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Hematopoietic Stem Cell Transplantation Nursing: A Practice Variation Study

Margaret Bevans, RN, PhD, AOCN[®], D. Kathryn Tierney, RN, PhD, Coleen Bruch, RN, BS, OCN[®], Mary Burgunder, RN, MSN, OCN[®], Kathleen Castro, RN, MS, AOCN[®], Rosemary Ford, BSN, BA, OCN[®], Michelle Miller, RN, BSN, OCN[®], Sandra Rome, RN, MN, AOCN[®], and Kim Schmit-Pokorny, RN, MSN, OCN[®]

Hematopoietic stem cell transplantation (HSCT) is an aggressive therapeutic option for many malignant and nonmalignant diseases. About 40,000 transplantations are performed worldwide each year (Rizzo et al., 2006). Specialized nursing care, which is required to prevent and manage the expected and unexpected toxicities of HSCT (Colombo, Solberg, Vanderhoeft, Ramsay, & Schouten, 2005; Tabbara, Zimmerman, Morgan, & Nahleh, 2002), has been reviewed in many articles and textbooks (Buchsel & Kaputsay, 2005; Buchsel, Leum, & Randolph, 1997; Ezzone & Schmit-Pokorny, 2007; Ford & Eisenberg, 1990). Infection following HSCT, which is associated with significant morbidity and mortality, has been a leading cause of unscheduled hospital admissions in this population (Grant, Cooke, Bhatia, & Forman, 2005; Moya et al., 2006). Therefore, infection prevention is critical to improving outcomes following transplantation.

The risk of infection is based on multiple variables, including the type of transplantation (autologous or allogeneic), source of hematopoietic cells (related or unrelated donor, peripheral blood, bone marrow, or cord blood), underlying disease, disease status (remission or relapse), intensity of the preparative regimen (ablative or nonmyeloablative), prior infections, endogenous microflora, and environmental exposure to micro-organisms. In addition, risk may vary based on infection control measures used by transplantation centers. Practices in infection control, such as type of isolation, dietary restrictions, and antimicrobial prophylaxis, vary widely among transplantation centers (Dadd, McMinn, & Monterosso, 2003; Kruger et al., 2001; Poe, Larson, McGuire, & Krumm, 1994) and affect the psychosocial well-being of transplantation recipients (Sasaki et al., 2000). Nurses are pivotal in implementing practices to prevent and manage infections and associated effects following HSCT.

Purpose/Objectives: To examine practice variation in hematopoietic stem cell transplantation (HSCT) nursing and to identify the gap between recommended standards of practice and actual practice across settings. Additional practices relevant to HSCT nursing also were explored.

Research Approach: Cross-sectional, descriptive survey.

Setting: National and international cancer centers.

Participants: A convenience sample was obtained from the 2006 Oncology Nursing Society Blood and Marrow Stem Cell Transplant Special Interest Group membership list (N = 205). Most participants were women (94%) with a median age of 45 years. The primary role was bedside nurse (46%), with an adult-only population (78%) in an academic (84%), inpatient (68%–88%) center. 39 (94%) U.S. states and 7 (6%) non-U.S. countries were represented.

Methodologic Approach: Survey development was guided by Dillman Mail and Internet survey design. Electronic questionnaires were conducted with Zoomerang[™] Market Tools.

Main Research Variables: Infection control practices across bone marrow transplantation settings.

Findings: Descriptive statistics revealed minimal practice variation regarding infection control across transplantation types or conditioning regimens. Practices regarding implementation of restrictions on patients' hygiene, diet, and social interactions varied by phase of transplantation, with the greatest variations occurring during the post-transplantation phase. Sixty-two percent of respondents reported using published guidelines; 72% reported using organization-specific policies.

Conclusions: Although published standards are under consideration, practice variation exists across transplantation centers. Whether the variation is caused by a lack of compliance with published guidelines or by the poor delineation of details for providers to translate the guidelines into practice is not known.

