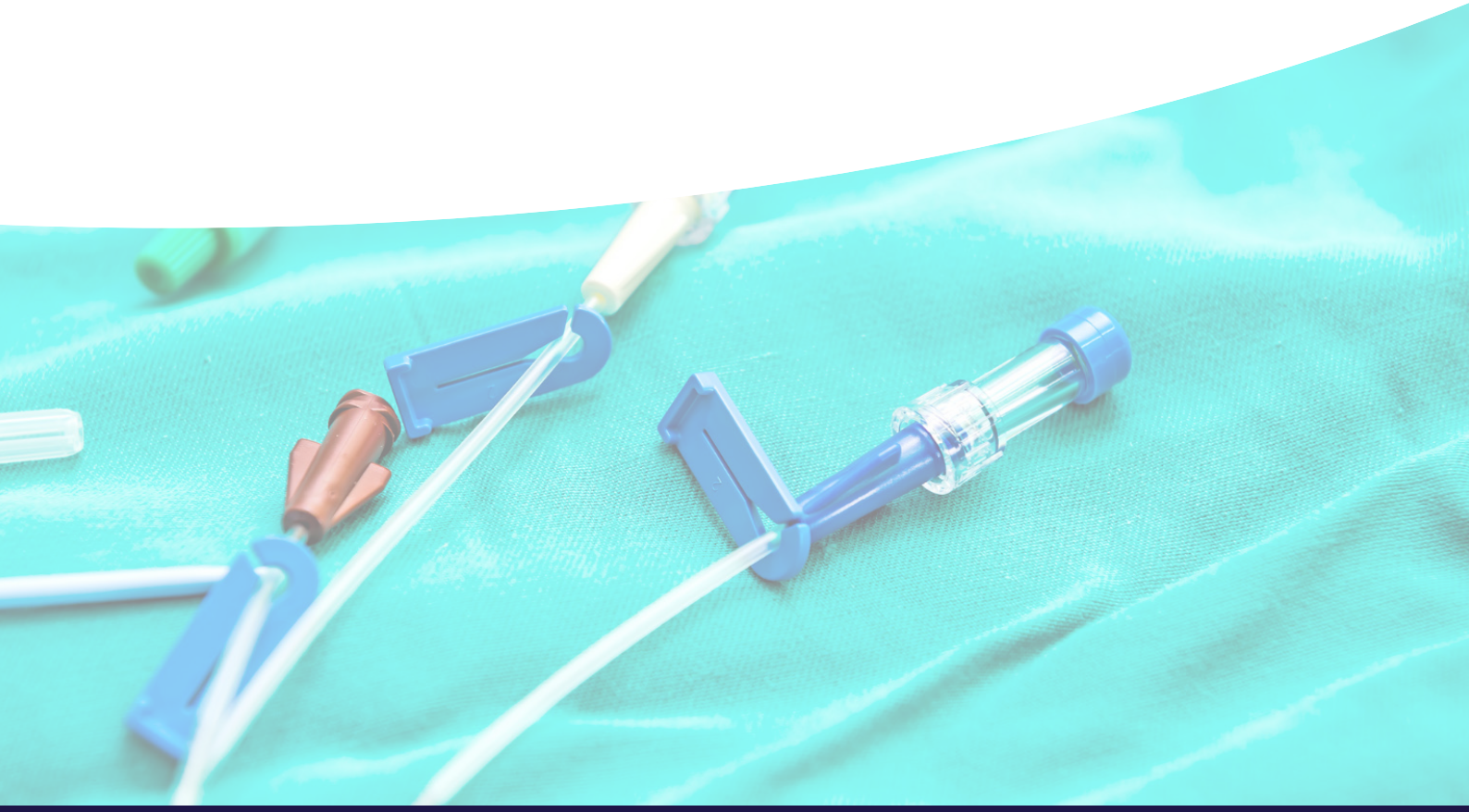
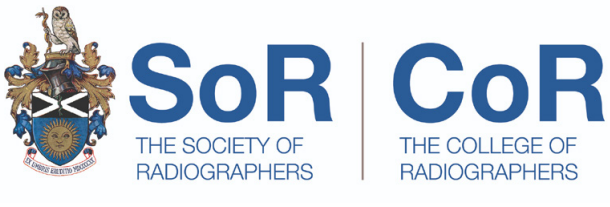
Intensive Care Society

Guidance for:

The use of central venous catheters for the administration of radiological contrast media in critically ill adults



Endorsing Organisations



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CT Advisory Group, Society and College of Radiographers

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Abbreviations

CT	Computed Tomography
CVAD	Central Venous Access Device
CVC	Central Venous Catheter
MHRA	Medicines and Healthcare products Regulatory Agency
MRI	Magnetic Resonance Imaging
PGD	Patient Group Direction
PICC	Peripherally Inserted Central Catheter
PIPICC	Power Injectable Peripherally Inserted Central Catheter
TIVAP	Totally Implantable Venous Access Port

Introduction

For every patient, a strategy that encourages performing the right imaging (with or without radiological contrast media) in order to answer the diagnostic question at the first time of asking, should always be the correct way to proceed.

