

# The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC) Initiative: A Summary and Review of Peripherally Inserted Central Catheter and Venous Catheter Appropriate Use

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Peripherally inserted central catheters (PICCs) are being selected for venous access more frequently today than ever before. Often the choice of a PICC, when compared with other vascular access devices (VADs), is attractive because of perceived safety, availability, and ease of insertion. However, complications associated with PICCs exist, and there is a paucity of evidence to guide clinician choice for PICC selection and valid use. An international panel with expertise in the arena of venous access and populations

associated with these devices was convened to clarify approaches for the optimal use of PICCs and VADs. Here we present for the busy hospital-based practitioner the methodology, key outcomes, and recommendations of the Michigan Appropriateness Guide for Intravenous Catheters (MAGIC) panelists for the appropriate use of VADs. *Journal of Hospital Medicine* 2016;11:306–310. © 2015 Society of Hospital Medicine

Vascular access devices (VADs), including peripherally inserted central venous catheters (PICCs) and traditional central venous catheters (CVCs), remain a cornerstone for the delivery of necessary therapy. VADs are used routinely to treat inpatients and increasingly outpatients too. PICCs possess characteristics that are often favorable in a variety of clinical settings when compared to traditional CVCs. However, a paucity of evidence regarding the indication, selection, application, duration, and risks associated with these devices exists. PICCs are often used in situations when peripheral venous catheters (PIVs—including ultrasound-guided peripheral intravenous catheters and midline catheters [midlines]) would meet patient needs and confer a lower risk of complications. An unmet need to define indications and promote utilization that conforms to optimal use currently exists. The purpose of this article was to highlight for hospitalists the methodology and subsequent key recommendations published recently<sup>1</sup> regarding appropriateness of PICCs as they pertain to other vascular access device use.

## BACKGROUND

Greater utilization of PICCs to meet a variety of clinical needs has recently emerged in hospital-based medicine.<sup>2,3</sup> This phenomenon is likely a function of

favorable characteristics when comparing PICCs with traditional CVCs. PICCs are often favored because of safety with insertion in the arm, compatibility with inpatient and outpatient therapies, ease of protocolization for insertion by vascular access nursing services, patient tolerability, and cost savings.<sup>4–8</sup> Yet limitations of PICCs exist and complications including malpositioning, dislodgement, and luminal occlusion<sup>9–11</sup> affect patient safety and outcomes. Most notably, PICCs are strongly associated with risk for thrombosis and infection, complications that are most frequent in hospitalized and critically ill patients.<sup>12–16</sup>

Vascular access devices and particularly PICCs pose a substantial risk for thrombosis.<sup>16–20</sup> PICCs represent the greatest risk factor for upper extremity deep vein thrombosis (DVT), and in one study, PICC-associated DVT risk was double that with traditional CVCs.<sup>17</sup> Risk factors for the development of PICC-associated DVT include ipsilateral paresis,<sup>21</sup> infection,<sup>22</sup> PICC diameter,<sup>19,20</sup> and prolonged surgery (procedure duration >1 hour) with a PICC in place.<sup>23</sup> Recently, PICCs placed in the upper extremity have been described as a possible risk factor for lower extremity venous thrombosis as well.<sup>24,25</sup>

Infection complicating CVCs is well described,<sup>12,15</sup> and guidelines for the prevention of catheter-associated blood stream infections exist.<sup>26,27</sup> However, the magnitude of the risk of infection associated with PICCs compared with traditional CVCs remains uncertain. Some reports suggest a decrease risk for infection with the utilization of PICCs<sup>28</sup>; others suggest a similar risk.<sup>29</sup> Existing guidelines, however, do not recommend substituting PICCs for CVCs as a technique to reduce infection, especially in general medical patients.<sup>30</sup>

It is not surprising that variability in the clinical use of PICCs and inappropriate PICC utilization has been

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**TABLE 1.** Guide for PICC Use

