et al., 1999).

This is problematic because they may have a reversible condition that could be treated with ICU care, but their underlying cancer diagnosis would prevent them from being admitted to the ICU for that care. This is why it is important to also consider cancer specific guidelines in these patients when making admission decisions.

Shelton (2010) outlined two guidelines that tried to define objective parameters focused on patients with cancer: Groeger and Aurora's broad categories and the Australian classification system. Under the Broad Category model, the cancer specific criteria for ICU admission are 1) postoperative care, 2) medical emergencies management due to cancer or cancer treatment, and 3) hemodynamic monitoring during oncologic treatments. Groeger and Aurora's categories also take into account the likelihood of meaningful survival, respecting patient wishes, and distributive justice with limited ICU beds (Shelton, 2010).

The cancer specific criteria for the Australian Classification System considers patients who may have: 1) a newly diagnosed cancer, 2) the possibility of a cure, 3) control of their disease, 4) benefit from supportive care needed due to treatment failure, and 5) benefit from palliative care symptom control. Based on this system the only patients with cancer that are denied ICU admission outright are patients who have elected to receive palliative care only (Shelton, 2010).

Cancer progresses at different rates in individuals, this is why individual patient evaluation for ICU admission is necessary in this population of patients (McCaughey et al., 2013). While there is consensus on the benefits of ICU admission using these additional criteria, there is limited research based evidence on improved outcomes using these criteria.

Mortality predictor tools

Mortality predictor tool, can also help practitioners make ICU admission decisions. Variables affecting mortality predicting tools include, but are not limited to, short term organ compromise, chronic immune suppression, previous organ insult, and prior health. Even with all the difficulty in using these mortality predictor tools, these tools can be fairly accurate in the prediction of mortality in critically ill patients with cancer in the ICU (Kopterides et al., 2011). Knowledge of prognostic scores, including short and long term prognosis is essential to act as a guideline for ICU admission in patients with cancer (Caruso et al., 2010).

Mortality predictor tools, also referred to as prognostic scores, for ICU admission include the Acute Physiology and Chronic Health Evaluation(APACHE I, II, III), and the shortened version of this called the Simplified Acute Physiology Score(SAPS II). The APACHE II uses patient data to produce a severity of illness score at ICU admission and 24-48 hours later. The

degree of organ failure is then used to predict mortality with the help of an equation. A modification of this model to account for oncological variables led to the development of the Intensive Care Mortality Model (ICMM) (Shelton, 2010).

The ICMM's poor performance in patients with sepsis lead to further development of tools that incorporated organ failures to determine mortality. This resulted in the development of the following mortality predictive models: 1) Logistic Organ Failure (LOD), 2) Sequential Organ Failure Assessment (SOFA), and 3) Multiple Organ Dysfunction Score (MODS) (Shelton, 2010).

Since the number of organ dysfunctions is a better predictor of mortality in patients with cancer than the underlying cancer alone, these tools became useful in determining ICU need and benefit. In her extensive history of mortality predicting tools, Shelton did not come to a conclusion in regards to which was best for use as part of ICU admission criteria in patients with cancer (Shelton, 2010).

Kopterides et al. (2011) studied outcomes of using mortality predicting tools in patients with cancer admitted into ICU. Whereas previous studies had looked at the use of these scoring systems in general ICU populations, this study focused on comparing the APACHE II, SAPS II, and SOFA prognostic scoring systems in patients with cancer. This study included 126 patients. The most critical values, obtained within 24 hours of ICU admission, in hematologic and solid tumor malignancies were used to calculate the APACHE II, SAPS II, and SOFA scores. The higher the scores, the worse the prognosis. Overall, an ICU mortality rate of 46.8%, with a median duration of the ICU stay of 6 days (5 days for patients needing mechanical ventilation) was reported.

Other factors that were unfavorably associated with ICU survival were being bedridden (poor patient performance status), receiving chemotherapy in the previous month, septic shock, organ failures, or aggressive supportive care (mechanical ventilation, vasopressors, and renal replacement therapy). They found that APACHE II, SAPS II, and SOFA were all good predictors of mortality in patients with cancer. APACHE II was predictive of 76.3% of non-survivors and 86.6% of survivors. SAPS II was predictive of 69.5% of non-survivors and 83.6% of survivors. SOFA was predictive of 62.7% of non-survivors and 83.6% of survivors. They also noted that combining scores of SOFA and SAPS II with variables not part of the calculated score, such as patient performance status and presence of septic shock, infection, or anemia, resulted in prognostic models with improved calibration and discrimination (Kopterides et al., 2011).

Performance status

Another scoring system that can be used during the ICU admission process is the performance status of the patient prior to admission. This scoring system is called Eastern Cooperative Oncology Group-Performance Status score (ECOG-PS). This score measures a cancer patient's general well-being and daily activity level on a scale from 0-5, with 0 being asymptomatic and 5 being dead (Chou et al., 2012). Multiple studies have found benefits combining scores of SOFA and SAPS II with variables not part of the calculated score, such as patient performance status (Kopterides et al., 2011).