Interpretation: Identifying gaps in the literature and inconsistencies in HSCT practices is an important first step in designing evidence-based projects that can be used to standardize practice and link best practices to improved patient outcomes.

Background

In 2001, an Institute of Medicine and Committee on Quality of Health Care in America report challenged healthcare providers to provide high-quality, cost-effective care based on the best available scientific evidence. Evidence-based practice combines the best scientific evidence, clinician expertise and judgment, and patient preferences in the development and execution of patient care (Craig & Smyth, 2002). Using research to inform practice is a key component of evidence-based practice and offers the opportunity to improve the quality of patient care and outcomes (Fink, Thompson, & Bonnes, 2005).

Centers for Disease Control and Prevention (CDC), the Infectious Disease Society of America, and the American Society of Blood and Marrow Transplantation (2000) have published guidelines for infection control based on the best available evidence. However, whether the guidelines have been applied effectively across transplantation centers is unclear. In 2006, the Center for International Blood and Marrow Transplantation Research conducted a survey of transplantation physicians (N = 526) to assess practice variation, including questions related to infection control (Lee et al., 2007). The survey revealed that 94%–97% recommended hand washing, 73%–86% provided rooms with high-efficiency particulate air (HEPA) filtration, and less than 50% used other isolation procedures during hospitalization, such as masks, gloves, and gowns. Recommendations for infection prevention following discharge, such as limited visitors in the home, use of masks and gloves in public, eating out, going to indoor public places, and when to return to work or school, were varied across participants. In general, infection control practices were more stringent in the setting of a myeloablative HSCT and with pediatric recipients versus adult recipients (Lee et al.).

This article describes the results of a survey distributed to members of the Oncology Nursing Society's (ONS's) Blood and Marrow Stem Cell Transplant Special Interest Group (BMSCT SIG). The survey aimed to identify variation in HSCT nursing practice with an emphasis on infection control practices. Variation in additional areas of practice relevant to HSCT nursing, including psychosocial care, patient and caregiver education, and symptom management, also were explored. In addition to reporting the survey results, this article describes current sources of guidelines for infection control and related components of HSCT nursing practice. Possible barriers to the implementation of these guidelines also are presented.

Methods

Design and Sample

This cross-sectional survey study employed an electronically distributed questionnaire. The target population was nurses working in national and international

HSCT centers. The convenience sample was derived from the 2006 ONS BMSCT SIG membership list. At the time of study, the list contained 1,457 members. The study aimed to survey all members.

Survey Development

The survey was designed by the authors (the study team) for the purpose of the current study. The study team consisted of nurses with clinical, educational, and research expertise in HSCT, representing eight hospitals across the United States. The team generated the survey questions based on the HSCT multidisciplinary literature as well as their own expertise, which served to establish content validity for the survey. The process for survey development was guided by Dillman (2000) and included the identification of topic areas and question development, questionnaire construction, pilot test, and survey implementation.

The questionnaire included 61 items divided into seven categories: demographics, HSCT center characteristics, program practices, patient precautions, staff precautions, evidence-based practice standards, and patient education. The questions were designed as individual items with a range of responses (e.g., "not at all" to "always") or as an item-in-a-series format, in which a question and response frame apply to a list of statements (e.g., "Please indicate the degree of restriction for each of the following: fresh flowers in room, sharing a bathroom . . .") (Dillman, 2000). Many questions offered a comment section for qualitative responses. The categories were selected based on practices that were covered in published guidelines, with a specific focus on areas that are influenced by, or are components of, nursing practice. The areas included isolation practices (e.g., room and unit systems, staff and personal protective barriers, hand hygiene), visitation limitations, and nutrition restrictions. In addition, areas of practice relevant to HSCT nursing, including psychosocial care, patient and caregiver education, and symptom management, also were explored. The questions addressed application of current evidence-based practice standards in transplantation or oncology, such as oral care, fatigue, pain management, and the care and management of venous access devices.

