



Universiteit
Leiden
The Netherlands

Safe transfer of pediatric patients from hematopoietic stem cell transplant unit into the pediatric intensive care unit: views of nurses and physicians

Hutt, D.; Arjona, E.T.; Mekelenkamp, H.; Galimard, J.E.; Kozijn, A.; Schroder, T.; ... ;
European Soc Blood Marrow Transpla

Citation

Hutt, D., Arjona, E. T., Mekelenkamp, H., Galimard, J. E., Kozijn, A., Schroder, T., ... Bader, P. (2022). Safe transfer of pediatric patients from hematopoietic stem cell transplant unit into the pediatric intensive care unit: views of nurses and physicians. *Bone Marrow Transplantation*, 57(5), 734-741. doi:10.1038/s41409-021-01559-5

Version: Publisher's Version

License: [Creative Commons CC BY 4.0 license](#)

Downloaded from: <https://hdl.handle.net/1887/3767982>

Note: To cite this publication please use the final published version (if applicable).

ARTICLE



Safe transfer of pediatric patients from hematopoietic stem cell transplant unit into the pediatric intensive care unit: views of nurses and physicians

Daphna Hutt¹✉, Eugenia Trigos Arjona², Hilda Mekelenkamp³, Jacques-Emmanuel Galimard⁴, Anne Kozijn⁵, Teija Schröder⁶, Marjola Gjergji⁷, Arnaud Dalissier⁸, Sarah J. Liptrott⁹, John Murray¹⁰, Michelle Kenyon¹¹, J. P. J. van Gestel¹², Selim Corbacioglu¹³, Peter Bader¹⁴, The Nurses Group of the European Society for Blood and Marrow Transplantation (EBMT)* and The Pediatric Diseases Working Party (PDWP) of the European Society for Blood and Marrow Transplantation (EBMT)*

© The Author(s), under exclusive licence to Springer Nature Limited 2022

Sufficient communication between hematopoietic stem cell transplantation (HSCT) and pediatric intensive care unit (PICU) teams is pivotal for a successful advanced support in the PICU for HSCT-related complications. We evaluated perceived communication and barriers between both teams with the aim of providing recommendations for improvement. In this cross-sectional survey, a self-designed online questionnaire was distributed among ESPNIC and EBMT members. Data were analyzed using descriptive statistics. Over half of HSCT respondents employed a transfer indication protocol and patient assessment tool, but less structured checklist prior to patient transfer. Nearly all PICU respondents perceived this checklist as improvement for communication. Most HSCT and PICU physicians have daily rounds upon patient transfer while this is mostly missing between nursing teams. Half of both HSCT and PICU nurses indicated that HSCT training for PICU nurses could improve communication and patient transfer. Most respondents indicated that structured meetings between HSCT and PICU nurses could improve communication. Overall there is good communication between HSCT and PICU units, although barriers were noted between members of both teams. Based on our findings, we recommend use of a structured and specific checklist by HSCT teams, HSCT training for PICU personnel, and structured meetings between HSCT and PICU nurses.

Bone Marrow Transplantation (2022) 57:734–741; <https://doi.org/10.1038/s41409-021-01559-5>

INTRODUCTION

Hematopoietic stem cell transplantation (HSCT) is a standardized therapy for various life-threatening pediatric malignant and non-malignant diseases. The number of HSCT is continuously increasing [1, 2]. A significant number of patients who undergo HSCT suffer from complications that require advanced support in the pediatric intensive care unit (PICU). The proportion of transplanted children admitted to the PICU varies between 10 and 20% in different studies [3]. PICU-admitted patients have two simultaneous needs: (1) immediate supportive care for organ dysfunctions, which is available only in PICUs, and (2) control of their disease and HSCT complications [4–6].

The decision to transfer HSCT patients to the PICU is often difficult and sometimes controversial, mainly due to different views of intensivists and oncologists on patient outcomes [7, 8]. Collaboration between hematologists and intensivists is invaluable

to resolve these complex problems. In the last decade, better survival of HSCT patients after PICU admission and improved communication between oncologists, PICU staff, patients, and families, may have resulted in better triage decisions regarding PICU transfer and improved patient management [7, 9].

Nursing handover is a complex phenomenon that is mediated through communication and marks a shift in responsibility from one health care provider to another [10]. It seems to be related to patient safety and quality of care [11]. According to the World Health Organization [12], breakdown and ineffective communication was the leading cause of adverse events, medical errors, inappropriate treatment and potential harm to the patient [12].

Handovers should be considered an essential part of patient-centered care for ensuring continuity of care. Poor communication during a handover could increase the nurse's burden or stress and adversely affect patient care [13]. There is a potential for

¹Division of Pediatric Hematology and Oncology, The Edmond and Lily Safra Children's Hospital, Sheba Medical Center, Ramat Gan 52621, Israel. ²Paediatric Transplant Unit, Hospital University and Polytechnic Hospital LA FE, Valencia, Spain. ³Willem-Alexander Children's Hospital, Department of Pediatrics, Leiden University Medical Centre, Leiden, The Netherlands. ⁴EBMT Statistical Unit, Paris, France. ⁵EBMT Leiden Data Unit, Leiden, The Netherlands. ⁶New Children's Hospital, Helsinki, Finland. ⁷Ospedale Pediatrico Bambino Gesù, Rome, Italy. ⁸EBMT Paris Data Unit, Paris, France. ⁹IEO, European Institute of Oncology IRCCS, Milan, Italy. ¹⁰Christie Hospital NHS Foundation Trust, Manchester, United Kingdom. ¹¹Department of Haematology, King's College Hospital NHS Foundation Trust, London, UK. ¹²Department of Pediatric Intensive Care, Wilhelmina Children's Hospital, University Medical Center Utrecht, Utrecht, The Netherlands. ¹³Department of Pediatric Hematology, Oncology and Stem Cell Transplantation, University of Regensburg, Regensburg, Germany. ¹⁴Center for Child Health, Dept. of Oncology, Immunology and Stem Cell Transplantation, Goethe University, Frankfurt, Germany. *Lists of authors and their affiliations appear at the end of the paper. ✉email: zeevlic@gmail.com

Received: 23 June 2021 Revised: 26 November 2021 Accepted: 22 December 2021

Published online: 21 February 2022

improvement in the quality of nursing handover in clinical practice, with nurses playing a pivotal role in evaluating the clarity of the handover communication process [10].

