

Appendix to “Appropriateness of peripherally inserted central catheter use among general medical inpatients: An observational study using routinely-collected data”

1. Identification of PICC Placements

At participating hospitals, PICC placements were primarily or exclusively performed by interventional radiology. PICC placements were identified by manually searching the hospital-specific procedure names of all interventional radiology records during the study period. All procedures that might include PICC placements were included for further review. A physician (FS) manually reviewed the entire radiologist report for the first 30 records for each procedure name. If PICC placements occurred in fewer than 29/30 records, all records with that procedure name were reviewed manually to identify all PICC placements. If PICC placements occurred in 29 or more records, all procedures with that name were included. A second physician (RK) independently reviewed 360 records and after discussing 3 discrepancies, there was 100% agreement between the physicians on which records should be included. A table describing the results of this process is found below.

Appendix Table 1. Manual identification of PICC placements.

Procedure Name*	Total Procedures (N)	Procedures Checked Manually (N)	Confirmed PICC Placements (N)	Confirmed PICC Placements (%)
A_Angiography Body Line Insertion	273	273	205	75.0
A_Angiography Peripheral Line Insertion	850	850	753	88.6
B_PIC line Insertion-1 lumen	207	30	30	100
B_PIC line Insertion-2 lumen	1291	30	29	96.7
B_PIC line Insertion-3 lumen	6	6	6	100
C_PICC Insert Double Lumen	521	30	30	100
C_PICC Insert Single Lumen	178	30	30	100
C_PICC Insert Venogram	4	4	4	100
C_PICC Insertion Us Guided	346	30	29	96.7
D_Angiography Body Line Insertion	37	37	5	13.5
D_Angiography Line PICC CCM	190	190	29	15.3
D_Angiography line PICC Insertion	1980	1980	1691	85.4
D_Angiography Peripheral line Insertion	120	120	112	93.3

*Note: Hospital names replaced with letters.

Appendix Table 2. Categorization and definitions of MAGIC criteria¹ for appropriateness of PICC line insertions.

Category	Appropriateness Criteria	Operational Definitions
Infused Medications	Delivery of non-peripherally compatible infusates (Appropriate)	Delivery of at least one non-peripherally compatible infusate (listed in Appendix Table 3) or an intravenous chemotherapy agent was considered “appropriate”.
	Delivery of peripherally compatible infusates when the proposed duration of such use is ≥ 6 days (Appropriate)	Intravenous delivery of a peripherally compatible drug for ≥ 6 days in hospital after the date of PICC placement was considered “appropriate”.
	Placement for any indication other than infusion of non-peripherally compatible infusates when the proposed duration of use is ≤ 5 days (Inappropriate)	No intravenous medication delivery in hospital after PICC placement and duration of PICC use or hospitalization of ≤ 5 days after PICC placement was considered “inappropriate”.
	Duration of hospitalization ≤ 5 days and PICC not removed (Uncertain)	Intravenous delivery of a peripherally compatible drug when the duration of hospitalization after PICC placement was ≤ 5 days was considered “uncertain” because medication use could have continued after hospitalization.
Critical Illness	Invasive hemodynamic monitoring or requirement to obtain central venous access in a critically ill patient, provided the proposed duration of such use is ≥ 15 days (Appropriate)	PICC use in the ICU was assumed to be for hemodynamic monitoring or central access. ≥ 15 days between the date of PICC placement in the ICU and date of transfer out of the ICU was considered “appropriate”.
	Invasive hemodynamic monitoring or requirement to obtain central venous access in critically ill patient with proposed duration < 15 days (Inappropriate)	< 15 days between the date of PICC placement in the ICU and date of transfer out of the ICU was considered “inappropriate” based on the MAGIC preference statement that temporary central venous catheters are preferred to PICC in this context. PICC use was not considered inappropriate if use after ICU discharge was appropriate for infusion of non-peripherally compatible infusates on a medical ward, infusion of peripherally compatible infusates for ≥ 6 days, or frequent phlebotomy for ≥ 6 days.
Phlebotomy Frequency	Frequent phlebotomy in a hospitalized patient, provided that the proposed duration of such use is ≥ 6 days (Appropriate)	Frequent phlebotomy is defined in MAGIC recommendations as bloodwork more than every 8 hours. To allow for delays in collection of laboratory samples, we defined frequent phlebotomy as an interval ≤ 9 hours between consecutive laboratory tests. PICC placements were considered “appropriate” if the continuous

		number of days with frequent phlebotomy was ≥ 6 .
	Placement for any indication other than infusion of non-peripherally compatible infusates (e.g., irritants or vesicants) when the proposed duration of use is ≤ 5 days (Inappropriate)	Both frequent and non-frequent phlebotomy for ≤ 5 days after PICC placement was considered "inappropriate" if patients were not also receiving non-peripherally compatible infusates.
	Nonfrequent phlebotomy in a hospitalized patient with a proposed duration of use ≥ 6 days (Uncertain)	If at least one laboratory test was performed ≥ 6 days after PICC placement (demonstrating ongoing phlebotomy) but the interval between consecutive tests was not continuously ≤ 9 hours (ie. phlebotomy was not frequent), PICC placement was considered "uncertain".
Chronic Kidney Disease Stage	Placement in a patient with stage 3a or better CKD (estimated glomerular filtration rate ≥ 45 mL/min) (Uncertain)	Estimated glomerular filtration rate was calculated using the Modification of Diet in Renal Disease (MDRD) Study equation ² using the lowest creatinine value during hospitalization. PICC placement in patients with eGFR > 45 mL/min and no dialysis was considered "uncertain".
	Placement in a patient with stage 3b or worse chronic kidney disease (estimated glomerular filtration rate ≤ 44 mL/min) or in patients currently receiving renal replacement therapy via any modality (Inappropriate)	PICC placement in patients with eGFR $> \leq 44$ mL/min or receiving dialysis (defined by Canadian Classifications of Intervention codes 1PZ21HQBR, 1PZ21HPD4, or 1PZ21HQBS) was considered 'inappropriate'.

Legend: Appropriate and inappropriate recommendations are included as per MAGIC¹. We added additional criteria to describe situations in which the MAGIC recommendations are ambiguous.

Appendix Table 3. Evidence-based list of non-peripherally compatible infusates developed by the Infusion Nurses Society³

Medication Name
Calcium Chloride
Calcium Gluconate
Dextrose concentration \geq 12.5%
Dobutamine
Dopamine
Epinephrine
Norepinephrine
Parenteral Nutrition
Phenylephrine
Phenytoin
Promethazine
Sodium bicarbonate
Sodium Chloride \geq 3%
Vasopressin

References

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3. Gorski LA, Stranz M, Cook LS, et al. Development of an Evidence-Based List of Noncytotoxic Vesicant Medications and Solutions. *J Infus Nurs.* 2017;40(1):26-40. doi:10.1097/NAN.0000000000000202