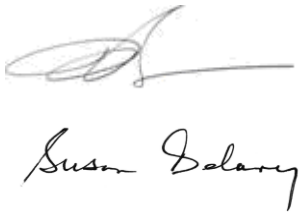
Capital Health

Diagnostic Imaging
Policy & Procedure

TITLE:	**Guidelines for Prevention of Contrast Induced Nephropathy**	**NUMBER:**	DI 01
Section: **Source:**	Quality Control Team, CDHA DI Clinical Affairs Committee	**Date Approved:** ***Date To Be Reviewed:***	May 2013 May 2016
Distribution:	All Policy & Procedure Manuals Professional Practice Manuals	**Issuing Authority:**	David Barnes, CDHA Department Chief Susan Delaney, DI Director
		Approval:	

POLICY

PURPOSE: To produce guidelines for CDHA for prevention of contrast induced nephropathy that minimize patient risk while obtaining necessary diagnostic studies.

1. **Define Contrast Induced Nephropathy (CIN)**

- There is NO universally accepted threshold of renal function loss to define CIN however two definitions of CIN have been extensively utilized in the literature:
  1) A rise in Serum creatinine (SCr) more than 25% above baseline within 24-72 hrs following contrast administration or
  2) A rise in SCr by 0.5 mg/dL (44umol/L) over baseline within 48-72 hrs after contrast.
- Note that:
  - Both definitions are somewhat random and not good measures of acute kidney injury.
  - The "Acute Kidney Injury Network" has defined 1st stage of Acute Kidney Injury as a rise of SCr of more than 0.3 mg/dL over 48hrs, being predictive of in-hospital adverse events. There is a significant lack of matched control groups in most studies and the true rates of CIN remain controversial.

- Most CIN shows mild rise in SCr that returns to baseline within 14 days; permanent rise in SCr (loss of renal function) is rare.

It is generally recognized that large doses of iodinated contrast media can cause kidney injury and that CIN risk is greater in patients with less renal function and this should be a guiding principle. It is recognized that the combination of BOTH diabetes and renal insufficiency has the highest risk

2. **Define Patients at Risk**

According to CAR manual on contrast nephropathy: "Chronic kidney disease is the single most important predictor of CIN and risk can be further stratified according to the K/DOQI (National Kidney Foundation- "Kidney Disease Outcomes Quality Initiative") classification based on GFR. The exacerbation of risk with BOTH diabetes and renal insufficiency is acknowledged. Significantly higher risks have been shown to exist in Inpatients as compared to Outpatients. Higher risks have been associated with intra-arterial injections of contrast as opposed to intravenous injection.

Risk factors predictive of chronic kidney disease or risk of acute renal failure include:

diabetes
renal disease or solitary kidney sepsis or acute hypotension dehydration
age over 70
previous chemotherapy
organ transplant
cardiovascular disease (HTN,CHD, cardiac or peripheral vascular disease)
nephrotoxic drugs (Amphotericin B, amino glycosides, vancomycin, NSAIDS, cancer and immunosuppressant chemotherapy).
human immunodeficiency syndrome or AIDS

Additional "risks" noted in the ACR include paraproteinemia syndromes such as myeloma, and collagen vascular disease. Hyperuricemia (gout) has also been identified as a risk factor. These risks should be addressed via a questionnaire or chart review.

The CAR currently recommends:

Outpatients: eGFR within six months of the contrast study in any patient with one or more of the listed risk factors.

Inpatients: eGFR within one week of the contrast study and more recent in the setting of unstable or evolving disease.

ER or Acutely Ill Inpatients, When SCr not Available: Risk factor screen and if risk factors present use preventive measures. The absence of risk factors for renal disease effectively eliminates the likelihood of renal impairment.

If one or more of the risk factors exists, and eGFR is not available as outlined above, the subjective decision regarding the requirement for contrast administration or not, or deferral and rescheduling of the exam, must be made by the Radiologist, and, if contrast given, preventive measures should be employed with follow up.