Many critically ill patients have central venous catheters (CVCs) in place and, over time, reliable peripheral venous access becomes increasingly difficult to obtain. A proportion of these patients will be required to undergo contrast enhanced computed tomography (CT) or occasionally Magnetic Resonance Imaging (MRI) scans as a part of their patient journey. This procedure often involves the administration of contrast media at relatively high volumes, rates and pressures in order to obtain images of adequate diagnostic quality to answer a clinical question. In many cases, CVCs are not approved by the manufacturer for this purpose thus meaning the use of such devices is “off-label”. The need to compromise image quality or create additional risk associated with the use of central access creates professional and ethical conflict.

The aim of this guidance is to propose pragmatic recommendations (which can be used as a basis for local policy development at an organisational level), with regards to the administration of radiological contrast media via CVCs in critically ill adult patients. This guidance is aimed at the use of non-tunnelled central venous catheters (inserted either in the internal jugular, subclavian or femoral veins) rather than other central venous access devices such as tunnelled catheters, Totally Implanted Venous Access Ports (TIVAPs) or peripherally inserted central catheters (PICCs).

Recommendations

- Peripheral intravenous access remains the first-choice route for high pressure contrast infusion during CT scanning.
- An attempt to obtain peripheral access should be made in all critical care patients prior to attempting a CT scan with contrast, except where this would result in an unacceptable delay in obtaining a time-critical diagnostic test.
- Local organisations should have written policies for the use of central venous catheters for the administration of radiological contrast media.
- Local organisations should review (and if necessary, update) any relevant patient group directions (PGDs) to include administration of intravenous radiological contrast media in the context of this guidance.
- Local organisations should consider procuring central venous catheters that have been approved by the manufacturer for administration of high-pressure infusions for the delivery of CT contrast in critically ill adult patients. These might be used in patients who are anticipated to need serial imaging.
- Where peripheral intravenous access or manufacturer approved central venous catheters are not available (or their insertion is not felt to be clinically feasible or appropriate), then it is recommended that a cautious approach (detailed below) is followed for using a standard central venous catheter.
- The decision to use a central venous catheter, which is not approved by the manufacturer for the administration of radiological contrast media at high pressure, should be made collaboratively between the senior responsible clinician in critical care and the senior responsible clinician in the radiology department. The discussion and decision should be documented in the patient record by those involved.
- We strongly recommend against hand injection of radiological contrast media via a central venous access device.
- Those involved in each case decision and process should firstly consider whether injection of contrast is necessary to answer the clinical question requiring the CT scan; and secondly whether any alterations to the scan protocol will be required to do so (as decided by an appropriately qualified radiology practitioner).
- Where possible the patient should be involved in this decision-making process. In cases wherein the patient lacks the mental capacity to make this decision, it should be made in their best interests and clearly documented in the patient's medical record.
- There should be an agreed procedure to confirm the correct position of the central venous catheter tip prior to commencing injection of radiological contrast media. This should include examination of the most recent radiograph by an appropriately qualified practitioner, an "aspirate and flush" check and confirmation of tip position on the scan projection radiograph by an appropriately qualified practitioner. When tip position is difficult to determine, consider performing limited axial slices of the tip position. Image review of axial slices should be performed by a supervising radiologist or tele-radiology service. Position checking and aspiration should be checked in the position in which the patient will receive the contrast bolus.
- All practitioners using the central venous catheter should be adequately trained in infection prevention and control measures for accessing these devices as per local organisational policy.
- If using a multi-lumen central venous catheter, preferentially use the distal port. In circumstances where the catheter has a specific port designed for rapid high-pressure infusion this port should always be used and, if in use already, steps should be taken to free the lumen for use. This lumen should be aspirated and flushed to ensure patency before transfer to the radiology department and clearly labelled to identify it for use.