The online survey was conducted using Zoomerang™ (Market Tools, Inc.). The questions were entered into survey development software and then sent to five HSCT nurses who were not members of the study team. The initial feedback guided survey revisions before final distribution and confirmed the content validity established by the study team.

Procedures

After obtaining approval from the office of human subjects protections at the National Institutes of Health Clinical Center, ONS created a mailing list from the

BMSCT SIG membership (N = 1,457). Prior to the official distribution of the survey, prenotice to the BMSCT SIG membership was completed in person at a BMSCT meeting and through an electronic version of the BMSCT SIG newsletter. The survey was distributed in October 2006, with a cover letter that explained the study, participation, confidentiality, importance of the content, and a live link to the electronic survey. Consent to participate was implicit with survey completion. Two weeks were allowed for initial response. A subsequent notice was distributed to inform BMSCT SIG members that the closing date had been extended for two additional weeks. The final date for responses was November 2, 2006.

Data Analysis

All responses were anonymous to encourage honest answers. Responses were downloaded from Zoomerang and collated by an administrative assistant in Membership/Leadership at ONS. Descriptive statistics were used, specifically frequency counts, for all categorical variables with Microsoft® Office Excel®. Qualitative responses were subject to a cross-case analysis in which responses were grouped together based on individual questions. The data then were subject to a content analysis by which the responses were categorized into common themes.

Results

Participant Characteristics

Of the 1,457 BMSCT SIG members, 1,272 (87%) had an e-mail address on record. A total of 1,190 (94%) electronic questionnaires were “delivered” (no electronic bounce back). From this sample, 345 (29%) participants visited the survey site. Of the participants, 17 (5%) declined participation for the following reasons: did not complete the survey because of participation in the pilot phase (n = 1), limited or no active HSCT program (n = 3), lack of content expertise (n = 10), too busy (n = 2), or not interested (n = 1). One hundred and twenty-five (11%) provided only partial responses, whereas 205 (18%) provided complete responses.

Most participants were women (94%) aged 40–49 years (39%) who were working as a “bedside” nurse (46%) with an adult HSCT population (78%). Of note, 36% of respondents had been in nursing longer than 20 years, with 35% of those nurses having 4–10 years of transplantation experience.

Cancer center characteristics included location and variables to characterize the participants’ transplantation experience. The centers represented by the participants were located in 39 states across six regions of the United States (New England [4%], Mid-Atlantic [21%], South [22%], Southwest [10%], West [19%], and Midwest [24%]). Seven additional countries were represented,

including Canada (n = 7), Australia (n = 2), and one response each from the countries of Iceland, Ireland, Switzerland, South Korea, and Saudi Arabia. Most participants (84%) classified their center as “academic.” The primary setting for HSCTs was inpatient, with minimal variability based on the type of transplantation (autologous or allogeneic) and regimen intensity (myeloablative or reduced intensity/nonmyeloablative). Factors that were reported to influence the primary setting for transplantation included insurance, current health status, complications, hospital resources, and inpatient co-operative care. Although autologous HSCT was reported in all centers represented, 20 participants (10%) reported that their center was not performing any allogeneic HSCT. The estimated length of stay varied across transplantation types, with patients receiving autologous HSCT (mode 11–20 days, 59%) having a shorter length of stay (range) compared to those receiving myeloablative conditioning (mode 21–30 days, 58%). The length of stay (range) for those receiving reduced intensity/nonmyeloablative conditioning was more variable (10 or fewer days, 17%; 11–20 days, 32%; 21–30 days, 29%, more than 30 days, 5%).