Risk stratification based on CAR guidelines:

a. eGFR >= 60 mL/min: **very low risk** for CIN. These patients require no specific prophylaxis or follow up.
b. eGFR 45 – 59 mL/min: **low risk** for CIN. In the absence of additional risk factors patients receiving IV CM require no specific prophylaxis or follow up. For patients receiving intra-arterial CM preventative measures are recommended.
c. eGFR < 45mL/min: **moderate risk** of CIN. Preventative measures are recommended. IV hydration recommended for patients receiving intra-arterial contrast. For intravenous administration, either oral or IV hydration could be used; IV hydration is preferred if eGFR , 30mL/min.
d. eGFR< 30mL/min: **high risk. Avoid contrast if possible. IV hydration rather than oral hydration.**
e. Patients with unstable renal function, an acute illness and/or acute renal failure: GFR calculation in these patients is unreliable. They are thought to be at particular risk, full preventative measures, including intravenous hydration and follow up are recommended.

3. **Patient Subgroups to Consider Separately (reference: Ellis and Cohan, AJR 2009):**

a. Anuric, ESRD patient on permanent dialysis cannot develop CIN and the timing of subsequent dialysis is not of concern.

b. ESRD patient on permanent dialysis, BUT with some residual renal function which may provide significantly improved quality of life. This subgroup is at **particularly high risk** and consultation with the referring physician, careful consideration, and employment of risk reduction strategies is suggested.

c. Acute Kidney Injury (ARF) patients, whether or not on temporary dialysis, are of special concern because the degree of damage and recovery potential cannot be accurately determined. Consultation with the referring physician, careful consideration, and employment of risk reduction strategies suggested.

4. **When to Employ Preventive Measures**

General guiding principle: For all levels of renal insufficiency, the radiologist should consider whether the clinical question can be addressed by other means, not requiring iodinated contrast media, and weigh the costs and benefits, qualitatively and subjectively, given the unknowns about the actual risks of CIN.

Use eGFR rather than SCr to better stratify chronic renal disease severity. This can be obtained via an on-line "GFR calculator" utilizing the MDRD (Modification of Diet in Renal Disease) equation.

Utilize preventative measures when:

a. eGFR < 60 ml/min for **intravenous CM in inpatient, intravenous CM in unstable patient**, or **intra-arterial CM in any patient.**
b. eGFR < 45 ml/min/1.73m sq for **intravenous CM in stable outpatient**

NOTE: eGFR < 30ml/min – these patients are at high risk and CM should be used only if absolutely necessary.

5. **Risk Reduction Strategies/Preventive Measures**:

a) Consider an alternative means of addressing the diagnostic question, not requiring iodinated contrast media.

b) Consider reducing the dose of contrast /frequency of exams requiring iodinated contrast. Risk of CIN is dose-related. The lowest risk occurs in doses less than 100-140 ml. Doses greater than 5 ml/kg strongly predict CIN requiring dialysis. A significant increased risk of CIN has been demonstrated among patients who received a second dose of contrast medium within 72 hours.

c) Use LOCM or IOCM (not HOCM). No clear difference between LOCM vs. IOCM.

d) In **moderate – high risk** patients (eGFR <45 mL/min stable outpatient or eGFR <60 mL/min for intra-arterial CM or inpatient or unstable patient), discontinue nonessential nephrotoxic medications 2-3 days before the contrast study; at least 48 hrs when possible. Diuretics, especially furosemide, should be withheld at least the day of the contrast, if possible (holding diuretics is a recommendation made to the referring physician who must assess if a patient can be taken off medication in order to decrease risk of CIN).

e) Hydration lowers Scr (**single most important measure**):
   i. I.V. better than oral
   ii. Normal saline better than ½ normal saline.

   - IV hydration
     - 1mL/kg/hr NS for 12 hrs before AND 12 hrs after contrast administration
       OR
     - 3 ml/kg/hr NS for 1 - 3 hrs before, and for 6 hrs after contrast.
     - depending on weight of patient, should receive at least 300-500 mLs of I.V. hydration before the contrast administration.