ICU trial

An alternative to using formalized admission criteria to the ICU is an ICU trial of 3 to 5 days. This trial calls for unlimited ICU support for a limited time, followed by reevaluation

(Lecuyer et al., 2007; Azoulay et al., 2011). This gives practitioners and patients another choice than direct ICU denial in patients with cancer and allows them to see if ICU care is necessary and beneficial. ICU trials may also provide patients and families a sense of support and relief of guilt that all available resources were used for the benefit of the patient. ICU trials can also be a time where palliative care can be discussed in further detail with patients and families (Lecuyer et al., 2007).

Lecuyer et al. (2007) studied outcomes of ICU trials for patients with cancer requiring mechanical ventilation. Their study included 188 patients that would normally not have been admitted into ICU based on General ICU admission criteria alone. Patients were given full-code management with reappraisal on day 6 for continuing or discontinuing the full use of all available ICU resources.

Results showed a 40% survival rate for mechanically ventilated patients with cancer in the ICU at day 5 and a 21% overall survival rate. Of the 188 participants, 85 died before their fifth day in ICU and 54 died after their fifth day in ICU. They also noted that initial data available at the time of ICU admission was not significantly different between survivors and non-survivors who received at least 5 days of the ICU trial. Based on the results found in their study, Lecuyer et al. (2007) advocated for ICU trial with full-code ICU management and reappraisal on day 6 for all patients with cancer (excluding bedridden, palliative care only, and patient refusal of ICU treatment) who do not meet current ICU admission criteria.

Outcomes in Oncology Patients Needing ICU Care

Practitioners should be familiar with recent outcomes in patients with cancer post ICU care. Understanding risk factors for ICU admission and outcomes post ICU care should provide

practitioners with the ability to make more objective decisions on what patients are most appropriate for ICU care on individual assessments. Understanding risk factors also enables practitioners with the ability to get patients appropriate ICU treatments as early as possible.

Patients with cancer should have access to the lifesaving treatments in ICU and be treated with the same courtesy as other patients who are referred for ICU admission. Risk factors that should be considered include, but are not limited to, being bedridden, receiving chemotherapy in the previous month, mechanical ventilation, renal treatments, or multi-organ failure (McCaughey et al., 2013).

Hematological/oncological outcomes

In the past 2 decades, hematology/oncology patients admitted into ICU had mortality rates of 54%-98% (Geerse et al., 2011; McCaughey et al., 2013). Today, survival rates for some hematological malignancies exceed 80% (McCaughey et al., 2013)

McCaughey et al. (2013) examined the characteristics and outcomes of haematological patients with cancer admitted to the intensive care unit. This study included 21 patients admitted into ICU for hematological malignancy. The most common risk factor for admission in these patients was acute respiratory failure secondary to sepsis with a median length of ICU stay of 4 days.

Results showed that the ICU mortality rate in leukemia and lymphoma patients was 43% at 3 months, and 67% at 6 months. This challenges the preconception that patients with cancer are inappropriate for ICU admission. The median number of failed organs in this study was 2.25 to 3. Fungal infections and bone marrow transplant (BMT) were adverse predictors of outcomes in this population (McCaughey et al., 2013).

Geerse et al. (2011) explored the prognosis of patients with haematological malignancies admitted to the intensive care unit and investigated SOFA and APACHI II scores' ability to predict mortality. This study included 75 patients suffering from hematological malignancy. The only exclusion criteria used, in this study, was patients with do not resuscitate (DNR) orders. Results of their study found ICU survival rate of 44% and in-hospital survival rate of 35%.

Geerse et al. (2011) found that APACHE II and SOFA were reliable predictors of mortality, but were not absolute predictors. Mortality was significantly higher in patients with higher APACHE II and SOFA scores and those who received mechanical ventilation within 24 hours of ICU admission. It was also higher in patients treated with ionotropic/vasopressor therapy and in patients who needed CPR. They also found that 33% of the survivors in their study had SOFA score ≥ 15. They concluded that high SOFA score is not an absolute predictor of mortality, however, increasing SOFA score throughout ICU admission was significantly associated with increased mortality.

Geerse et al. (2011) also looked at individual risk factors for ICU admission in relation to patient survival outcomes. The most common risk factors for admission were respiratory failure and sepsis. Others were heart failure, post resuscitation, and neurological. The survival rates for the risk factors were: 67% for neurological, 54% for heart failure, 50% for post resuscitation, 43% for respiratory failure, and 37% for sepsis.

These numbers were all relative to the number of patients admitted for each risk factor, and it is important to note that these outcomes were seen in hematological patients with cancer who are traditionally thought to have poorer outcomes than solid tumor cancers. This supports

the assertion that it is not the cancer itself but the acute complications and organ failures that are more predictive of outcomes.

Solid tumor outcomes

Mortality in patients with cancer is chiefly due to the number and nature of organ failures, not stage or nature of malignancy itself (Azoulay et al., 2011; Kopterides et al., 2011; Geerse et al., 2011). Therefore, metastatic solid cancer diagnosis itself should not exclude patients from ICU admission.