Following this line of thought, the objective of this research was to evaluate the perception of the communication between HSCT and PICU nurses and physicians and its potential barriers.

METHODS

Study design, sample and setting

An online questionnaire was designed by an expert panel of nurses and physicians of the EBMT Nurses Group (NG) and the Pediatric Disease Working Party (PDWP). The link to the survey was sent in September 2017 by email to all physicians and principal nurses of 202 pediatric EBMT member centers, and to members of European Society of Pediatric & Neonatal Intensive Care (ESPNIC) and was published on the ESPNIC March 2018 Newsletter. Snowball sampling was used to build the sample. Two reminders were sent in January & March 2018. Data collection was closed in September 2018. Participation was voluntary and anonymous.

The questionnaire (see Supplementary Information), available only in English, included single and multiple-choice questions as well as open-ended questions which were divided into five main sections for a total of 47 questions: (1) demographic data, (2) unit structure, (3) complications requiring transfer to PICU, (4) methods of information transfer, and (5) communication.

Data analysis

All answers were described for all the respondents and separately considering the four categories of respondents: Nurse HSCT, Physician HSCT, Nurse PICU and Physician PICU. Quantitative answers were described as median associated with first and third quartiles. Categorical answers were described as number and percentage. The answers to the open-ended question on the perceived communication between HSCT and PICU units were independently classified by four investigators as three categories: "Good", "Need for improvement" and "Poor". Interpretations given by the four investigators were then validated by consensus in case of differences by investigator classification. The same process was applied on the open-ended question on the barriers description. The frequency of each multiple-choice answer is presented as a proportion of all non-missing answers. As a descriptive study, no statistical testing was applied. The analysis was performed using the open-source statistical software R, version 4.0.0 [14].

RESULTS

Participant characteristics

A total of 143 online questionnaires were received. Eighteen were excluded: five as three double respondents and two questionnaires from non-medical respondents additionally, 13 questionnaires were incomplete (Fig. 1).

The respondents of the 125 questionnaires remaining, were 50 (40%) HSCT nurses, 40 (32%) HSCT physicians, 19 (15.2%) PICU nurses and 16 (12.8%) PICU physicians. Table 1a represents the characteristics of the respondents. Participants represented 25 countries, with the vast majority coming from European countries ($n = 118$, 94.4%) as compared to non-European countries ($n = 7$, 5.6%). The primary patient setting of respondents was pediatric ($n = 61$, 48.8%), adolescence ($n = 36$, 28.8%), young adults ($n = 20$, 16%) adults ($n = 2$, 1.6%) or combined pediatric and adult ($n = 6$, 4.8%) (Supplementary Table S1).

Unit structure

Table 1b presents the unit characteristics of the respondents. Of all HSCT respondents, 41 (45.6%) worked in dedicated HSCT units and 49 (54.4%) worked in combined HSCT and Hematology-Oncology units. The majority reported to perform both allogeneic and autologous HSCT and to treat patients up to 18 years (Table 1b). More than half of PICU staff ($n = 19$, 57.6% Supplementary Table S2) report having their own isolation Policy. Regarding practical communication barriers, most respondents ($n = 91$, 72.8%) indicated

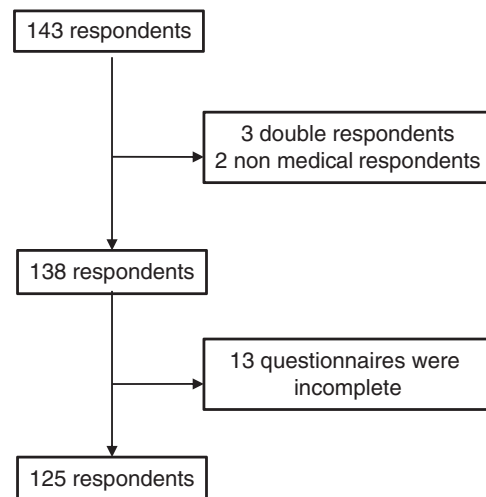


Fig. 1 Survey participation.

that the PICU was located on a different floor in the same hospital. More than half of HSCT respondents ($n = 57$, 63.3%, Supplementary Table S3) were from JACIE accredited centers. Out of the 33 (36.7%) non-accredited centers, respondents indicated that 17 (53.1%) centers were in the process of accreditation (Supplementary Table S3).

Complications requiring transfer to PICU

Several complications requiring transfer to the PICU were proposed from the perspective of the respondents (Table 2). The majority of respondents indicated the need for transfer when the patient requires ventilation ($n = 119$, 95.2%). The lowest accordance of indications requiring transfer to ICU, both between HSCT and PICU teams and between nurses and physicians, was the need for CPAP and neurological problems (Table 2). Differences between the teams were noted in the indication for transfer in patients with severe sepsis or septic shock, with the need for pharmacological support and for renal failure. Almost all PICU nurses ($n = 18$, 94.7%) and PICU physicians ($n = 16$, 100%) agreed that in severe sepsis and septic shock patients should be transferred while only 71% of HSCT teams consider this indication. With the need for pharmacological support, two third of the HSCT nurses indicated the need for transfer although the physicians (HSCT & PICU) and PICU nurses thought transfer is needed (Table 2).