   - "oral" regimen (outpatients): 300 - 500 mLs the evening before and the morning of the contrast study (up to 2 hrs before), then at least extra 300 – 500 mLs for the next 24 hrs. Isotonic fluid is best (eg isotonic sports drink, salty soup).

f) N-Acetylcysteine (NAC): There are conflicting reports as to the benefits of NAC in CIN prevention. NAC administration should not be an obstacle to performing the study. This is often the case in the outpatient setting where compliance is problematic and therefore it is not recommended for use in outpatients. If considered for in-patients, the following doses are recommended:
   - Oral: 600 PO mg bid the day before and the day of contrast (total of 4 doses).
     OR
   - I.V.: 150mg/kg in 500mL nsaline over 30 minutes immediately prior to contrast and 50 mg/kg over 4 hrs after contrast.

g) Hemodialysis is not effective in reducing the CIN rate even when performed ASAP after administration. Hemofiltration with continuous renal replacement therapy has been shown to reduce the rate of CIN but is invasive, expensive, and occurs in ICU setting.

6. **Follow Up**

The following patients require follow up assessment of renal function after CM administration:

a. eGFR < 45 ml/min/1.73m sq for **intravenous CM in stable outpatient**
b. eGFR < 60 ml/min/1.73m sq for **intravenous CM in inpatient, intravenous CM in unstable patient**, or **intra-arterial CM in any patient.**

1. Inpatients: Contact referring physician and advise to follow up SCr in 2-3 days post contrast.

2. Outpatients: Provide patient with a lab requistion for sCr and eGFR to be checked 48 – 72 hours post contrast administration with results sent to the referring clinician. Detail this in radiology report and request referring physician review this result using the appropriate programmed voice recognition shortcut.

RELEVANT REFERENCES

Canadian Association of Radiologists: Consensus Guidelines for the Prevention of Contrast Induced Nephropathy. See CAR website, under "Standards and Guidelines"

American College of Radiology Manual on Contrast Media, Version 6, 2008, "Contrast Nephrotoxicity", 31-37.

National Kidney Foundation, K/DOQI (Kidney Disease Outcomes Quality Initiative) Guidelines, Section "Chronic Kidney Disease: Evaluation, Classification, and Stratification".

Ellis JH, Cohan RH. Prevention of Contrast-Induced Nephropathy: An Overview. Radiol Clin N Am 47 (2009) 801-811.

Solomon R. Contrast-Induced Acute Kidney Injury (CIAKI). Radiol Clin N Am (2009) 783-788