Caruso et al. (2010) were the first to evaluate short and long term survival of metastatic solid tumor cancers admitted into ICU due to an emergency. This study included 83 patients. They found a 1 year survival rate of 55.4% and a 2 year survival rate of 12%. They came to the conclusion that survival rates in patients with metastatic solid cancers admitted to the ICU were low, but mirror rates of other patients with cancer admitted to the ICU. They noticed that higher SAPS II score and lower platelet count (thrombocytopenia) on admission were associated with poorer outcomes.

Caruso et al. (2010) also concluded that no sole characteristic of metastasis (number of organ metastasis or central nervous system involvement) affected mortality, so this should not be an exclusion criteria for ICU admission in patients with cancer. Short term outcomes were associated with the acute disease presentation and not with the underlying malignancy itself.

Chou et al. (2012) looked at outcomes of ICU admission in patients with stage III and IV lung cancer. All patients with stage III or IV lung cancer were included. No restrictions were placed on ICU admission. Chou et al. (2012) looked at outcomes for sepsis related acute respiratory failure needing invasive mechanical ventilation in patients with cancer, and reported

a 41.4% survival rate. Patients that died in this study had poor performance status, lower serum albumin level, higher percentage of disseminated coagulation(DIC), and higher SOFA scores. The mortality predictor tool, SOFA was the only independent predictor of mortality on multivariate analysis, p value = 0.026. They concluded that patients with late stage lung cancer with sepsis-related respiratory failure that presented with lower SOFA scores (5.9 ± 2) seemed to have relatively good outcomes and may benefit from ICU care.

DISCUSSION

Factors that should play a role in the ICU admission process are general ICU criteria, cancer specific criteria, mortality predictor tools, and patient performance status prior to ICU admission. The aforementioned factors in conjunction with ICU trials should be considered instead of immediate refusal of ICU care in patients with cancer.

Shelton (2010) suggests that ICU practitioners do not necessarily use admission guidelines in daily practice. As many as 75% do not adhere to their own admission criteria, and 79% do not have restriction criteria. This has been supported by local practitioners. Dr. Patty Geddie, an Oncology Clinical Nurse Specialist and Ms. Jenny Edwards an Oncology PCU charge nurse, who state that no formal written criteria currently exists for admission of patients with cancer into ICU at our local hospitals (P. Geddie, personal communication, May 11, 2016; J. Edwards, personal communication, June 12, 2016).

In these hospitals when there is suspicion about the need for ICU care in an oncology patient, a specialized team called a rapid response team comes to evaluate the patients for ICU admission based on the patient's current status and the clinical experience of the health care providers. Eventually the decision for ICU admission falls into the hands of the ICU practitioner/physician (P. Geddie, personal communication, May 11, 2016; J. Edwards, personal communication, June 12, 2016).

While this shows that a collaborative effort is already being made between nurses and practitioners, clinical judgement and experience by itself can lead to bias in patient selection for ICU. Basing ICU admission decisions solely on clinical judgement in patients with cancer can prove to be misleading, since, traditionally, patients with cancer have been viewed as poor

candidates for ICU admission (Kopterides et al., 2011). Not using admission criteria, especially in patients with cancer who already face a disadvantage to admission, can deprive these patients of the care that they deserve.

This review looked at outcomes for hematological and solid tumor cancers and found that survival rates post ICU care in these patients have improved from values found in the past. Several factors that significantly resulted in poorer outcomes in patients with cancer admitted into ICU included thrombocytopenia, low albumin levels, DIC, or chemotherapy within the month prior to admission (Chou et al., 2012).

Through the reviewed studies, and in discussion with oncology nurses, it was concluded that one of the most common reasons for patients with cancer to need ICU resources is for the treatment of sepsis that most often results in respiratory failure and hemodynamic instability (P. Geddie, personal communication, May 11, 2016; J. Edwards, personal communication, June 12, 2016). Also, patients with non-acutely reversible lung injury that had early invasive ventilation had better outcomes than NIMV failure followed by later invasive intubation (Chou et al., 2012). Currently there is no debate in treating sepsis with antibiotics in patients with cancer, ICU treatments for respiratory failure should be no different.

Each of the studies reviewed used at least one mortality predicting tool and, while there was no consensus on which tool is a better predictor of outcomes, several of the studies found that combining the mortality predictor tools with other patient characteristics, like performance status, produced better outcome predictions.

The most commonly mentioned predictor tools in the studies reviewed were the APACHE II, SAPS II, SOFA, and LOD scores. There is a general trend that higher the mortality

predictor score the worse the patient outcome will be. A contradiction to this general trend was the study done by Geerse et al. (2011) where 30% of the survivors in the study had a SOFA score ≥ 15, but they noted increasing SOFA scores (≥2 points) during ICU care, had higher mortality than patients with unchanged or decreasing SOFA scores.

The ideal course of admission for patients with cancer in need of ICU care is a combination of general ICU criteria, cancer specific criteria, mortality predictor tools, performance status and ICU trials. McCaughey et al. (2013) stressed the importance of flexible admission criteria and importance of individualized patient selection, advocating for individual case by case selection for admission due to the excess mortality found in patients considered too well for ICU admission and the relative good survival rates found in patients considered too sick for ICU care. As such, ICU trials should be considered instead of immediate refusal of ICU care in patients with cancer.