Methods of information transfer

Medical information was communicated between the HSCT and PICU teams in various ways (Supplementary Table S3). The use of a structured patient assessment prior to patient transfer to the PICU was reported by 53 (58.9%) of HSCT respondents, nurses ($n = 27$, 54%) and physicians ($n = 26$, 65%). Most of them ($n = 51$, 96.2%) listed the use of a patient assessment algorithm like the Pediatric Early Warning Signs (PEWS), few use other assessment tools ($n = 2$, 3.8%). The use of a protocol to determine when patient transfer is indicated was reported by 49 (54.4%) of all HSCT respondents, nurses ($n = 27$, 54%) and physicians ($n = 22$, 55%). To this end, written guidelines/SOPs for patient transfer to PICU were available in 42 (46.7%) HSCT centers: nurses ($n = 25$, 50%) and physicians ($n = 17$, 42.5%).

The majority of nurses ($n = 40$, 80%) and physicians ($n = 27$, 67.5%) of HSCT respondents used both written documentation and oral communication ($n = 67$, 74.4% of total). Overall, half of the HSCT respondents shared patient documentation within the same electronic system as their PICU colleagues ($n = 45$, 50%),

Table 1. a Characteristics of respondents. b Characteristics of the respondents' unit.

Questions	Answers	All respondents (N = 125)	HSCT (N = 90)		PICU (N = 35)	
			Nurse (N = 50)	Physician (N = 40)	Nurse (N = 19)	Physician (N = 16)
a						
Age	Median [IQR]	48 [40–55]	46.5 [39–53.8]	53.5 [46–57]	40 [35–43.5]	49 [41.8–51]
Working experience (in years)	Median [IQR]	16 [10–21]	15.5 [10.2–21]	20 [15–25]	10 [5.5–15]	16 [9.8–20]
	1–5	14 (11.2)	5 (10)	2 (5)	5 (26.3)	2 (12.5)
	5–10	20 (16)	8 (16)	4 (10)	5 (26.3)	3 (18.8)
	10–40	91 (72.8)	37 (74)	34 (85)	9 (47.4)	11 (68.8)
Gender	Female	84 (67.2)	45 (90)	21 (52.5)	13 (68.4)	5 (31.3)
	Male	41 (32.8)	5 (10)	19 (47.5)	6 (31.6)	11 (68.8)
Academic qualification	Bachelor of Arts (BA)	32 (25.6)	18 (36)	1 (2.5)	10 (52.6)	3 (18.7)
	Diploma + Registered Nurse (RN)	34 (27.2)	26 (52)	0 (0)	8 (42.11)	0 (0)
	Master of Arts (MA)	7 (5.6)	5 (10)	1 (2.5)	1 (5.26)	0 (0)
	Doctor of Medicine (MD)	34 (27.2)	0 (0)	26 (65)	0 (0)	8 (50)
	Doctor of Philosophy (PhD)	18 (14.4)	1 (2)	12 (30)	0 (0)	5 (31.3)
Country	European	118 (94.4)	47 (94)	38 (95)	18 (94.74)	15 (93.8)
	Non-european	7 (5.6)	3 (6)	2 (5)	1 (5.26)	1 (6.2)
Q14. Are there nurses in your HSCT (PICU) unit with PICU (HSCT) training?	No		27 (54)		10 (52.6)	
	Yes		23 (46)		9 (47.4)	
Q12. Does your hospital or service require that all nurses caring for hematology/oncology patients have a training in Hematology /HSCT care?	No		10 (20.4)		6 (50)	
	Yes		39 (79.6)		6 (50)	
	missing		1		7	
Answers described as number (percentage) or median[IQR]						
b						
Q23. What is your age limit of your pediatric HSCT (PICU) patients?	Combined pediatric/ adult	7 (5.6)	5 (10)	2 (5)	0 (0)	0 (0)
	Up to 16 years	18 (14.4)	7 (14)	5 (12.5)	1 (5.2)	5 (31.3)
	Up to 18 years	73 (58.4)	24 (48)	24 (60)	15 (79)	10 (62.5)
	Young adults (<24 years)	27 (21.6)	14 (28)	9 (22.5)	3 (15.8)	1 (6.2)
Q7. What kind of transplants are performed in your unit?	Autologous + Allogeneic	101 (84.2)	43 (86)	34 (85)	12 (80)	12 (80)
	Allogeneic	15 (12.5)	7 (14)	3 (7.5)	3 (20)	2 (13.3)
	Autologous	4 (3.3)	0 (0)	3 (7.5)	0 (0)	1 (6.7)
	missing	5	0	0	4	1
Q18. How many HSCT beds does your unit have?	median[IQR] (range)		6.5 [6–10] (3–25)	6 [4–8] (2–20)		
Q19. Is it a combined HSCT and Hematology-Oncology unit?	No		22 (44)	19 (47.5)		
	Yes		28 (56)	21 (52.5)		
Q24. In your hospital, where is the PICU located in relation to the HSCT unit?	It is in a different building	19 (15.2)	7 (14)	9 (22.5)	0 (0)	3 (18.7)
	It is in a different hospital	5 (4)	0 (0)	1 (2.5)	3 (15.8)	1 (6.3)
	On a different floor	91 (72.8)	40 (80)	24 (60)	16 (84.2)	11 (68.7)
	On the same floor	10 (8)	3 (6)	6 (15)	0 (0)	1 (6.3)
Answers described as number (percentage) or median [IQR]						

Table 2. Complications requiring transfer to the PICU.