- Following completion of the procedure, the central venous access device should be checked for any signs of external damage. It is also recommended that post-procedure imaging is undertaken to confirm the tip position, particularly where there will be ongoing use of vasoactive medications via the device.
- Ensure new members of staff are adequately trained on local procedures regarding the use of central venous lines, including review of the available central venous catheter devices and any policy regarding their use.

Background

Some CT departments may have adopted a “do not power inject through a central venous catheter” policy owing to a historical Medicines and Healthcare products Regulatory Agency (MHRA) alert recommending limits on their use due to reported incidences of device rupture. This alert has since been withdrawn.[1] In many cases, central venous catheters are not approved by manufacturers for the purpose of high-pressure injections thus meaning the use of such devices is “off-label.” The MHRA has offered the following useful advice with regards “off-label” use:

“Where the healthcare organisation or healthcare professional judges that there is no alternative but to use a medical device off-label or modify an existing medical or non-CE marked medical device:

- carry out and document a risk assessment
- consider the ethical and legal implications
- implement suitable precautions to minimise the risk
- review the risk assessment at suitable periods

Where a healthcare professional judges that there is no alternative to off-label device use, the patient must be fully informed during the consent procedure and a note made in the patient's records.”[2]

Non-power rated lines are often designed for slow infusion flow rates and tested to 0.3ml per second. A bolus of CT contrast media, for arterial phases can require infusion of up to 6ml/s and portal venous phases 1.5-3 ml/s to obtain peak enhancement for the region of interest when injected through a peripheral venous cannula. A reduction in flow rate may reduce pressures, but may also reduce peak enhancement of the region of interest, this would potentially jeopardise diagnostic image quality and/or risk producing non-diagnostic images.

Several manufacturers do however produce central venous catheters (CVCs) for this purpose and as such, the primary recommendation is for routine procurement and use of these devices. However, these devices are not routinely stocked on most units at present and secondarily patients may arrive with CVCs already in situ that are not approved by the manufacturer for administration of infusions at high pressure. This necessitates a risk assessment and decision making prior to use.

Evidence for complications associated with high pressure injection of radiological contrast media

Two in-vivo studies[3] [4] examined the complication rate associated with the use of exclusively non-tunnelled central venous catheters. Each recruited 104 patients and found no complications associated with their use for power injection (flow rates of 3-5ml/s; injection pressures of approximately 300psi) of contrast media. Both studies established strict safety procedures regarding the confirmation of line position, patency, and pressure limitation setting (amongst others) which have informed the recommendations in this guidance. Regarding line position, one study, evaluating the displacement of power injectable peripherally inserted central catheters (PIPICCs), reported an event rate of 15.4%.[5]

Other studies have examined complication rates but have often focused almost entirely on other CVADs such as tunnelled catheters, implanted catheters or peripherally inserted central catheters. These studies have however also reported low complication rates and suggest injection of contrast media via such devices would be both feasible and safe.[6]

A systematic review examining contrast injection via a range of central venous access devices found reports of complications including: external catheter rupture (these were related to peripherally inserted central catheters (PICCs) where the catheter was found to be clamped or kinked at the site of entry); dislocation of the catheter tip (related to a totally implantable venous access port (TIVAP) with catheter rupture during an interventional retrieval event); loss of patency of a CVC (however the catheter was used successfully after contrast injection prior to this event); and positive blood cultures (but the review reported that the incidence was in keeping with previously reported rates of infection).[7]

Hand injection of intravenous radiological contrast media

Another scenario raised by the group and identified in the literature is regarding hand injection of contrast media. A review of the evidence in The British Journal of Radiology advised caution with this practice owing to the risk of uncontrolled and unlimited pressure, as well as documented evidence of catheter damage.[1] Furthermore, this potentially exposes the person performing the injection to the risks of radiation dependent upon the scan type and phase of imaging.

Diagnostic scans and the use of Intravenous Radiological Contrast Media

One of the questions raised in the development of this guidance was whether administration of contrast media via such devices could yield clinically useful images. Of overall importance to the critically ill patient is ensuring that their transfer to the radiology department yields a result which answers the clinical question that is being posed. The transfer of a critically ill patient for a procedure confers an inherent risk to that patient. These risks are acceptable because the evidence supports CT scans providing a clinical evaluation that leads to therapeutic changes in more than half of cases.[8] However, by removing patients from a place of relative safety to, what is often, a remote location in the hospital, for a substantial time period, there is a significant risk of having an adverse or life threatening event during the transfer.