These trials would give patients with cancer full access to ICU resources for a limited amount of time with reassessments to see if such care is beneficial. Reassessments during ICU trials are essential in these patients because they are likely to suffer from acutely reversible organ failures due to treatments and acute cancer complications.

Shelton (2010), recommended the use of many factors in the admission process of patients with cancer, and Lecuyer et al. (2007), also recommended the use of ICU trials in patients with cancer. Both supported the conclusion that mortality predictor tools play an essential role in ICU trials reassessments, helping in the determination to continue or withdraw full ICU support.

IMPLICATIONS

Nursing Implications

Nurses share in the responsibility for ensuring patients with cancer have access to the best available care, whether by taking an active role in pain management, early infection recognition and control, providing emotional support to their patient, or by acting as liaisons between patients and practitioners. Nurses can play a powerful role in the care of patients with cancer by advocating for patient education and the inclusion of patients and families in the ICU admission process.

Educating patients and families, imparting knowledge about all aspects of ICU care being offered and knowledge of the consequences of such care, can help diffuse stressful situations when a patient's health deteriorates. It can also reduce the hopelessness that patients and families feel when they believe everything possible is not being done for their loved one. This will empower patients and families with the ability to make informed decisions for themselves. Active communication between practitioners, nurses, patients, and families can lead to improved collaborative decisions for appropriate ICU use and reduction of waste in limited ICU resources.

Research Implications

More research will also be beneficial in the areas of ICU trials, performance status scores and mortality predictor tools in relation to patients with cancer in ICU. There is currently no consensus on which tools are the best to use in patients with cancer. This can produce different outcomes at different hospitals depending on which tool they use in the overall ICU admission and care process.

Researchers are exploring long and short term outcomes but there is no general consensus of times frames in relation to short and long term outcomes. In some studies, the short term outcomes might be described at 1 month while in another the short term outcome might be 1 year. Further work is needed to classify time frames for short and long term outcomes to make more correlative decisions based on outcomes.

Several limitations also play significant roles in the research of ICU care in patients with cancer. Most of the studies have small sample sizes, done at individual hospitals, and are retrospective convenience sample chart reviews. More prospective randomized studies are needed incorporating large sample sizes and multiple hospitals.

Also, many studies exploring this topic are done outside the United States, it is essential that more research be done in the United States to test for similar outcomes and evaluate issues that are unique to the United States.

Currently, most of the research, in this area, is still being conducted by doctors. More collaborative work including active participation of nurses, respiratory therapists, nutritionists, and social workers is appropriate and necessary for this type of research.

APPENDIX A: GENERAL ICU ADMISSION TABLES

Table 1: Prioritization Model	
Priority 1	• Critically ill and unstable patients that require intensive treatments and monitoring only available in ICU. • Examples of the needed treatments include ventilator support, continuous monitoring, continuous vasopressor infusions, continuous drug titration… • No therapeutic limits of ICU care placed on these patients • Patient examples include acute respiratory failure requiring mechanical ventilator support, shock or hemodynamically unstable patients receiving invasive monitoring and/or vasopressor treatments…
Priority 2	• Patients requiring intensive monitoring and at some point may need immediate intervention. • No therapeutic limits of ICU care placed on these patients. • Patient examples include acute severe medical or surgical complications worsening chronic comorbid conditions.
Priority 3	• Critically ill and unstable patients with reduced likelihood of recovery due to nature of acute illness or underlying disease. • May receive intensive treatment to relieve acute illness. • Therapeutic limits such as no intubation or cardiopulmonary resuscitation. • Patient examples include metastatic malignancy complicated by airway obstruction, infection, or cardiac tamponade.
Priority 4	These patients are placed into category A or Category B. • Category A: Little or no anticipated benefit from ICU care versus non-ICU care. These patients are considered too well to benefit from ICU care. • Category B: Terminal and IRREVERSIBLE illness facing death. These patients are considered too sick to benefit from ICU care. • Not appropriate for ICU admission • Patient examples include metastatic cancer unresponsive to chemotherapy and/or radiation therapy, patients declining ICU care/invasive monitoring and choosing instead comfort care only through informed consent…

Note: Adapted from Guidelines for ICU admission, discharge, and triage by the Society of Critical Care Medicine.