During hospitalization, little variation existed in program practices by transplantation type and regimen intensity (see Table 1). Most participants reported that HEPA filtration (range 78%–85%) and positive pressure (range 68%–74%) were used at their transplantation centers. The use of laminar airflow was reported less frequently (range 28%–32%) but existed across all transplantation categories. Most participants (range 58%–63%) reported completing visitor health screening, with few (11%) reporting the use of a formal method of assessment. More than 35% of participants reported that patients had a common gathering area, and more than 61% reported that visitors had a common area. Additional guidelines for visitor limitations included age criteria (e.g., older than 15 years), number of visitors per visit, and use of personal

Table 1. Unit Practices During Hospitalization by Transplantation Category

Unit Practice	Autologous		Myeloablative		RIC/NMC	
	n	%	n	%	n	%
Laminar airflow	61	30	66	32	58	28
HEPA filtration	174	85	165	80	159	78
Positive pressure	152	74	147	72	140	68
Common gathering area for patients	85	41	72	35	75	37
Common gathering area for visitors	144	70	129	63	126	61
Visitor screening	130	63	122	60	119	58

N = 205

HEPA—high-efficiency particulate air; RIC/NMC—reduced intensity conditioning/nonmyeloablative conditioning

protective barriers (e.g., gown, gloves, mask) that might be worn during a visit. Two participants reported that visitors wear a gown, gloves, and mask when visiting the transplantation recipient at their centers.

Psychosocial screening practices for the transplantation recipient were consistent across centers as opposed to psychosocial screening for donors. Sixty-six percent of participants reported that their center includes a formal psychosocial screening assessment as a routine component of HSCT care. Meeting with a psychosocial provider before HSCT occurs more often for transplantation recipients (72%) than donors (28%).

Transplantation Phase Practices

Patient restrictions during the transplantation phase in the absence of an active infection or graft-versus-host disease include environmental, personal protective equipment, and nutritional limitations (see Table 2). Most (53%) participants reported that HSCT recipients were not isolated to their room during the transplantation phase, whereas others (31%) implemented room restrictions during the severe neutropenic period (absolute neutrophil count less than 500). Although guidelines commonly were present, participants commented that compliance varied among members of the interdisciplinary healthcare team. Most participants reported limitations on flowers and live plants in the room (78%) and on the unit (71%). The practice of wearing a mask

during the transplantation phase was variable in type (surgical procedure or particulate respirator) as well as timing of use. Participants reported that a mask was required when patients were out of their rooms or off the unit (46%–53%, respectively). Particulate respirator masks are provided routinely in some centers when the recipient is hospitalized (53%). Participant comments reflected little variation by transplantation category for mask precautions. In addition, limited use of the particulate mask in the pediatric population was noted.

Inconsistencies related to nutritional guidelines are shown in Table 2. Most participants reported that patients were limited in eating raw seafood (74%) and eggs (75%) either all the time or “whenever in the hospital.” In contrast, limitations for the preparation and consumption of fruits and vegetables and the timing for eating take-out food varied. Participant comments included criteria that were applied to specific nutritional limitations. The criteria included the degree of immune reconstitution, time since transplantation (day 0) (e.g., longer than three months), and food preparation details (e.g., no food from a buffet). Hygiene restrictions during the transplantation phase also varied. Participants (71%) indicated that recipients had limitations on sharing their bathroom whenever in the hospital. The comments suggested that this included limitations for family. Most (54%) participants reported that patients had no limitations on taking a shower. However, participant comments suggest

Table 2. Criteria for Implementation of Infection Control Precautions During Transplantation Phase