Q28. In your experience, what are the complications requiring transfer to ICU?	Answers	All respondents (N = 125)	HSCT (N = 90)		PICU (N = 35)	
			Nurse (N = 50)	Physician (N = 40)	Nurse (N = 19)	Physician (N = 16)
Renal failure. Need for dialysis/hemofiltration	No	38 (30.4)	16 (32)	13 (32.5)	7 (36.8)	2 (12.5)
	Yes	87 (69.6)	34 (68)	27 (67.5)	12 (63.2)	14 (87.5)
Need for CPAP	No	55 (44)	24 (48)	17 (42.5)	9 (47.4)	5 (31.3)
	Yes	70 (56)	26 (52)	23 (57.5)	10 (52.6)	11 (68.8)
Need for invasive ventilation	No	6 (4.8)	1 (2)	1 (2.5)	3 (15.8)	1 (6.3)
	Yes	119 (95.2)	49 (98)	39 (97.5)	16 (84.2)	15 (93.8)
Severe Sepsis/Septic shock	No	28 (22.4)	16 (32)	11 (27.5)	1 (5.3)	0 (0)
	Yes	97 (77.6)	34 (68)	29 (72.5)	18 (94.7)	16 (100)
Need for pharmacological support of the circulation (dopamine, milrinone, etc)	No	30 (24)	18 (36)	8 (20)	3 (15.8)	1 (6.3)
	Yes	95 (76)	32 (64)	32 (80)	16 (84.2)	15 (93.8)
Neurological problems	No	60 (48)	24 (48)	24 (60)	8 (42.1)	4 (25)
	Yes	65 (52)	26 (52)	16 (40)	11 (57.9)	12 (75)

Answers described as number (percentage)

being the majority of the physicians ($n = 24$, 60%) and less than half of nurses ($n = 21$, 42%).

Fifty-six (62.2%) HSCT respondents reported that they had no specific structured checklist for patient transfer to the PICU. Of the respondents that did employ a structured checklist ($n = 34$, 37.8%), checklists included information such as: reason for transfer ($n = 27$, 81.8%), disease diagnosis ($n = 26$, 78.8%), type of transplant ($n = 25$, 75.8%), date of transplant ($n = 25$, 75.8%), information on medication and nutrition ($n = 28$, 84.9%), presence and type of central venous catheter ($n = 27$, 81.8%), and the name of the family caregiver ($n = 19$, 57.6%).

Communication

Several questions were dedicated to the communication between the HSCT and PICU teams in order to understand the characteristics and barriers of the transfer situation (Table 3). Overall, the communication between the HSCT and PICU units were described as good by most respondents ($n = 79$, 64.8%). Almost one third ($n = 34$, 27.9%) suggested communication is in need of improvement, with a few respondents describing communication as poor ($n = 9$, 7.4%) (Fig. 2).

More than half ($n = 70$, 56%) of all respondents indicated no barriers in the handover process. The perceived barriers that were identified related mainly to the organization ($n = 17$, 36.2%), such as different electronic or medication systems, isolation, and hygiene rules, communication ($n = 10$, 21.3%) or knowledge ($n = 9$, 19.2%), and to a lesser extent to timing of transfer ($n = 7$, 14.9%) or PICU capacity ($n = 4$, 8.5%). Good communication often corresponded with an absence of perceived barriers in the transfer process ($n = 54$, 43.2%).

Once the patient was admitted to the PICU, the majority of HSCT nurses ($n = 31$, 62%) reported that they do not enter the PICU and do not have daily rounds with the PICU nurses. The HSCT nurses who enter the PICU do so whenever needed ($n = 10$, 58.8%) or once a day ($n = 7$, 41.2%). In contrast, all nurses reported that the majority of HSCT physicians ($n = 63$, 91.3%) enter the PICU, once a day ($n = 51$, 82.3%), whenever needed ($n = 9$, 14.5%), and few on transfer only ($n = 2$, 3.2%) (Supplementary Table S4). The indications for PICU rounds vary and are related in the majority of all HSCT respondents to both patients and staff ($n = 65$, 77.4%). Reasons included amongst others: patient support ($n = 75$, 89.3%), support of the family ($n = 70$, 83.3%), and support of the PICU nurses ($n = 52$, 61.9%). However, the majority of HSCT nurses ($n = 36$, 81.8%) indicated that the administration of

chemotherapy and medications, was mainly the obligation of the HSCT nurse ($n = 29$, 42%) less by the PICU nurse ($n = 26$, 37.7%) (Supplementary Table S3).

Daily multidisciplinary discussions between HSCT and PICU were reported by the majority ($n = 24$, 60%) of HSCT physicians but only by a third of the HSCT nurses ($n = 15$, 32.6%); discussions that accrue whenever needed were reported by a third of all HSCT participants ($n = 31$, 36.1%) (Supplementary Table S3).

Perceived improvements for communication

Respondents were asked to suggest ways to improve communication and patient transfer to PICU (Table 4). Overall, most respondents ($n = 89$, 71.2%) thought that a structured checklist for patient transfer would be helpful. Almost all PICU nurses ($n = 18$, 94.7%) and physicians ($n = 15$, 93.8%) indicated this checklist as a good improvement, compared to 64% ($n = 32$) and 60% ($n = 24$) of the HSCT nurses and physicians, respectively. Half ($n = 66$, 52.8%) of the respondents indicated that HSCT training for PICU nurses could improve communication and patient transfer. Of note, this improvement was supported by more than half ($n = 11$, 57.9%) of the PICU nurses surveyed. Half of PICU nurses ($n = 10$, 52.6%) indicated that HSCT nurses should follow up patients while in the PICU, while fewer HSCT nurses thought this necessary ($n = 19$, 38%). Nearly half of HSCT nurses ($n = 23$, 46%) answered that PICU training for HSCT nurses would improve communication, but only few ($n = 4$, 2%) of PICU nurses thought this would help. The minority ($n = 45$, 36%) of all respondents indicated that HSCT training for PICU physicians could improve the communication. Overall, respondents ($n = 74$, 59.2%) indicated that structured meetings between HSCT and PICU nurses could improve the communication. Nearly half of all respondents ($n = 59$, 47.2%) indicated that structured meetings between HSCT and ICU physicians could improve communication as well. PICU physicians placed most trust in structured meetings between either HSCT and PICU nurses or HSCT and PICU physicians as a means to improve the communication (Table 4).

DISCUSSION

To our knowledge, this is the first multicenter survey evaluating the views of both pediatric HSCT and PICU nurses and physicians on patient transfer to the PICU – including the complications requiring patient transfer, communication between the teams and perceived barriers for a safe transfer. This approach gives a more

Table 3. Communication and perceived barriers between HSCT and PICU.