Reference

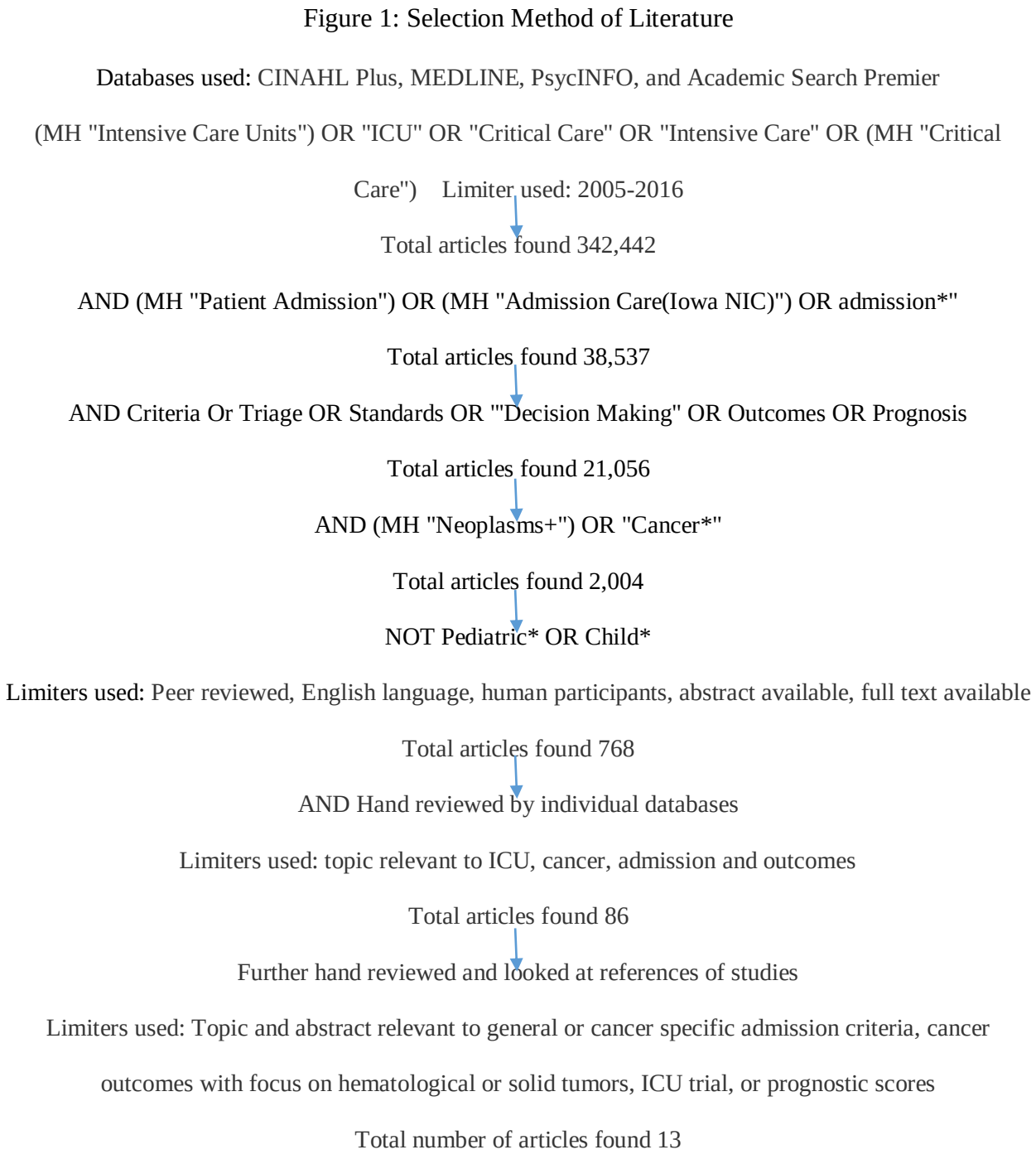
Egol, A., Fromm, R., Guntupalli, K. K., Fitzpatrick, M., Kaufman, D., Nasraway, S., ... Zimmerman, J . (1999). Guidelines for intensive care unit admission, discharge, and triage. *Critical Care Medicine, 27(3)*, 633-638.

Table 2: Diagnosis Model	
Pulmonary	• Acute respiratory failure needing intubation or ventilatory support • Respiratory deterioration in non-ICU floor • Pulmonary emboli with hemodynamic instability • Continuous nursing/respiratory monitoring and care • Massive hemoptysis • Etc.
Cardiac	• Acute myocardial infraction with complications • Cardiogenic shock • Acute congestive heart failure with respiratory failure and/or requiring hemodynamic instability • Hypertensive emergencies • Etc.
Neurologic	• Acute stroke or altered mental status • Coma • Etc.
Gastrointestinal	• Life threatening gastrointestinal bleed • Fulminant hepatic failure • Severe pancreatitis • Etc.
Endocrine	• Diabetic ketoacidosis complicated by respiratory insufficiency, altered mental status, hemodynamic instability, or severe acidosis. • Thyroid storm or myxedema coma with hemodynamic instability • Hyperosmolar state with coma and/or hemodynamic instability • Adrenal crisis with hemodynamic compromise • Severe uncontrolled hypercalcemia with altered mental status • Etc.
Surgical	Post operation patients requiring hemodynamic monitoring/ventilatory support or continuous monitoring
Drug Overdose	Drug ingestion resulting in significantly altered mental status with inadequate airway protection Etc.
Miscellaneous	Septic shock with hemodynamic instability New/experimental therapies with potential for complications Etc.
Note: Adapted from Guidelines for ICU admission, discharge, and triage by the Society of Critical Care Medicine. Reference Egol, A., Fromm, R., Guntupalli, K. K., Fitzpatrick, M., Kaufman, D., Nasraway, S., ... Zimmerman, J . (1999). Guidelines for intensive care unit admission, discharge, and triage. *Critical Care Medicine, 27(3)*, 633-638.	