<b>A. Appropriate indications for PICC use</b>
Delivery of peripherally compatible infusates when the proposed duration is 6 or more days*
Delivery of nonperipherally compatible infusates (eg, irritants/vesicants) regardless of proposed duration of use
Delivery of cyclical or episodic chemotherapy that can be administered through a peripheral vein in patients with active cancer, provided the proposed duration of such treatment is 3 or more months†
Invasive hemodynamic monitoring or necessary central venous access in a critically ill patient, provided the proposed duration is 15 or more days‡
Frequent phlebotomy (every 8 hours) in a hospitalized patient provided the proposed duration is 6 or more days
Intermittent infusions or infrequent phlebotomy in patients with poor/difficult peripheral venous access, provided that the proposed duration is 6 or more days§
Intermittent infusions or infrequent phlebotomy in patients with poor/difficult peripheral venous access, provided that the proposed duration is 6 or more days§
For infusions or palliative treatment during end-of-life care
Delivery of peripherally compatible infusates for patients residing in skilled nursing facilities or transitioning from hospital to home, provided that the proposed duration is at least 15 or more days¶
<b>B. Inappropriate indications for PICC use</b>
Placement for any indication other than infusion of nonperipherally compatible infusates (eg, irritants/vesicants) when the proposed duration is 5 or fewer days
Placement in a patient with active cancer for cyclical chemotherapy that can be administered through a peripheral vein, when the proposed duration of treatment is 3 or fewer months and peripheral veins are available
Placement in a patient with stage 3b or greater chronic kidney disease (estimated glomerular filtration rate <44 mL/min) or in patients currently receiving renal replacement therapy via any modality
Insertion for nonfrequent phlebotomy if the proposed duration is 5 or fewer days
Patient or family request in a patient that is not actively dying/on hospice for comfort from daily lab draws
Medical or nursing provider request in the absence of other appropriate criteria for PICC use

NOTE: Table is derived from Chopra et al.<sup>1</sup> Abbreviations: PICC, peripherally inserted central catheters. \*Use of ultrasound-guided peripheral intravenous catheters or midlines is preferred over use of PICCs for infusion of peripherally compatible infusates up to 14 days. In patients with poor peripheral venous access, use of ultrasound-guided peripheral intravenous catheters and midlines is also preferred over use of PICCs. †In patients with cancer, the risk of thrombosis associated with PICCs may outweigh benefits. Patients who are scheduled to receive multiple cycles of peripherally compatible chemotherapy for durations <3 months should do so via peripheral intravenous catheters with each infusion. ‡Use of nontunneled central venous catheters is preferred over use of PICCs for central venous access or invasive hemodynamic monitoring <14 days and in patients with documented hemodynamic instability where urgent venous access is necessary. §Use of ultrasound-guided peripheral intravenous catheters or midlines is preferred over use of PICCs for patients with poor/difficult peripheral venous access. ||Placement of a PICC in a terminally ill patient is appropriate if it facilitates comfort goals of care. PICCs may be left in place in such patients to attain similar goals. ¶Use of PICCs for home-based infusions or in skilled nursing facilities (where resources are limited) is inappropriate for the short-term (<14 days). In such settings, use of peripheral intravenous catheters or midlines is rated as appropriate.

described<sup>31,32</sup> given the heterogeneity of patients and clinical situations in which PICCs are used. Simple awareness of medical devices in place is central to optimizing care. Important to the hospitalist physician is a recent study that found that 1 in 5 physicians were unaware of a CVC being present in their patient.<sup>33</sup> Indeed, emphasis has been placed on optimizing the use of PICC lines nationally through the Choosing Wisely initiative.<sup>34,35</sup>

A panel of experts was convened at the University of Michigan in an effort to further clarify the appropriate use of VADs. Panelists engaged in a RAND Corporation/University of California Los Angeles (RAND/UCLA) Appropriateness Methodology review<sup>36</sup> to provide guidance regarding VAD use. The RAND/UCLA methodology is a validated way to assess the appropriateness of medical and surgical resource utilization, and details of this methodology are published elsewhere.<sup>1</sup> In brief, each panelist was provided a series of clinical scenarios associated with the use of central venous catheters purposefully including areas of consensus, controversy, and ambiguity. Using a standardized method for rating appropriateness, whereby median ratings on opposite ends of a 1 to 9 scale were used to indicate preference of one device over another (for example –9 reflected appropriate and 1–3 reflected inappropriate), the methodology classified consensus results into three levels of appropriateness. These three levels are: appropriate when the panel median is between 7 and 9 and without disagreement, uncertain/neutral when the panel

median is between 4 and 6 or disagreement exists regardless of the median, or inappropriate when the panel median is between 1 and 3 without disagreement.