It is therefore essential, that a detailed discussion takes place between the senior responsible decision maker for critical care and responsible radiologist, to ensure that the right scan is done, for the right patient, at the first attempt. In addition, a discussion with the radiographer will ensure that they prepare and employ the appropriate protocols for the scan, considering the intravenous access the patient has available. The recommendations set out within this document support the most effective acquisition of diagnostic scans first time.

Anecdotally, a frequent reason for delaying transfer of critically ill adult patients to radiology has been a reluctance to use contrast in critically ill patients. One reason for this may have been the issues with intravenous access addressed in detail within this guidance. However, we acknowledge that there have also been concerns regarding an association between the use of radiological contrast media and the development of acute kidney injury. This should now be considered unacceptable. The potential for harm due to missed or delayed diagnoses, coupled with the risk of an additional patient transfer if a non-diagnostic scan is initially performed, is likely to be far greater than that of receiving radiological contrast media. There is an increasing number of studies supporting this, particularly in an emergency or critical care setting.[9] [10]

Use of patient group directions (PGDs)

A radiographer usually administers radiological contrast media under a PGD and as such must be trained and entitled by their organisation to use a PGD. The practitioner acting under a PGD remains responsible and accountable for their activity and any decisions made. This is a challenge with contrast PGDs in that there is a decision being made before the radiographer becomes involved. The radiographic practitioner must be able to make an autonomous decision on whether to administer intravenous radiological contrast media and where necessary that the route is appropriate.[11] [12]

PGDs can specify multiple routes and it is for the practitioner acting under the PGD to ascertain the most appropriate route. Safety must be considered and if doses are different for different routes, then it may be safer to have separate PGDs to reduce the risk of incorrect dosing.

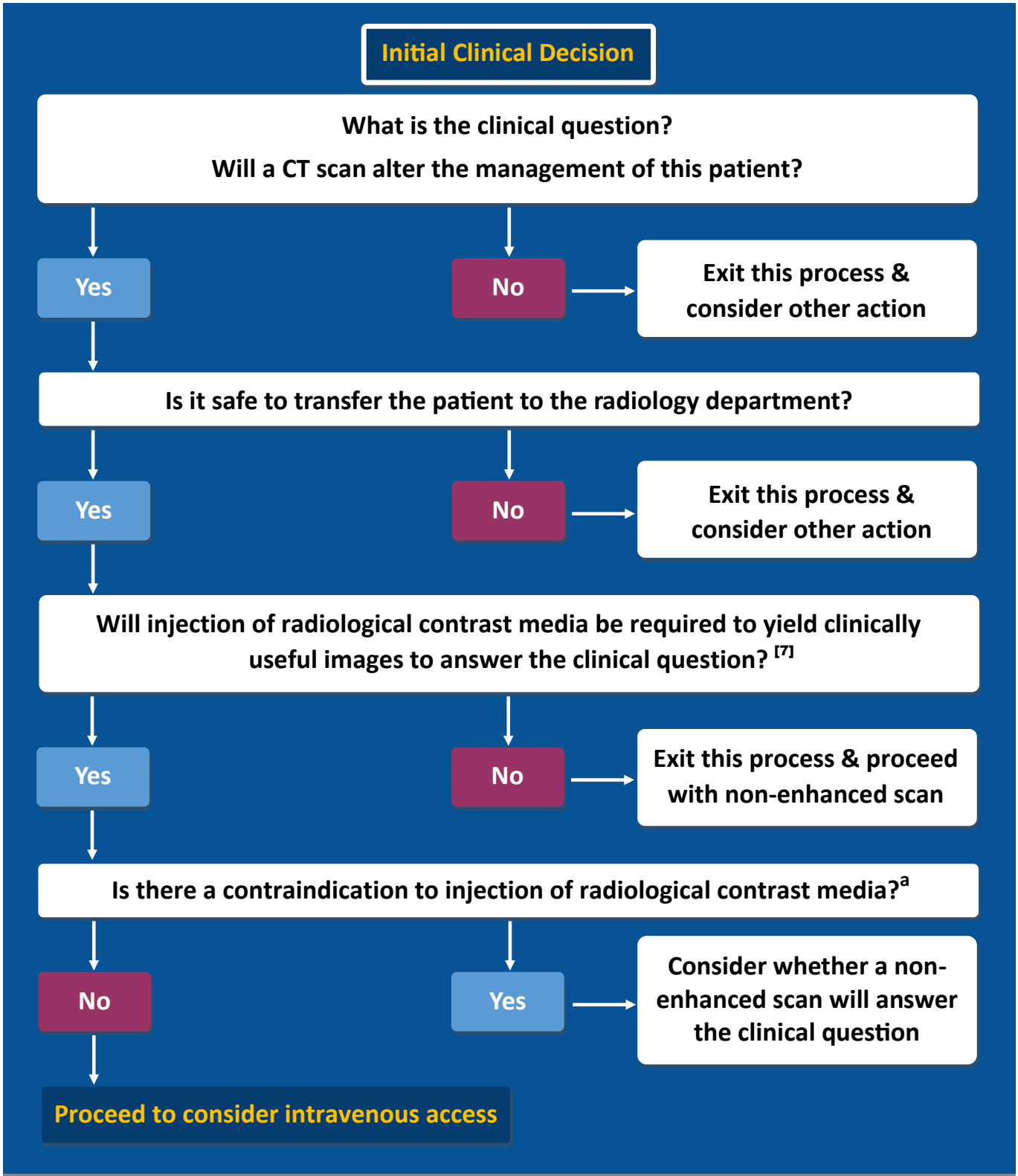
It may be clear cut that the central line route is the appropriate one due to lack of peripheral access and the radiographer agrees – however, the radiographer must be able to challenge the decision if they feel it is not appropriate and refer to a prescriber. This guideline includes an algorithm to support decision making on the most appropriate route to use.