Table 3: Objective Parameters Model	
Vital Signs	• Heart rate(HR) < 40 beats/minute • HR > 150 beats/minute(min) • Respiratory rate(RR) > 35breaths/min • Systolic arterial pressure: A or B A. <80 millimeter of mercury(mmHg) B. 20mmHg below patient's normal • Etc.
New Laboratory Values	• PO2<50 • PH <7.1 or >7.7 • Serum calcium >15 • Toxic drug levels • Etc.
Radiography/Ultrasonography	• Dissecting aortic aneurism • Etc.
Electrocardiogram(EKG)	• Myocardial infraction(MI) with complex arrhythmias, hemodynamic instability or congestive heart failure(CHF) • Sustained ventricular tachycardia or ventricular fibrillation • Etc.
Acute Physical Findings	• Airway obstruction • Anisocoria in unconscious patient • Anuria • Status epilepticus • Cardiac tamponade • Etc.
Note: Adapted from Guidelines for ICU admission, discharge, and triage by the Society of Critical Care Medicine. Reference Egol, A., Fromm, R., Guntupalli, K. K., Fitzpatrick, M., Kaufman, D., Nasraway, S., ... Zimmerman, J . (1999). Guidelines for intensive care unit admission, discharge, and triage. *Critical Care Medicine, 27(3),* 633-638.	

APPENDIX B: SELECTION METHOD OF LITERATURE

Figure 1: Selection Method of Literature



APPENDIX C: TABLE OF EVIDENCE

Table 4: Table of Evidence

Inclusion criteria: 2005-2016, peer reviewed, English language, human participants, abstract available, full text available, all countries.

Exclusion criteria: Pediatrics (<18 years old), not English, not relevant to literature analysis by article topic or abstract.

Article	Country	Purpose	Sample size	Study design	Intervention	Results/ Key Findings	Nursing Implication
Azoulay, Soares, Darmon, Benoit, Pastores & Afessa (2011) "Intensive care of the cancer patient: Recent achievements and remaining challenges"	France	To increase the ability of cancer patients to receive ICU care.	None	Consensus opinion from experts, review	None	Short term survival after critical care improved. Improved understanding in organ dysfunction in cancer patients has led to improved survival.	Better outcomes in cancer today so need for ICU care.
Caruso, Ferreira, Laurienzo, Titton, Terabe, Carnieli & Deheinzelin (2010) "Short- and long-term survival of patients with metastatic solid cancer admitted to the intensive care unit:	Brazil	To look at short and long term survival of metastatic solid tumor cancers.	83 patients over 1 year	Retrospective chart analysis	None, observational	Survival rates in patients with metastatic solid cancers mirror rates of other cancers post ICU treatment. Higher SAPS II score and lower platelet count(thrombocytopenia) associated with poorer outcomes. No sole characteristic of metastasis by self is a predictor for mortality.	Metastasis itself is not a predictor of death, so ICU admission decisions should not only rely on this. One of the few studies to look at 1 and 2-year survival post ICU treatment

Article	Country	Purpose	Sample size	Study design	Intervention	Results/ Key Findings	Nursing Implication
Prognostic factors"							in cancer patients.
Chou, Chen, Su, Hung, Hsiao, Tseng, ... Perng (2012) "Hospital outcomes for patients with stage III and IV lung cancer admitted to the intensive care unit for sepsis-related acute respiratory failure"	Taiwan	To look at outcomes in stage III and IV patients with lung cancer admitted into ICU.	70 patients over 1 year	Retrospective chart analysis	None, observational	SOFA was the only independent predictor of mortality on multivariate analysis, p value = 0.026). They concluded that patients with late stage lung cancer with sepsis-related respiratory failure that presented with lower SOFA scores (5.9 ± 2) seemed to have better outcomes and may benefit from ICU care.	SOFA mortality predictor tool can be helpful in making better decisions about ICU admission in patients with cancer.
Darmon, Thiery, Ciroldi, Miranda, Galicier, Raffoux, ... Azoulay (2005) "Intensive care in patients with newly diagnosed malignancies and a need for cancer chemotherapy"	France	To determine if patients with newly diagnosed cancer and organ failure need ICU admission and immediate chemotherapy.	100 patients, done over 6 years	Prospective observational cohort study	None	Mortality is chiefly due to number of organ failures not nature of malignancy. 40% mortality after 30 days and 51% after 180 days, these results suggest that advanced cancer at diagnosis should not be reason for ICU denial. They also found that administering	Important to note organ failures and not the cancer itself predicts mortality.