## RESULTS

Comprehensive results regarding appropriateness ratings are reported elsewhere.<sup>1</sup> Results especially key to hospital-based practitioners are summarized below. Table 1 highlights common scenarios when PICC placement is considered appropriate and inappropriate.

### Appropriateness of PICCs in General Hospitalized Medical Patients

The appropriateness of PICCs when compared to other VADs among hospitalized medical patients can be broadly characterized based upon the planned infusate and the anticipated duration of use. PICCs were the preferred VAD when the anticipated duration of infusion was greater than 15 days or for any duration if the infusion was an irritant/vesicant (such as parenteral nutrition or chemotherapy). PICCs were considered appropriate if the proposed duration of use was 6 to 14 days, though preference for a midline or an ultrasound-guided PIV was noted for this time-frame. Tunneled catheters were considered appropriate only for the infusion of an irritant/vesicant when the anticipated duration was ≥15 days; similarly, implanted ports were rated as appropriate when an irritant/vesicant infusion was planned for ≥31 days. Both tunneled catheters and ports were rated as appropriate when episodic infusion over the duration of several months was necessary.

Disagreement existed between the panelists regarding the appropriateness of PICC placement for the indication of frequent blood draws ( $\geq 3$  phlebotomies per day) and among patients with difficult venous access, when phlebotomy would be needed for  $\leq 5$  days. In these cases an individualized patient-centered approach was recommended. PICC placement was considered appropriate in these situations if venous access was required  $\geq 6$  days, but ultrasound-guided and midline PIVs were again preferred to PICCs when the expected duration of use was  $< 14$  days.

### Appropriateness of PICCs in Patients With Chronic Kidney Disease

The appropriateness of PICC use among patients with chronic kidney disease (CKD) takes into consideration disease stage as defined by the Kidney Disease: Improving Global Outcomes workgroup.<sup>37</sup> Although panelist recommendations did not differ for patients with stage 1 to 3a CKD (estimated GFR  $\geq 45$  mL/min) from those noted above, for patient's stage 3b or greater CKD, insertion of devices into an arm vein was rated as inappropriate (valuing the preservation of peripheral and central veins for possible hemodialysis/creation of arteriovenous fistulae and grafts). Among patients with stage 3b or greater CKD, PIV access in the dorsum of the hand was recommended for an expected duration of use  $\leq 5$  days. In consultation with a nephrologist, the use of a tunneled small-bore central catheter (4 French or 5 French) inserted into the jugular vein was rated as appropriate in stage 3b or greater CKD patients requiring venous access for a longer duration.

### Appropriateness of PICC Use in Patients with Cancer

The panelists' acknowledged the heterogeneity of thrombosis risk based on cancer type; recommendations reflect the assumption of cancer as a solid tumor. Vascular access choice among cancer patients is complicated by the cyclic nature of therapy frequently administered, the diversity of infusate (eg, nonirritant or nonvesicant versus irritant/vesicant), and uncertainties surrounding duration of therapy. To address this, the panelists chose a pragmatic approach considering the infusate (irritant/vesicant or not), and dichotomized treatment duration ( $\geq 3$  months or not). Among cancer patients requiring nonvesicant/nonirritant chemotherapy for a duration  $\leq 3$  months, interval placement of PIVs was rated as appropriate, and disagreement existed among the panelists regarding the appropriateness of PICCs. If  $\geq 3$  months of chemotherapy was necessary, then PICCs or tunneled-cuffed catheters were considered appropriate. Ports were rated as appropriate if the expected use was  $\geq 6$  months. Among cancer patients requiring vesicant/irritant chemotherapy, PICCs and tunneled-cuffed catheters were rated as appropriate for all time intervals,

and ports were rated as neutral for 3- to 6-month durations of infusion, and appropriate for durations greater than 6 months. When acceptable, PICCs were favored over tunneled-cuffed catheters among cancer patients with coagulopathy (eg, severe thrombocytopenia, elevated international normalized ratios).