Questions	Answers	All respondents (N = 125)	HSCT (N = 90)		PICU (N = 35)	
			Nurse (N = 50)	Physician (N = 40)	Nurse (N = 19)	Physician (N = 16)
Q44. In your opinion, are there any perceived barriers in the handover process?	No	70 (56)	26 (52)	28 (70)	8 (42.1)	8 (50)
	Yes	55 (44)	24 (48)	12 (30)	11 (57.9)	8 (50)
	Organization	17 (36.2)	6 (33.3)	4 (33.3)	5 (50)	2 (28.6)
	Timing	7 (14.9)	1 (5.6)	1 (8.3)	2 (20)	3 (42.9)
	Capacity	4 (8.5)	1 (5.6)	2 (16.7)	1 (10)	0 (0)
	Knowledge	9 (19.2)	5 (27.8)	2 (16.7)	2 (20)	0 (0)
	Communication	10 (21.3)	5 (27.8)	3 (25)	0 (0)	2 (28.6)
Q47. Over all, how would you describe the communication/ cooperation between your HSCT unit and the ICU?	missing	8 on 55	6 on 24	0 on 12	1 on 11	1 on 8
	Good	79 (64.8)	29 (60.4)	29 (74.4)	11 (57.9)	10 (62.5)
	Need for improvement	34 (27.9)	14 (29.2)	9 (23.1)	6 (31.6)	5 (31.3)
	Poor	9 (7.4)	5 (10.4)	1 (2.6)	2 (10.5)	1 (6.3)
	missing	3	2	1	0	0
	No barriers & Good communication	54 (43.2)	19 (38)	21 (52.5)	7 (36.8)	7 (43.8)
	No barriers & Communication need for improvement	11 (8.8)	4 (8)	5 (12.5)	1 (5.3)	1 (6.3)
Combination of barriers and communication	No barriers & Poor communication	2 (1.6)	1 (2)	1 (2.5)	0 (0)	0 (0)
	No barriers & missing info on communication	3 (2.4)	2 (4)	1 (2.5)	0 (0)	0 (0)
	Barriers and Good communication	25 (20)	10 (20)	8 (20)	4 (21.0)	3 (18.8)
	Barriers & Communication need for improvement	23 (18.4)	10 (20)	4 (10)	5 (26.3)	4 (25)
	Barriers & Poor communication	7 (5.6)	4 (8)	0 (0)	2 (10.5)	1 (6.3)
	Answers described as number (percentage)					

complete picture of the transfer situation. The main findings of our study emphasize the differences and similarities between HSCT and PICU personnel views on 1) the complications that require transfer, 2) the perceived barriers to the safe transfer process, and 3) the communication between the teams and the perceived ways for improvement.

Previous literature described outcomes of patients transferred to PICU [6, 15–17] or discharge from the unit [18–20] as well as nurses' handover of patients into the ICU [21]. Our study adds to this knowledge with details on different views between respondents of HSCT and PICU teams and insight into perceived barriers. Different views between the teams were noted on the need for transfer in patients with severe sepsis in need of pharmacological support. Almost all PICU nurses and physicians and HSCT physicians indicated that in that case patients should be transferred but only 64% of HSCT nurses indicated that transfer is needed. Maybe part of it could be explained by the structure of the HSCT unit and the agreement between HSCT unit and PICU as which medication and treatments could be given and where. In the absence of literature, we believe from our experience that the different views on the complications requiring patient transfer to the PICU could be explained by the fact that PICU teams mainly

treat the more complicated patients who could no longer be treated by the HSCT unit and needed PICU support. HSCT personnel are accustomed to relatively ill patients during a HSCT trajectory that are being treated at the HSCT unit with complications such as severe sepsis or septic shock. It is possible that PICU teams are not aware of that situation and this can explain some of the differences between the HSCT and PICU teams regarding the complications that require transfer to the PICU. Once a patient has been admitted to the PICU, most HSCT nurses come to the PICU only when needed. This is in contrast to the HSCT physicians who have daily rounds in the PICU as well as daily multidisciplinary discussions between HSCT and PICU. HSCT physicians remain responsible for the HSCT-related care, which could explain this difference in daily PICU visits between physicians and nurses. The nursing care is taken over by the PICU nurse and the HSCT nurse is not responsible for the nursing care at the PICU, except when their expertise was specifically requested.

Overall, communication between the HSCT and PICU units was described as good by most of the respondents. Differences between both teams were noted in the perceived improvements for communication. Almost all PICU nurses and physicians indicated that a structured checklist for patient transfer is an improvement, although HSCT nurses and physicians placed less trust in that tool. The Joint Accreditation Committee ISCT-Europe & EBMT (JACIE) standards state that there shall be written guidelines for communication, patient monitoring, and prompt transfer of patients to an intensive care unit or equivalent when appropriate (B2.8) [22]. Previous studies reported the need and importance of a systematic structured handover [13, 23, 24] as the Situation, Background, Assessment, Recommendation (SBAR) system [25, 26]. A pre-Medical Emergency Team [27] could help to improve communication and collaboration between HSCT and PICU teams and possibly reduce the number of required transfers to the PICU.

Others validated the importance of using a checklist for transfer of patient information [28] as focused uniformity of information prevents the omission of data [29] and promotes patients safety. Other ways to improve the communication, as suggested by survey respondents, was training for HSCT and PICU nurses as well as HSCT training for the PICU physicians. Half of the respondents agreed that HSCT training for PICU nurses would improve the communication but only 36% training for the PICU physicians.

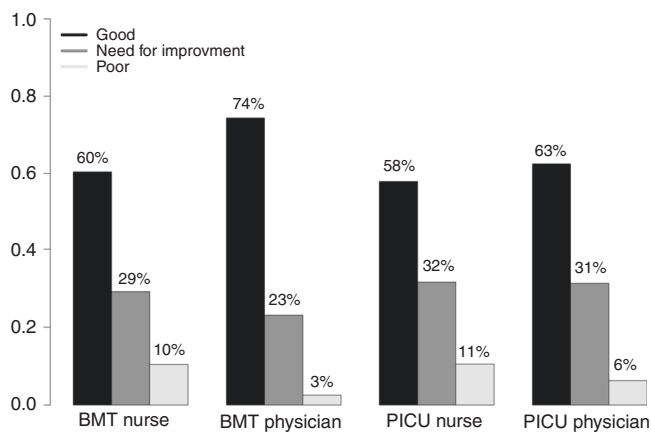


Fig. 2 Perception of communication between HSCT and PICU units.