If the radiographer can independently clinically assess an individual and agrees that the route is appropriate, then administration under a PGD is acceptable.

An additional consideration in the context of this guidance is that if a medicine is being administered via equipment that is not licensed to take the medicine, then administration is “off-label”. The National Institute for Clinical Excellence states that off-label use of a licensed medicine should be included in a PGD only when clearly justified by best clinical practice. This should be clearly stated on the PGD, and practitioners should consider informing the patient of this. [13]

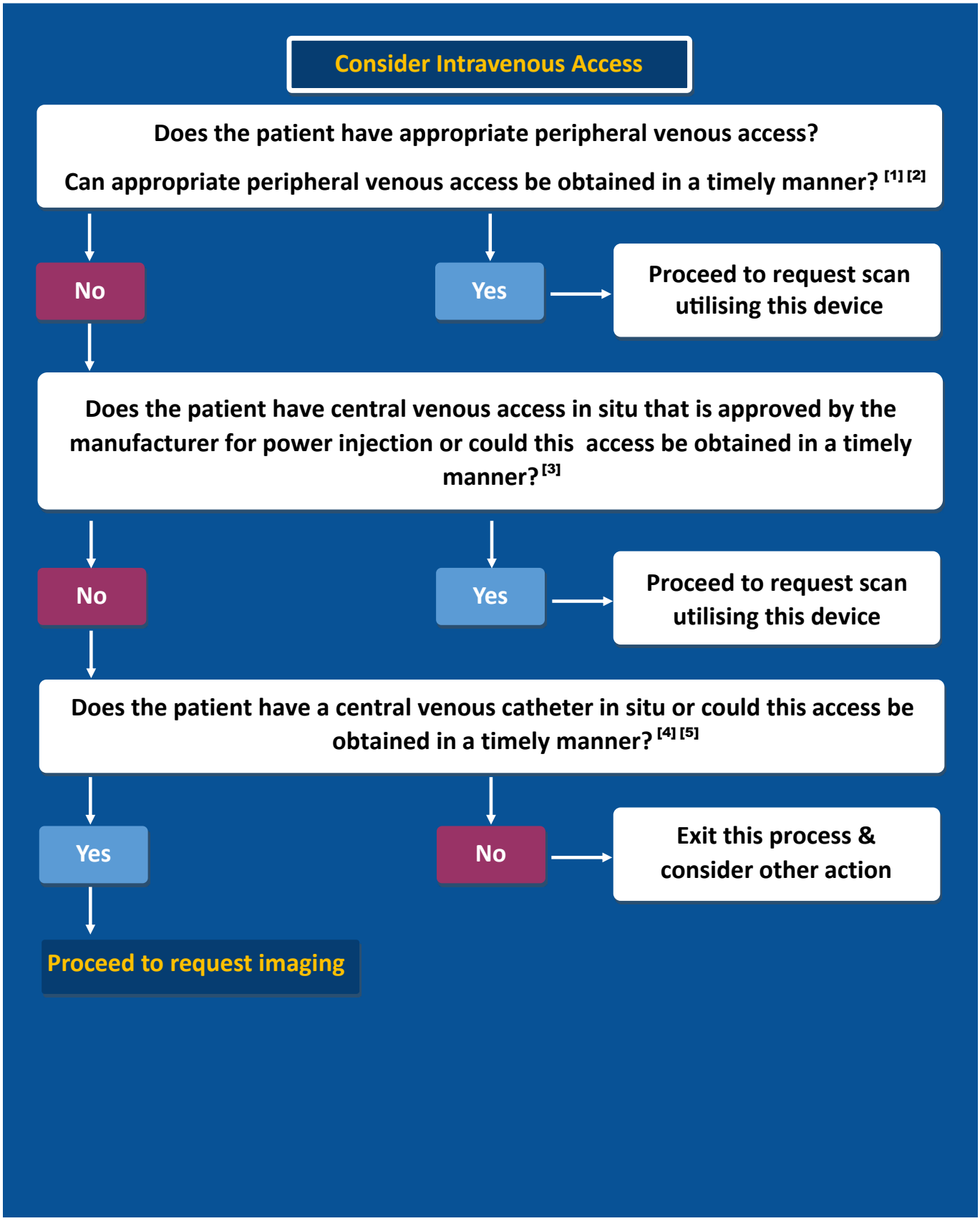
We have prepared an appendix to assist with decision-making. This includes initial clinical decision making, considering intravenous access, image requests, radiology transfer, return to critical care, and reviewing scan reports.