### Appropriateness of PICCs in Patients With Critical Illness

Among critically ill patients, PIVs and midline catheters were rated as appropriate for infusion of  $\leq 5$  days, and 6 to 14 days, respectively, whereas PICCs were considered appropriate only when use  $\geq 15$  days was anticipated. Although both CVCs and PICCs were rated as appropriate among hemodynamically unstable patients in scenarios where invasive cardiovascular monitoring is necessary for durations of  $\leq 14$  days and  $\geq 15$  days, respectively, CVCs were favored over PICCs among patients who are hemodynamically unstable or requiring vasopressors.

### Appropriateness of PICC Use In "Special" Populations

The existence of patients who require lifelong, often intermittent, intravenous access (eg, sickle cell anemia, short-gut syndrome, cystic fibrosis) necessitates distinct recommendations for venous access. In this population, recommendations were categorized based on frequency of hospitalization. In patients that were hospitalized infrequently ( $< 5$  hospitalizations per year), use of midlines was preferred to PICCs when the hospitalization was expected to last  $\leq 5$  days; PICCs were rated as appropriate for a duration of use  $\geq 15$  days. However, in patients who require frequent hospitalization ( $\geq 6$  hospitalizations annually), tunneled-cuffed catheters were rated as appropriate and preferred over PICCs when the expected duration of use was  $\geq 15$  days per session.

For long-term residents in skilled nursing facilities, PICCs were rated as appropriate for an expected duration of use  $\geq 15$  days, but uncertain for a duration of 6 to 14 days (when midlines were rated as appropriate). For venous access of  $\leq 5$  days, PIVs were rated as most appropriate.

### How, When, by Whom, and Which PICCs Should Be Inserted

Societal recommendations<sup>26</sup> and guidelines<sup>38</sup> for routine placement and positioning of PICCs by dedicated nursing services exist.<sup>39,40</sup> Panelists favored consultation with the specialists ordering vascular access devices (eg, infectious disease, nephrology, hematology, oncology) within the first few days of admission for optimal device selection and timing of insertion. For example, PICCs were rated as appropriate to be placed within 2 to 3 days of hospital admission for patients requiring longterm antimicrobial infusion (in the absence of bacteremia). Preferential PICC placement by

interventional radiology was rated as appropriate if portable ultrasound did not identify a suitable target vein, the catheter fails to advance over the guidewire during a bedside attempt, or the patient requires sedation not appropriate for bedside placement. Interventional radiology insertion was also preferred in patients with bilateral mastectomy, altered chest anatomy, and for patients with permanent pacemakers or defibrillators if the contralateral arm is was not amenable for insertion. PICCs are generally placed at the bedside (with radiographic confirmation of catheter position, or with electrocardiography guidance when proficiency with this technique exists) or under direct visualization in the interventional radiology suite. As recommended elsewhere,<sup>21,26,41</sup> panelists rated the placement of the PICC catheter tip in the lower one-third of the superior vena cava, at the cavoatrial junction, or in the right atrium as being appropriate. Nuanced recommendations surrounding PICC adjustment under varying circumstances can be found in the parent document.<sup>1</sup> Single-lumen devices, which are associated with fewer complications, were rated as the appropriate default lumen of choice in the absence of a documented rationale for a multilumen PICC as a mechanism to decrease possible complications.<sup>19,20,42</sup> The insertion of multilumen PICCs for separating blood draws from infusions or ensuring a “backup” lumen is available was rated as inappropriate. Consistent with recent recommendations,<sup>43,44</sup> normal saline rather than heparin was rated as appropriate to maintain catheter patency. The advancement of a migrated PICC was rated as inappropriate under all circumstances.

## CONCLUSIONS

In-hospital healthcare providers are routinely confronted with dilemmas surrounding choice of VAD. The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC) initiative is a multidisciplinary effort to clarify decision-making related to VAD use. The systematic literature review and RAND/UCLA appropriateness method applied by the MAGIC panelists identifies areas of broad consensus surrounding the use of PICCs in relation to other VADs, and highlights uncertainties regarding the best practice to guide clinical care. Appropriateness statements facilitate standardization for the use, care, and discontinuation of VADs. These recommendations may be important to healthcare quality officers and payers as they allow for measurement of, and adherence to, standardized practice. In an era of electronic medical records and embedded clinical decision support, these recommendations may facilitate a just-in-time resource for optimal VAD management, outcomes measurement, and patient follow-up. In addition to directing clinical care, these recommendations may serve as a lattice for the formation of future randomized clinical trials to further clarify important areas of the uncertainty surrounding VAD use.

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