Restriction	No Limitations		Conditioning		Neutropenia (ANC Less Than 500)		Hospital Admission or Always	
	n	%	n	%	n	%	n	%
Environment								
Fresh flowers or live plants in room	26	13	3	1	17	8	159	78
Fresh flowers or live plants on unit	46	23	3	1	11	5	145	71
Visitors in room	119	58	3	1	32	16	51	25
Isolated to room	108	53	6	3	64	31	27	13
Isolated to unit	30	14	6	3	81	40	88	43
Sharing bathroom	38	19	4	2	17	8	146	71
Taking shower	111	54	4	2	10	5	80	39
Personal protective equipment								
Surgical procedure mask worn out of room	44	21	7	4	59	29	95	46
Particulate respirator mask (e.g., N95 face-mask) worn out of room	107	52	6	3	35	17	57	28
Surgical procedure mask worn off unit	30	15	8	4	58	28	109	53
Particulate respirator mask (e.g., N95 face-mask) worn off unit	96	47	5	2	34	17	70	34
Gloves worn out of room	150	73	2	1	20	10	33	16
Nutrition								
Eating take-out food	62	30	12	6	67	33	64	31
Eating raw seafood	23	11	3	1	27	13	152	74
Eating raw eggs	24	12	3	1	25	12	153	75
Eating fresh, uncooked fruits and vegetables	47	23	4	2	73	36	81	40

N = 205

ANC—absolute neutrophil count

Note. Because of rounding, not all percentages total 100.

Table 3. Criteria for Implementation of Social Activity Precautions During Post-Transplantation Phase

Restriction	No Limits		ANC Less Than 500		ANC Less Than 1,000		Taking Immunosuppression		More Than One Year Post-Transplantation	
	n	%	n	%	n	%	n	%	n	%
Visitors at home	107	52	29	14	30	15	36	18	3	1
Return to work or school	19	9	6	3	43	21	92	45	45	22
Indoor public places	21	10	30	15	81	40	61	30	12	6
Outdoor public places	56	27	33	16	79	39	31	15	6	3
Wearing masks in public	165	80	8	4	14	7	15	7	3	1

N = 205

ANC—absolute neutrophil count

Note. Because of rounding, not all percentages total 100.

additional precautions are implemented, including covering the IV line dressing and cleaning the shower before recipient use.

Post-Transplantation Phase Practices

Greater variation in practice was reported during the post-transplantation phase of HSCT versus the transplantation phase. Little consistency existed across participant responses related to resumption of social activities (e.g., visitors in the home, returning to work) (see Table 3). General comments indicated that teaching was an important element during the post-transplantation phase, encouraging the application of principles used in the transplantation phase. Principles included good hand washing, screening to avoid children with contagious illnesses or those who have received a live vaccine, and avoiding crowds, soil, dirt, and construction sites. The timing to remove limitations on diet restrictions also varied (see Table 4). Participants reported many parameters that influence nutritional practices, including the degree of neutrophil recovery and the degree of immunosuppression.

Less variation existed related to patient education. Most participants reported that the primary provider of patient education was the bedside nurse (65%); the transplantation coordinator (19%), nurse practitioner or physician assistant (6%), physician (1%), or others (9%) also were noted. The caregiver identified during HSCT usually was included in the educational process (range 88%–98%), despite the type of transplantation. Although one-to-one teaching was reported as the most frequent method of education, 36%–39% of participants offered a group class across transplantation types. Participants reported that hard copy education materials commonly are provided, with online resources being used less frequently. The primary source of education for patients and caregivers was organization or program specific (68%). Other sources included the Leukemia and Lymphoma Society (20%), the Internet, BMT InfoNet (Blood and Marrow Transplant Information Network),

the Blood and Marrow Transplant Network, and the National Marrow Donor Program.

Most participants reported that common areas of oncology practice were supported by evidence and established guidelines versus experience only (see Table 5). Standards for infection control specific to bone marrow transplantation care included the CDC HSCT guidelines (62%), organization or department guidelines (72%), practitioner preference (unwritten) (33%), ONS guidelines, bone marrow transplantation guidelines, and expert recommendations on apheresis and infectious disease.