1. Clinical process for performing CT imaging in critically ill adult patients

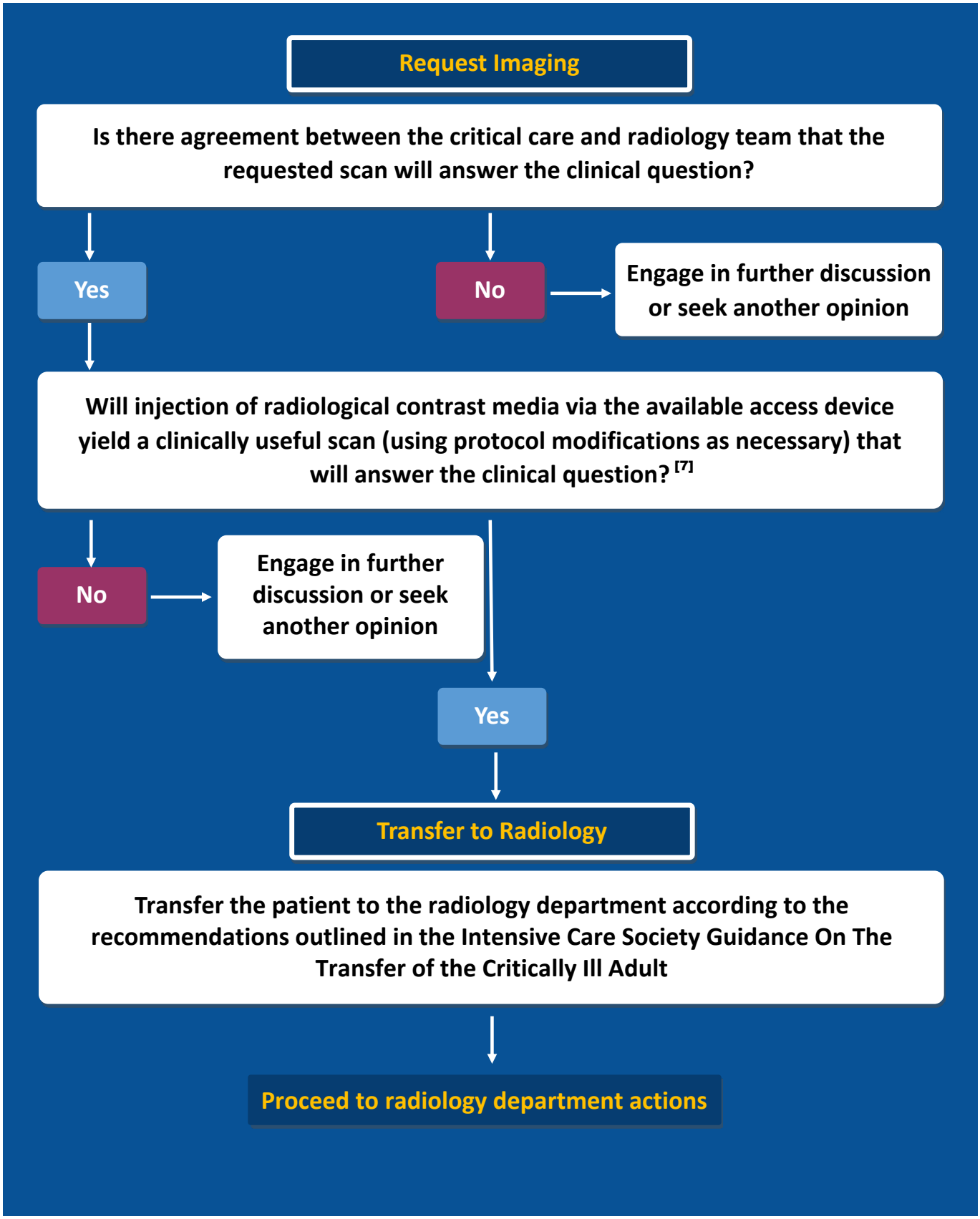


[a] A contraindication would be a severe allergy or anaphylaxis to radiological