Table 4. How to improve communication and patient transfer.

Q46. In order to improve the communication and the transfer of the patient to the ICU, what would be helpful in your opinion?	Answers	All respondents (N = 125)	HSCT (N = 90)		PICU (N = 35)	
			Nurse (N = 50)	Physician (N = 40)	Nurse (N = 19)	Physician (N = 16)
A structured checklist for patient transfer	No	36 (28.8)	18 (36)	16 (40)	1 (5.3)	1 (6.3)
	Yes	89 (71.2)	32 (64)	24 (60)	18 (94.7)	15 (93.8)
HSCT training to the PICU nurses	No	59 (47.2)	23 (46)	20 (50)	8 (42.1)	8 (50)
	Yes	66 (52.8)	27 (54)	20 (50)	11 (57.9)	8 (50)
HSCT nurse that will continue to follow the patient while in the PICU	No	81 (64.8)	31 (62)	28 (70)	9 (47.4)	13 (81.3)
	Yes	44 (35.2)	19 (38)	12 (30)	10 (52.6)	3 (18.8)
PICU training to HSCT nurses	No	82 (65.6)	27 (54)	29 (72.5)	15 (79)	11 (68.8)
	Yes	43 (34.4)	23 (46)	11 (27.5)	4 (21.1)	5 (31.3)
Structured meetings between HSCT & PICU nurses	No	51 (40.8)	19 (38)	22 (55)	9 (47.4)	1 (6.3)
	Yes	74 (59.2)	31 (62)	18 (45)	10 (52.6)	15 (93.8)
HSCT training for PICU physicians	No	80 (64)	36 (72)	23 (57.5)	15 (79)	6 (37.5)
	Yes	45 (36)	14 (28)	17 (42.5)	4 (21.1)	10 (62.5)
Structured meetings between HSCT & PICU physicians	No	66 (52.8)	31 (62)	21 (52.5)	13 (68.4)	1 (6.3)
	Yes	59 (47.2)	19 (38)	19 (47.5)	6 (31.6)	15 (93.8)
Answers described as number (percentage)						

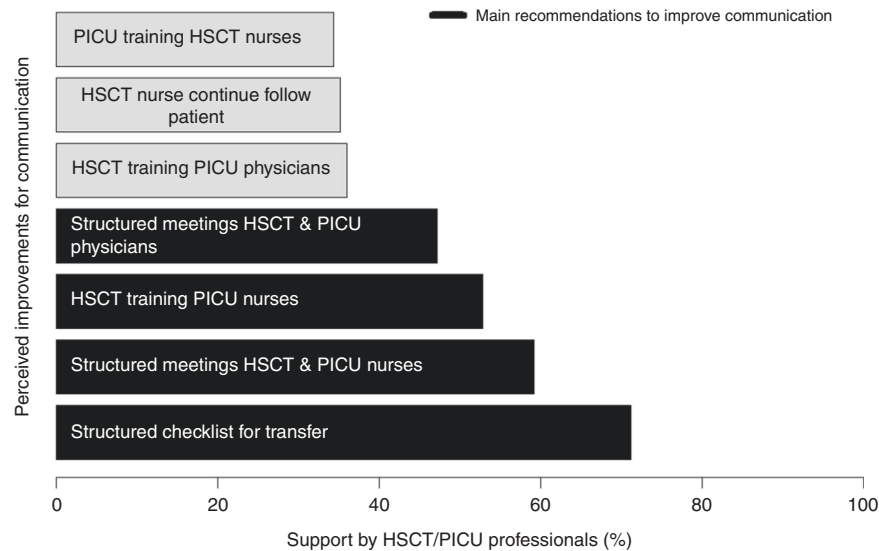


Fig. 3 Main recommendations to improve communication between HSCT and PICU units.

Most physicians (HSCT & PICU) and PICU nurses did not support ICU training for HSCT nurses. We believe from our experience that those differences between the teams could be explained by the fact that PICU and HSCT are unique professions that require special skills, expertise and training. From a practical point of view, PICU care can only be provided at the PICU because of facilities, technique and skilled personnel. For HSCT patients who need to be treated at the PICU, the HSCT care needs to be continued as well. HSCT care is complex, non-standard care and therefore we believe it is reasonable for PICU personnel to receive specific training on this specific type of care.

Next to differences in perceived improvements for communication, we also observed differences in perceived barriers for communication that were related mainly to the organization, e.g., different electronic and medication systems, isolation and hygiene rules, communication and knowledge, and to a lesser extent PICU capacity. Despite experiencing inter-professional communication as satisfactory, it could be worthwhile to evaluate potential existing barriers especially the structural differences that were identified.

This multicenter study presents views from both nurses and physicians from HSCT units and PICU on patient transfer, providing a detailed picture of the transfer situation. It has to be noted here that a smaller numbers of PICU participants, compared with HSCT participants was included in this survey. This could be due to the fact that at time of the survey, no list of PICUs in Europe regularly treating children after HSCT was available. Therefore it was decided to use snowball sampling in order to increase the number of PICU participants. Instead, the HSCT participants were asked to invite their PICU contacts to participate.

In conclusion, effective communication is a vital factor in providing safe patient care. This study is a first to present an overview of the communications and perceived barriers between HSCT and PICU units. Overall there is good communication between HSCT and PICU units although barriers and differences have been noted between physicians and nurses HSCT and PICU staff. Based on our findings, we recommend that HSCT units use a structured and detailed checklist ensuring that all key principles are adhered, for a safe transfer of the patient to the PICU. As well as providing HSCT training for PICU personnel and setting-up structured meetings between the HSCT and PICU nurses (Fig. 3). These suggestions for improvements will support the safety of the transition and the continuity of care of our pediatric HSCT patients.