Discussion

Published guidelines and reviews that summarize best practices in oncology and transplantation exist for HSCT healthcare teams (see Figure 1). The primary objective of the current study was to explore current practice variation in HSCT centers and identify the gap between recommended practice and actual practice as reported by HSCT nurses. Patients undergoing HSCT, particularly those experiencing graft-versus-host disease, require greater nursing activity time versus those with other hematologic diseases and treatments (Colombo et al., 2005). Therefore, practices that promote optimal outcomes for HSCT recipients, contain cost for the organization, and enhance positive psychological and quality-of-life outcomes for patients and their families should be maintained.

Overall, most participants reported unit practices that were in compliance with the 2000 CDC recommendations, with little variation by transplantation type or regimen intensity. The recommendations for HEPA filtration and positive pressure are applied in most centers. Some centers continue to exceed the standard with laminar airflow, despite recent evidence suggesting that laminar airflow isolation has no benefit (Mank & van der Lelie, 2003; Russell et al., 2000); laminar airflow isolation also raises additional concern for the emotional health of the recipient (Cohen, Ley, & Tarzian, 2001; Gaskill, Henderson, & Fraser, 1997; Sasaki et al., 2000; Zerbe, Parkerson, & Spitzer, 1994).

Table 4. Criteria for Implementation of Infection Control Precautions During Post-Transplantation Phase

Restriction	No Limits		ANC Less Than 500		ANC Less Than 1,000		Taking Immunosuppression		More Than One Year Post-Transplantation	
	n	%	n	%	n	%	n	%	n	%
Eating take-out food	60	29	29	14	51	25	44	21	21	10
Eating raw seafood	11	5	11	5	26	13	62	30	95	46
Eating raw eggs	11	5	10	5	25	12	61	30	98	48
Eating fresh fruits or vegetables	42	20	31	15	56	27	53	26	23	11
Showering	179	87	9	4	6	3	6	3	5	2

N = 205

ANC—absolute neutrophil count

Note. Because of rounding, not all percentages total 100.

In one study, recipients with HEPA or laminar airflow isolation had less treatment-related and overall mortality than recipients with conventional isolation; however, the effect was limited to the first 100 days and the difference between HEPA-filtration and laminar airflow was not discussed (Passweg et al., 1998). The outpatient setting was less common as the primary site for transplantation and more likely to be used with reduced intensity/nonmyeloablative conditioning recipients versus autologous and myeloablative allogeneic transplantation recipients. Outpatient reduced intensity/nonmyeloablative conditioning has decreased the overall cost of allogeneic HSCT without compromising long-term clinical outcomes (Saito et al., 2007). However, isolation practices in the outpatient setting have not been described.

Optimal time to implement individual infection control guidelines was more inconsistent across centers versus overall compliance. Food safety practices (e.g., avoiding raw seafood and eggs) and avoiding fresh flowers or live plants is mandated commonly; however, the commencement and duration of restriction is unclear. The inconsistencies are present in inpatient as well as outpatient settings and warrant additional attention. Neutropenia has been a common marker of infection risk and is easy to assess, but the period of neutropenia following HSCT has shortened with procedural improvements, such as peripheral blood stem cells (Pavletic et al., 1997) and granulocyte-colony-stimulating factor (Dekker et al.,

2006). Although neutropenia is a risk factor for infection in HSCT recipients, a much greater incidence of infection is caused by delayed immune recovery (T- and B-cell function) (Einsele, 2003); however, no standard guideline exists for assessing the degree of immune compromise. The literature offers various guidelines for the management of neutropenia in patients with cancer and HSCT recipients (Larson & Nirenberg, 2004; Polovich, White, & Kelleher, 2005; West & Mitchell, 2004; Zitella et al., 2008). Considering the increased use of procedures and medications that can cause severe immunosuppression in HSCT recipients, consensus on assessment parameters beyond myelosuppression would be valuable.