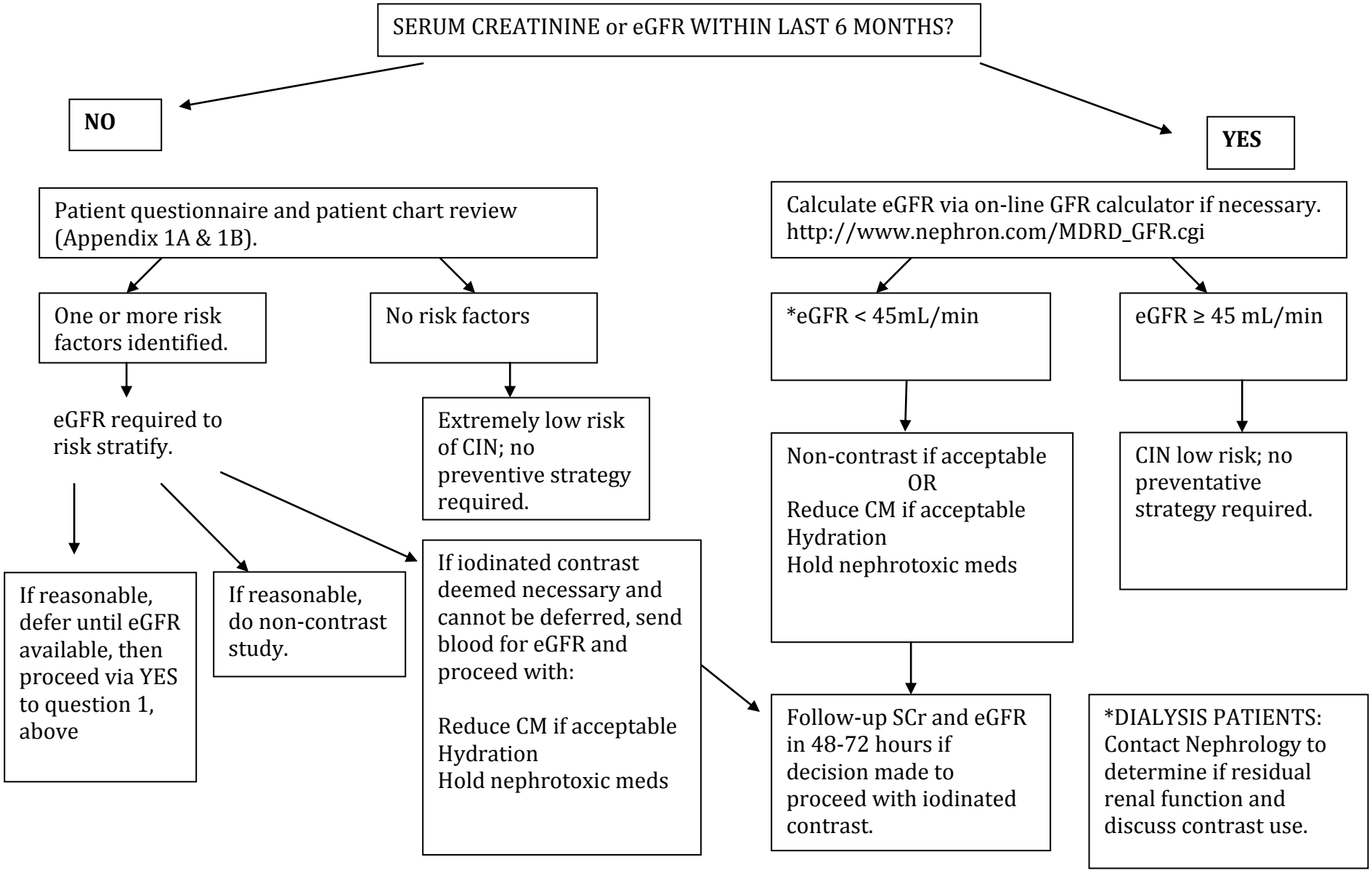
Ellis JH, Cohan RH. Reducing the Risk of Contrast-Induced Nephropathy: A Perspective on the Controversies. AJR 2009; 192: 1544-1549.

Caixeta A, Nikolsky E, Mehran R. Prevention and Treatment of Contrast-Associated Nephropathy in Interventional Cardiology. Current Cardiology Reports 2009, 11:377-383.