contrast media. Renal dysfunction should not be considered a contraindication.

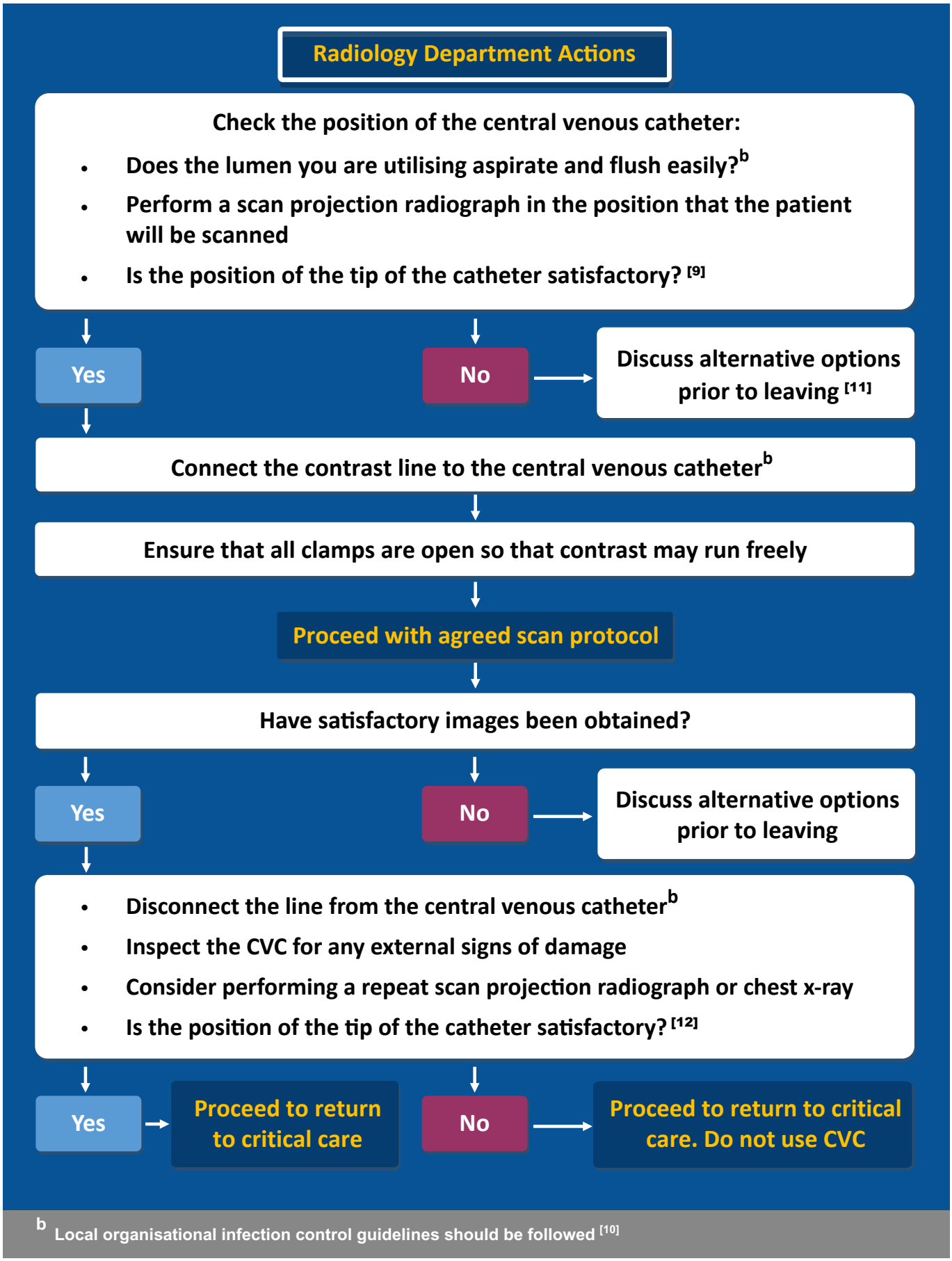
2. Clinical process for performing CT imaging in critically ill adult patients