Inconsistent infection control practices were most prevalent when related to room and unit limitations, personal protective equipment (e.g., masks), and hygiene recommendations for HSCT recipients. No evidence exists that supports using masks to decrease infection risk during HSCT. Although evidence shows that the N95 respirator facemask is more efficient relative to air filtration and water vapor permeability (Li et al., 2006), no study has explored its efficacy related to clinical outcomes in HSCT recipients except in an environment in which construction was prevalent. The recommendation for a daily shower is applied inconsistently, despite evidence that a primary source of infection during neutropenia is endogenous cutaneous organisms (Klastersky, 1985). Although evidence supports a decrease in skin bacteria following

Table 5. Level of Evidence Applied in Hematopoietic Stem Cell Transplantation Nursing Care

Variable	Experience Based		Evidence Based		Published Guidelines		None		Other	
	n	%	n	%	n	%	n	%	n	%
Venous access device	59	29	177	86	66	32	4	2	6	3
Oral care	75	37	159	78	52	25	2	1	9	4
Fatigue	70	34	124	60	49	24	27	13	4	2
Pain	76	37	163	80	65	32	2	1	2	1

N = 205

Note. Response format allowed for more than one selection.

Guidelines

- Buchsel, P.C., & Kaputsay, P.M. (Eds.). (2005). *Stem cell transplantation: A clinical textbook*. Pittsburgh, PA: Oncology Nursing Society.
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- West, F., & Mitchell, S.A. (2004). Evidence-based guidelines for the management of neutropenia following outpatient hematopoietic stem cell transplantation. *Clinical Journal of Oncology Nursing*, 8(6), 601–613.

Web Resources

- Apheresis Society of America: www.apheresis.org
- Blood and Marrow Transplant Information Network: www.bmtinfonet.org
- Infectious Diseases Society of America: www.idsociety.org
- Leukemia and Lymphoma Society: www.leukemia-lymphoma.org
- National Marrow Donor Program: www.marrow.org

Figure 1. Hematopoietic Stem Cell Transplantation Nursing Guidelines and Resources

a shower (Keswick, Berge, Bartolo, & Watson, 1997), evidence also shows that showering can increase the dispersion of skin bacteria into the air (Speers, Bernard, O'Grady, & Shooter, 1965). Antiseptic bathing is suggested in selected surgical populations (Larson, 2001), but no studies have included HSCT recipients.

Practices or limitations placed on visitation either during hospitalization or outside the hospital vary.

CDC et al. (2000) emphasized thorough screening of visitors, but fewer than 66% of the participants reported that screening was a component of their practice. In addition, few had a formal approach to visitor screening in their organization; the application of visitor limitations also was inconsistent in the post-transplantation phase. Although no specific guidelines on screening procedures exist, the CDC highlighted the role of nurses and the education of patients, family members, and visitors as essential components of a successful infection control program (Siegel, Rhinehart, Jackson, & Chiarello, 2007). Therefore, efforts by HSCT nurses to develop specific guidelines, team procedures, and education materials related to visitor screening across settings (inpatient, ambulatory care, and home) would be of value.

Implications for Practice and Research

Nursing care of HSCT recipients can be complex and demanding; as a result, the need for evidence-based practice guidelines is high. In the current study, the use of evidence-based guidelines by nurse participants was consistent when practices were influenced most directly by HSCT nurses. When publications existed to summarize evidence related to a practice area, most participants reported adherence. The finding suggests that the survey participants are familiar with the literature and promote evidence-based practice in the specialty of HSCT nursing. Nurses also serve as the primary educator for HSCT recipients and their caregivers across transplantation centers, providing one-on-one education to HSCT recipients along with written materials. Additional details that were not addressed in the survey regarding education practices, including the timing of education and the value of phased education (admission versus discharge materials), may have provided additional insights. Although the results suggest that patient and caregiver education occurs in most HSCT cases, strategies to improve materials and processes may benefit HSCT recipients and healthcare providers alike.

The current study's results suggest that, although some practices are common across organizations (e.g., airflow systems), variation exists regarding the criteria and timing for initiation or discontinuation of a specific practice. An explanation of the findings may be related to one or more of the following.