Article	Country	Purpose	Sample size	Study design	Intervention	Results/ Key Findings	Nursing Implication
						chemotherapy during ICU treatment is doable.	
Egol, Fromm, Guntupalli, Fitzpatrick, Kaufman, Nasraway, S., ... Zimmerman (1999) "Guidelines for intensive care unit admission, discharge, and triage"	United States	To provide ICU guidelines for admission, discharge, and triage of adult patients.	None	Guidelines formed by Society of Critical Care Medicine	None, statement of guidelines	The Society of Critical Care Medicine(SCCM) recommends that an intensivist led multi-professional team should be involved in developing and implementing the unit-specific admission protocol from the existing guidelines. Collaboration with nursing and ancillary staff is recommended. The SCCM recommends that admission to the intensive care unit be based on using models of Prioritization, Diagnosis, and Objective Parameters.	Nurses should be involved in the admission process of patients into the ICU. The admission process should be a collaborative effort consisting of all types of health care providers.
Geerse, Span, Sietsma, & Mook (2011) "Prognosis of patients with	The Netherlands	To investigating SOFA and APACHI II scores ability to predict mortality of patients with	75 patients, done over 7 years	Chart review retrospective cohort study	None, observational	APACHE II and SOFA were reliable predictors of mortality, but are not absolute predictors. Concluded that high SOFA score is not an	Important to note not just an initial high SOFA score but increasing SOFA score

Article	Country	Purpose	Sample size	Study design	Intervention	Results/ Key Findings	Nursing Implication
haematological malignancies admitted to the intensive care unit: Sequential organ failure assessment (SOFA) trend is a powerful predictor of mortality"		haematological malignancies admitted to the intensive care unit.				absolute predictor of mortality, however, increasing SOFA score throughout ICU admission was significantly associated with increased mortality.	throughout ICU admission was significantly associated with increased mortality.
Hull, & O'Rourke (2007) "Oncology-critical care nursing collaboration: Recommendation for optimizing continuity of care of critically Ill patients with cancer"	United States	To promote continuity of care through communication between oncology nurses and critical care nurses.	None	Recommendations, review	None	Collaborative relationship building between oncology nurse and ICU nurse helps with continuity of care in patients with cancer needing ICU care. The sharing of oncology specific knowledge can reduce mortality and morbidity.	Collaborative effort is needed in the care of cancer patients in the ICU.
Kopterides, Liberopoul, Llias, Anthi, Pragkastis, Tsangaris, ...Dimopoulou	Greece	To compare the effectiveness of APACHE II, SAPS II, and SOFA prognostic	126 patients, done over 3 years	Prospective observational cohort study	None	General prognostic models are predictive of mortality in patient with cancer in the ICU. Outcome prediction tools are not perfect	General prognostic models can help in the process of admission and

Article	Country	Purpose	Sample size	Study design	Intervention	Results/ Key Findings	Nursing Implication
(2011) "General prognostic scores in outcome prediction for cancer patients admitted to the intensive care unit"		scoring systems in patients with cancer.				preadmission tools for ICU, but can help in telling current patient status and in informing patients and families about prognosis.	care of patients with cancer in the ICU.
Lecuyer, Chevert, Thiery, Darmon, Schlemmer, & Azoulay (2007) "The ICU trial: A new admission policy for cancer patients requiring mechanical ventilation"	France	To evaluate the ICU trial as a new admission policy for cancer patient requiring mechanical ventilation with at least one other organ failure.	188 patients, over 3 years	Prospective interventional cohort study	711 patients referred for ICU admission over a 3 year period. Out of these 188 patients were included in the ICU trial. Excluded bedridden and palliative care only patients. Patients were given full-code management with reappraisal on day 6 for continuing or discontinuing	Recommend ICU trial with full code management and reappraisal on day 6 in all non-bedridden patients with cancer who are not on palliative care. Found that day 6 is most predictive of mortality when using prognostic scores rather than when it is done earlier during ICU care.	ICU trials can be used in patients that do not meet general ICU admission criteria. Decisions to withdraw full ICU support when doing and ICU trial should not take place prior to day 6 because this is time then mortality predictor tool has best predictive ability.

Article	Country	Purpose	Sample size	Study design	Intervention	Results/ Key Findings	Nursing Implication
					the full use of all available ICU resources.		
McCaughey, Blackwood, Glackin, Brady & McMullin (2013) "Charateristics and outcomes of haematology patients admitted to the intensive care unit"	United Kingdom	To profile outcome of adult hematological oncology patients admitted into ICU.	21 patients, done over 1 year	Chart review retrospective cohort study	None	ICU mortality rate in leukemia and lymphoma patients was 43% at 3 months, and 67% at 6 months. This challenges the preconception that patients with cancer are inappropriate for ICU admission. The median number of failed organs in this study was 2.25 to 3. Fungal infections and bone marrow transplant (BMT) were adverse predictors of outcomes in this population.	Patients with hematological cancer today have better outcomes then in the past so this should be considered in decisions for ICU admission. Practitioners and nurses should be updated on the newest outcomes to make appropriate patient decisions.
Paz, Crilley, Weiner & Brodsky (1993) "Outcomes of patients requiring	United States	To compare outcomes of BMT patients requiring and not requiring invasion	36 patients, done over 6 years	Chart review retrospective cohort study	None	Adults with cancer who required mechanical ventilation while in the ICU had a discharge rate of only 3.7% compared to 81.3% in patients with cancer	Invasive mechanical ventilation may be a poor predictor of outcome.