3. Clinical process for performing CT imaging in critically ill adult patients

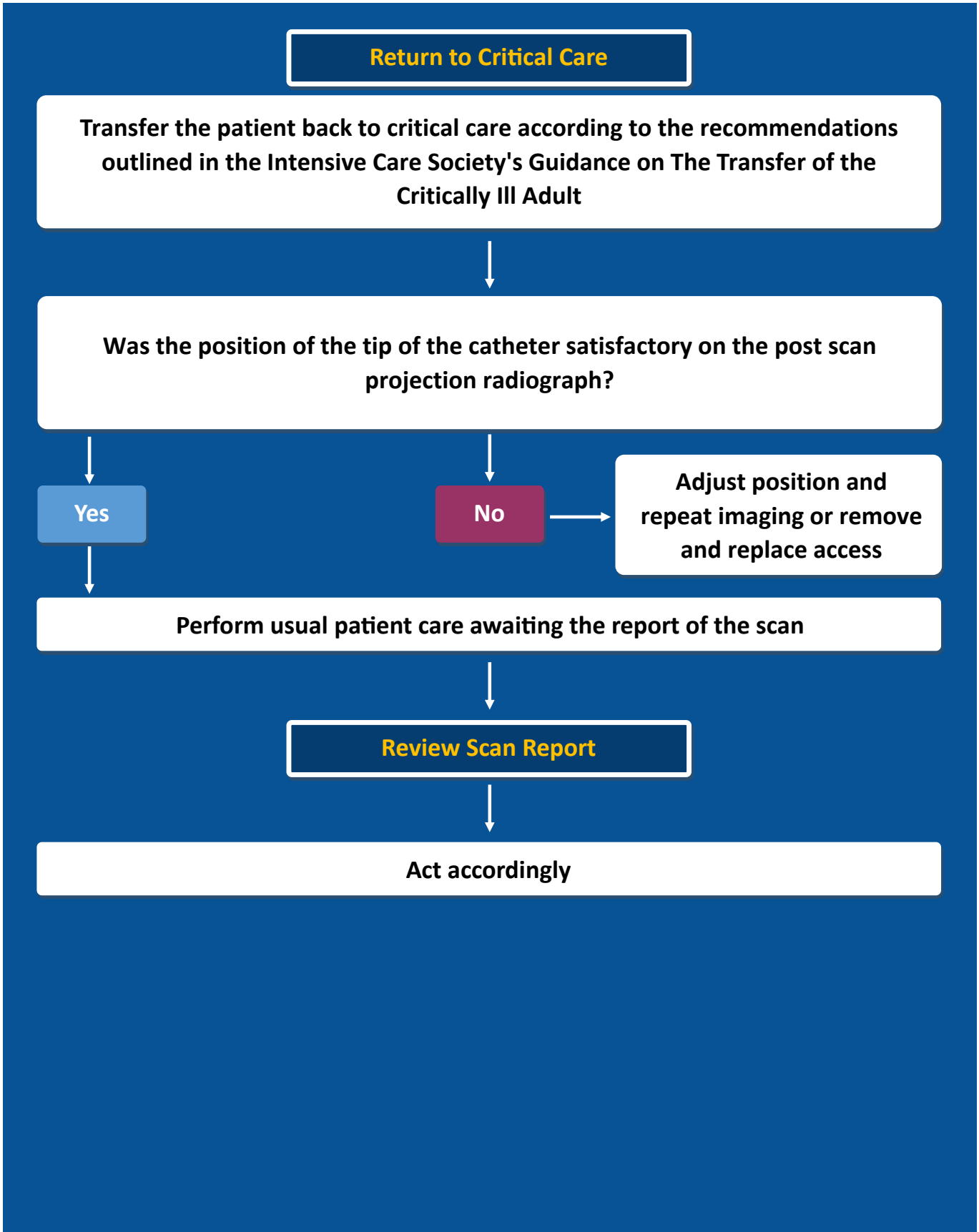


4. Clinical process for performing CT imaging in critically ill adult patients



b Local organisational infection control guidelines should be followed [10]

5. Clinical process for performing CT imaging in critically ill adult patients



[1], [2], [3], [4], [5], [7], [9], [10], [11], [12] Denotes a recommendation from the clinical guideline

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Notes

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