- HSCT teams have a lack of knowledge related to current guidelines.
- HSCT teams lack compliance with the standards based on experience or preference by individual providers.
- Published guidelines lack the level of detail necessary to translate recommendations into clinical practice.

Because of the complex nature of a HSCT, a challenge in this area of research is how to measure and document the outcomes associated with known practice variation or an individual practice.

Suggestions for future work include evaluating links between practice behaviors or adherence and clinical outcomes. Although clinical outcomes such as disease relapse and survival are critical, outcomes more proximal to practice behaviors should also be explored. The outcomes can include length of stay, reasons and length of readmissions, psychological distress, quality of life, and economic impact. In addition, many practices are not isolated to one discipline. Therefore, research should be conducted by an interdisciplinary team including nurses, physicians, nutritionists, and infectious disease specialists.

Limitations in the current study should be understood before generalizing the results. The nurse participants who provided complete responses may have been more or less qualified to accurately reflect the practices of their center. This concern, along with the low response rate, should generate caution when interpreting the results. In addition, the anonymity of participation and limitations posed by the survey software prevented the investigators from seeking response clarification and data exploration. Although content expertise was established on the study team, pertinent questions may have been eliminated from the survey. Administration of the questionnaire beyond the current study is recommended.

The current study illustrates variation in practice despite widely published guidelines, suggesting that transplantation nurses should take an active role in refining current HSCT practice. HSCT nurses play an integral role in ensuring quality care to transplantation recipients and their families, which requires knowledge of the current scientific evidence as it affects practice. Where limited guidance exists, HSCT nurses are empowered to perfect their practice based on their clinical expertise and judgment and disseminate the outcomes

for peer review. Identifying clinical outcomes and patient preferences associated with HSCT practice will ultimately validate practice recommendations and improve care. The ONS BMSCT SIG offers a forum for the discussion of HSCT practice and evidence-based projects. In collaboration with organizations such as the Center for International Blood and Marrow Transplantation Research, the American Society of Blood and Marrow Transplantation, and others, the quality of care for HSCT recipients and their families can be optimized.

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Margaret Bevans, RN, PhD, AOCN[®], is a clinical nurse scientist in the Clinical Center at the National Institutes of Health in Bethesda, MD, and the ex officio coordinator of the Oncology Nursing Society Blood and Marrow Stem Cell Transplant Special Interest Group; D. Kathryn Tierney, RN, PhD, is an oncology clinical nurse specialist in the Department of Nursing at Stanford University Medical Center in California; Coleen Bruch, RN, BS, OCN[®], is a nurse manager in the inpatient blood and marrow transplantation unit at the University of Utah Hospital in Salt Lake City; Mary Burgunder, RN, MSN, OCN[®], is a senior manager of clinical operations in Specialty Programs and Education at the University of Pittsburgh Medical Center in Pennsylvania; Kathleen Castro, RN, MS, AOCN[®], is a clinical nurse specialist in the Department of Nursing in the Clinical Center at the National Institutes of Health; Rosemary Ford, BSN, BA, OCN[®], is a manager in the transplantation clinic at Seattle Cancer Care Alliance in Washington; Michelle Miller, RN, BSN, OCN[®], is a nurse leader in inpatient cancer nursing services at the University of Rochester Medical Center in New York; Sandra Rome, RN, MN, AOCN[®], is a clinical nurse specialist in oncology-hematology at Cedars-Sinai Medical Center in Los Angeles, CA; and Kim Schmit-Pokorny, RN, MSN, OCN[®], is a manager and case manager at the University of Nebraska Medical Center in Omaha. No financial relationships to disclose. Bevans can be reached at mbevans@cc.nih.gov, with copy to editor at ONFEditor@ons.org. (Submitted May 2008. Accepted for publication January 29, 2009.)

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