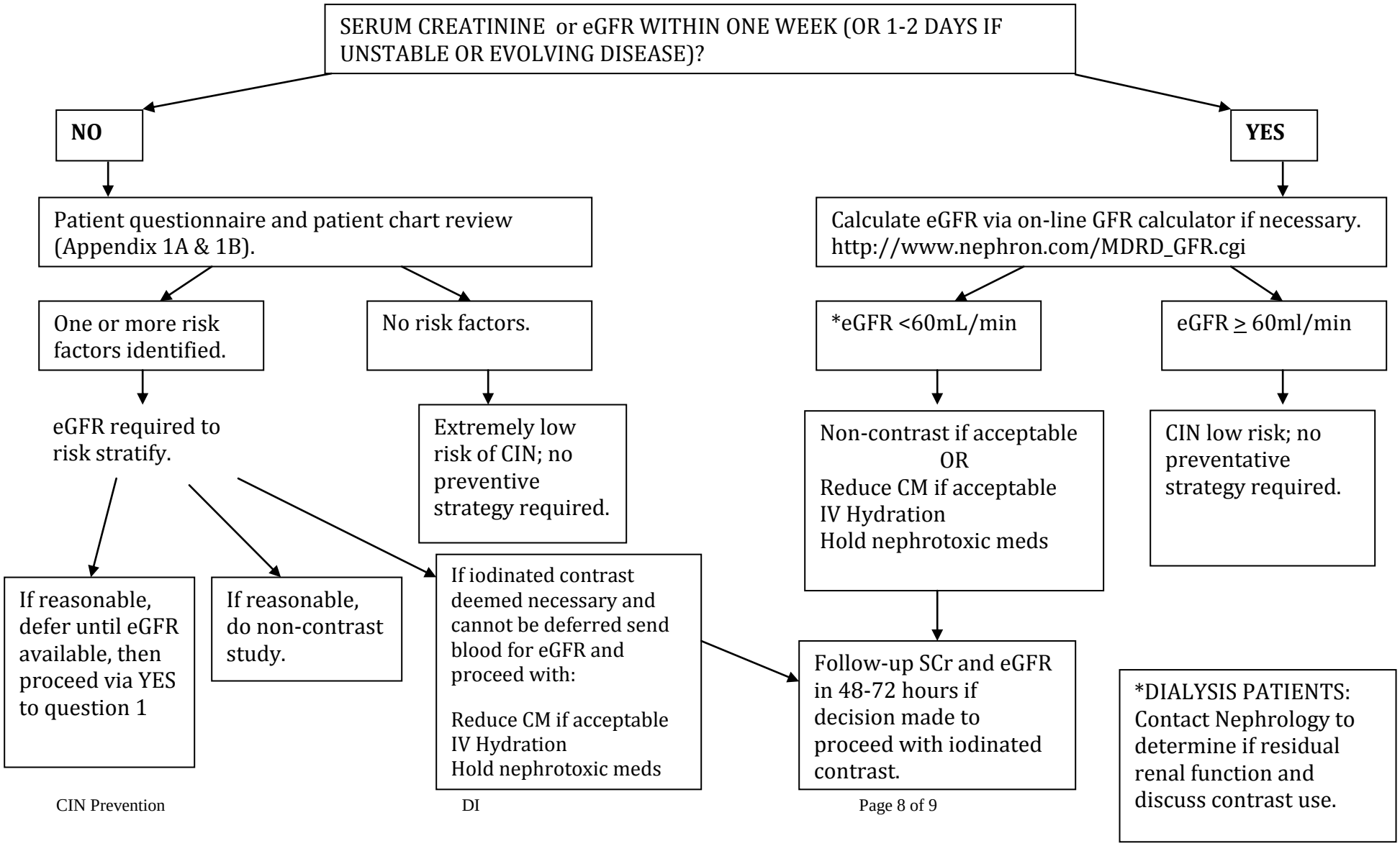
Thomsen HS, Morcos, SK. Risk of contrast-medium-induced nephropathy in high risk patients undergoing MDCT-A pooled analysis of two randomized trials. Eur Radiology (2009) 19: 891-897.

Rao QA, Newhouse JH. Risk of Nephropathy after Intravenous Administration of Contrast Material: A Critical Literature Analysis. Radiology 2006: 239; 302-397.

STABLE OUTPATIENT ALGORITHM APPROACH TO CONTRAST INDUCED NEPHROPATHY



INPATIENT OR UNSTABLE OUTPATIENT INTRAVENOUS, OR ANY INTRAARTERIAL INJECTION OF IODINATED CONTRAST - ALGORITHM APPROACH TO CONTRAST INDUCED NEPHROPATHY



METFORMIN – SUGGESTED ALGORITHM FOR IODINATED CONTRAST ADMINISTRATION BASED ON C.A.R. GUIDELINES