REFERENCES

1. Passweg JR, Baldomero H, Peters C, Gaspar HB, Cesaro S, Dreger P, et al. Hematopoietic SCT in Europe: Data and trends in 2012 with special consideration of pediatric transplantation. *Bone Marrow Transplant.* 2014;49:744–50.
2. Passweg JR, Baldomero H, Chabannon C, Basak GW, de la Cámara R, Corbacioglu S, et al. Hematopoietic cell transplantation and cellular therapy survey of the EBMT: monitoring of activities and trends over 30 years. *Bone Marrow Transplant.* 2021;56:1651–64.
3. Demaret P, Pettersen G, Hubert P, Teira P, Emeriaud G. The critically-ill pediatric hemato-oncology patient: epidemiology, management, and strategy of transfer to the pediatric intensive care unit. Vol. 2, *Ann of Intensive Care.* Springer Verlag; 2012. <https://doi.org/10.1186/2110-5820-2-14>.
4. van Gestel J, Bollen CW, Bierings MB, Boelens JJ, Wulffraat NM, van Vught AJ. Survival in a recent cohort of mechanically ventilated pediatric allogeneic hematopoietic stem cell transplantation recipients. *Biol Blood Marrow Transpl.* 2008;14:1385–93. <https://doi.org/10.1016/j.bbmt.2008.09.020>.
5. Van Gestel J, Bollen CW, Van Der Tweel I, Boelens JJ, Van Vught AJ. Intensive care unit mortality trends in children after hematopoietic stem cell transplantation: a meta-regression analysis. *Crit Care Med.* 2008;36:2898–904.
6. Van Gestel J, Bierings MB, Dager S, Dalle JH, Pavlíček P, Sedláček P, et al. Outcome of invasive mechanical ventilation after pediatric allogeneic hematopoietic SCT: results from a prospective, multicenter registry. *Bone Marrow Transplant* 2014;49:1287–92.
7. Naeem N, Reed MD, Creger RJ, Youngner SJ, Lazarus HM. Transfer of the hematopoietic stem cell transplant patient to the intensive care unit: does it really matter? *Bone Marrow Transplant.* 2006;37:119–33.
8. Nassar AP, Dettino ALA, Amendola CP, dos Santos RA, Forte DN, Caruso P. Oncologists' and intensivists' attitudes toward the care of critically ill patients with cancer. *J Intensive Care Med.* 2019;34:811–7.
9. Azoulay E, Pène F, Darmon M, Lengliné E, Benoit D, Soares M, et al. Managing critically ill hematology patients: time to think differently. *Blood Rev.* 2015;29:359–67.
10. Lofgren Vretare L, Anderzén-Carlsson A. The critical care nurse's perception of handover: a phenomenographic study. *Intensive Crit Care Nurs.* 2020;58:102807.
11. Riesenberger LA, Leisch J, Cunningham JM. Nursing handoffs: a systematic review of the literature. *Am J Nurs.* 2010;110:24–34.
12. Abdellatif A, Baglan JP, Barajas ER, Cohen M, Cousins D, Denham CR, et al. Communication during patient hand-overs. *Jt Comm J Qual Patient Saf.* 2007;33:439–42.
13. Ahn JW, Jang HY, Son YJ. Critical care nurses' communication challenges during handovers: a systematic review and qualitative meta-synthesis. *J Nurs Manag.* 2021;29:623–34.
14. R Core Team. NR: a language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2020. <https://www.r-project.org/>.
15. An K, Wang Y, Li B, Luo C, Wang J, Luo C, et al. Prognostic factors and outcome of patients undergoing hematopoietic stem cell transplantation who are admitted to pediatric intensive care unit. *BMC Pediatr.* 2016;16:138.

16. Pillon M, Amigoni A, Contin A, Cattelan M, Carraro E, Campagnano E, et al. Risk factors and outcomes related to pediatric intensive care unit admission after hematopoietic stem cell transplantation: a single-center experience. *Biol Blood Marrow Transplant*. 2017;23:1335–41.
17. Wösten-van Asperen RM, van Gestel JPJ, van Grotel M, Tschiedel E, Dohna-Schwake C, Valla FV, et al. PICU mortality of children with cancer admitted to pediatric intensive care unit: a systematic review and meta-analysis. *Crit Rev Oncol. Hematol*. 2019;142:153–63.
18. Häggström M, Bäckström B. Organizing safe transitions from intensive care. *Nurs Res Pract*. 2014;2014:1–11.
19. Sluisveld N, Hesselink G, Hoeven JG, Westert G, Wollersheim H, Zegers M. Improving clinical handover between intensive care unit and general ward professionals at intensive care unit discharge. *Intensive Care Med*. 2015;41:589–604.
20. Enger R, Andershed B. Nurses' experience of the transfer of ICU patients to pediatric wards: a great responsibility and a huge challenge. *J Clin Nurs*. 2018;27:e186–94.
21. Mcfetridge B, Gillespie M, Goode D, Melby V. An exploration of the handover process of critically ill patients between nursing staff from the emergency department and the intensive care unit. *Nurs Crit Care*. 2007;12:261–9. <https://doi.org/10.1111/j.1478-5153.2007.00244.x>.
22. Fact-jacie. international standards for hematopoietic cellular therapy product collection, processing, and administration. 7th Edition March 2018 pp.20.
23. Müller M, Jürgens J, Redaelli M, Klingberg K, Hautz WE, Stock S. Impact of the communication and patient hand-off tool SBAR on patient safety: a systematic review. *BMJ Open*. 2018;8:e022202. <https://doi.org/10.1136/bmjopen-2018-022202>.
24. Powell M, Brown D, Davis C, Walsham J, Calleja P, Nielsen S, et al. Handover practices of nurses transferring trauma patients from intensive care units to the ward: A multimethod observational study. *Aust Crit Care [Internet]* 2020;33:538–45. <https://doi.org/10.1016/j.aucc.2020.03.004>.
25. Shahid S, Thomas S. Situation, background, assessment, recommendation (SBAR) communication tool for handoff in health care – a narrative review. *Saf Heal*. 2018;4:7.
26. Achrekar M, Murthy V, Kanan S, Shetty R, Nair M, Khattry N. Introduction of situation, background, assessment, recommendation into nursing practice: a prospective study. *Asia Pac J Oncol Nurs*. 2016;3:45.
27. Sprogis SK, Currey J, Jones D, Considine J. Use of the pre-medical emergency team tier of rapid response systems: a scoping Review. *Intensive Crit Care Nurs*. 2021;65:103041 <https://doi.org/10.1016/j.iccn.2021.103041>.
28. Salzwedel C, Bartz HJ, Kühnelt I, Appel D, Haupt O, Maisch S, et al. The effect of a checklist on the quality of post-anaesthesia patient handover: a randomized controlled trial. *Int J Qual Health Care*. 2013;25:176–81.
29. Porteous JM, Stewart-Wynne EG, Connolly M, Crommelin PF. iSoBAR-a concept and handover checklist: the National Clinical Handover Initiative. *Med J Aust*. 2009;40. www.mja.com.au.