Article	Country	Purpose	Sample size	Study design	Intervention	Results/ Key Findings	Nursing Implication
medical ICU admission following bone marrow transplantation"		mechanical ventilation.				who did not need this therapy. Multiple organ failure was seen in 3 of the 12 survivors and in 20 of the 24 non-survivors. Concluded there is high chance of survival without and reasonable chance of survival with invasive mechanical ventilation.	Multiple organ failure development is associated with higher mortality.
Shelton (2010) "Admission criteria and prognostication in patients with cancer admitted to the intensive care unit"	United States	To look at cancer specific guidelines for ICU admission in patients with cancer.	None	Review	None	Outlined two guidelines that tried to define objective parameters focused on patients with cancer: Groeger and Aurora's Broad categories and the Australian classification system.	Incorporation of cancer specific guidelines into the Objective Parameters model of general ICU admission will provide for improved decision making abilities in patients with cancer in relation to ICU care.

Article	Country	Purpose	Sample size	Study design	Intervention	Results/ Key Findings	Nursing Implication
Smith & Wigmore, (2008) "Outcomes of cancer patients in critical care"	United Kingdom	To look at outcome in ICU patients with cancer.	None	Review	None	Internists concerning patients with cancer needing ICU treatment had long been What is the point? In the 1980s and 1990s, published studies demonstrated very poor survival rates, especially in patients with neutropenic hematology cancer in the ICU.	Individual patient selection is needed for ICU admission. Understanding current outcomes will help in admission decisions.

REFERENCES

American Cancer Society. (2016). Facts and Figures. Powerpoint Presentation. http://www.cancer.org/research/cancerfactsstatistics/cancerfactsfigures2016/index.

Azoulay, E., Soares, M., Darmon, M., Benoit, D., Pastores, S., & Afessa, B. (2011). Intensive care of the cancer patient: Recent achievements and remaining challenges. *Annals of Intensive Care, 1*, 1-13.

Caruso, P., Ferreira, A. C., Laurienzo, C. E., Titton, L. N., Terabe, D. S. M., Carnieli, D. S., & Deheinzelin, D. (2010). Short- and long-term survival of patients with metastatic solid cancer admitted to the intensive care unit: Prognostic factors. *European Journal of Cancer Care, 19*, 260-266.

Chou, K. T., Chen, C. S., Su, K. C., Hung, M. H., Hsiao, Y. H., Tseng, C. M., ... Perng, D. W. (2012). Hospital outcomes for patients with stage III and IV lung cancer admitted to the intensive care unit for sepsis-related acute respiratory failure. *Journal of Palliative Medicine, 15(11)*, 1234-1239.

Darmon, M., Thiery G., Ciroldi, M., Miranda, S. D., Galicier, L., Raffoux, E., ... Azoulay, E. (2005). Intensive care in patients with newly diagnosed malignancies and a need for cancer chemotherapy. *Critical Care Medicine, 33(11)*, 2488-2493.

Egol, A., Fromm, R., Guntupalli, K. K., Fitzpatrick, M., Kaufman, D., Nasraway, S., ... Zimmerman, J . (1999). Guidelines for intensive care unit admission, discharge, and triage. *Critical Care Medicine, 27(3),* 633-638.

Geerse, D. A., Span, L. F. R., Sietsma, S. J. P., & Mook, W. N. K. A. V. (2011). Prognosis of patients with haematological malignancies admitted to the intensive care unit: Sequential organ failure assessment (SOFA) trend is a powerful predictor of mortality. *European Journal of Internal Medicine, 22,* 57-61.

Hull, C. S., & O'Rourke, M. E. (2007). Oncology-critical care nursing collaboration: Recommendation for optimizing continuity of care of critically Ill patients with cancer. *Clinical Journal of Oncology Nursing, 11(6),* 925-927.

Kopterides, P., Liberopoulos, P., Llias, I., Anthi, A., Pragkastis, D., Tsangaris, I., ... Dimopoulou, I. (2011). General prognostic scores in outcome prediction for cancer patients admitted to the intensive care unit. *American Journal of Critical Care, 20(1),* 56-66.

Lecuyer, L., Chevert, S., Thiery, G., Darmon, M., Schlemmer, B., & Azoulay, E. (2007). The ICU trial: A new admission policy for cancer patients requiring mechanical ventilation. *Critical Care Medicine, 35(3),* 808-814.

McCaughey, C., Blackwood, B., Glackin, M., Brady, M., & McMullin, M. F. (2013). Charateristics and outcomes of haematology patients admitted to the intensive care unit. *Nursing in Critical Care, 18(4),* 193-199.

Paz H.L., Crilley P., Weiner M., & Brodsky, I. (1993). Outcomes of patients requiring medical ICU admission following bone marrow transplantation. *Chest, 104,* 527-531.

Shelton, B. K. (2010). Admission criteria and prognostication in patients with cancer admitted to the intensive care unit. *Critical Care Clinics, 26*, 1-20.

Smith, W.P., & Wigmore, T. (2008). Outcomes of cancer patients in critical care. *Current Anesthesia & Critical Care, 19,* 91-95.