ACKNOWLEDGEMENTS

We thank the many questionnaire respondents who provided data for this survey and to the ESPNIC colleagues for their collaboration. We highly appreciate the support of Christina Peters to this work.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1038/s41409-021-01559-5>.

Correspondence and requests for materials should be addressed to Daphna Hutt.

Reprints and permission information is available at <http://www.nature.com/reprints>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

THE NURSES GROUP OF THE EUROPEAN SOCIETY FOR BLOOD AND MARROW TRANSPLANTATION (EBMT)

Marjola Gjergji¹⁵, Corien Eeltink¹⁶, Daphna Hutt^{17,18}, Michelle Kenyon¹⁹, Sarah J. Liptrott²⁰, Hilda Mekelenkamp²¹, John Murray²², Teija Schröder²³, Jacqui Stringer²⁴ and Eugenia Trigos Arjona²⁵

¹⁵Ospedale Pediatrico Bambino Gesù, Rome, Italy. ¹⁶Department of Hematology, Cancer Center Amsterdam, Amsterdam University Medical Center, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands. ¹⁷Division of Pediatric Hematology and Oncology, The Edmond and Lily Safra Children's Hospital, Sheba Medical Center, Ramat Gan 52561, Israel. ¹⁸The Edmond and Lily Safra Children's Hospital, Sheba Medical Center, Ramat Gan 52561, Israel. ¹⁹Department of Haematology, King's College Hospital NHS Foundation Trust, London, UK. ²⁰IEO, European Institute of Oncology IRCCS, Milan, Italy. ²¹Willem-Alexander Children's Hospital, Department of Pediatrics, Leiden University Medical Centre, Leiden, The Netherlands. ²²Christie Hospital NHS Foundation Trust, Manchester, United Kingdom. ²³New Children's Hospital, Helsinki, Finland. ²⁴The Christie NHS Foundation Trust, Manchester, UK & University of Manchester, Manchester, UK. ²⁵Paediatric Transplant Unit, Hospital University and Polytechnic Hospital LA FE, Valencia, Spain.

THE PEDIATRIC DISEASES WORKING PARTY (PDWP) OF THE EUROPEAN SOCIETY FOR BLOOD AND MARROW TRANSPLANTATION (EBMT)

Abdulah Al Jefri²⁶, Peter Bader²⁷, Alice Bertaina²⁸, Buchner Jochen²⁹, Selim Corbacioglu³⁰, Arnaud Dalissier³¹, Jacques-Emmanuel Galimard³², Brenda Gibson³³, Tayfun Güngör³⁴, Marianne Ifversen³⁵, Roland Meisel³⁶, Ingo Muller³⁷, Christina Peters³⁸, Kim Vetterranta³⁹, Paul Veys⁴⁰, Jacek Wachowiak⁴¹ and Andre Willasch⁴²

²⁶Department of Pediatric Hematology/Oncology, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia. ²⁷Center for Child Health, Dept. of Oncology, Immunology and Stem Cell Transplantation, Goethe University, Frankfurt, Germany. ²⁸Division of Stem Cell Transplantation and Regenerative Medicine, Department of Pediatrics, School of Medicine, Stanford University, Stanford, CA, USA. ²⁹Department of Pediatric Hematology and Oncology, Oslo University Hospital, Oslo, Norway. ³⁰Department of Pediatric Hematology, Oncology and Stem Cell Transplantation, University of Regensburg, Regensburg, Germany. ³¹EBMT Paris Data Unit, Paris, The Netherlands. ³²EBMT Statistical Unit, Paris, France. ³³Royal Hospital for Children, Glasgow, United Kingdom. ³⁴Universitäts-Kinderspital, Zurich, Switzerland. ³⁵Copenhagen University Hospital Rigshospitalet, Copenhagen, Denmark. ³⁶Division of Pediatric Stem Cell Therapy, Department of Pediatric Oncology, Hematology and Clinical Immunology, Medical Faculty, Heinrich-Heine-University, Duesseldorf, Germany. ³⁷Department of Pediatric Hematology and Oncology, University Medical Centre Hamburg Eppendorf, Hamburg, Germany. ³⁸St. Anna Children's Hospital, Children's Cancer Research Institute, University Vienna, Vienna, Austria. ³⁹Children's Hospital, University of Helsinki, Helsinki, Finland. ⁴⁰Great Ormond Street Institute of Child Health, University College London, London, UK. ⁴¹Department of Pediatric Hematology, Oncology and Hematopoietic Stem Cell Transplantation, University of Medical Sciences, Poznan, Poland. ⁴²University Hospital Frankfurt/Main, Goethe University, Department for Children and Adolescents, Division for Stem Cell Transplantation and Immunology, Frankfurt/Main, Germany.