CONTRAST OPTIMISATION

A PRACTICAL APPROACH

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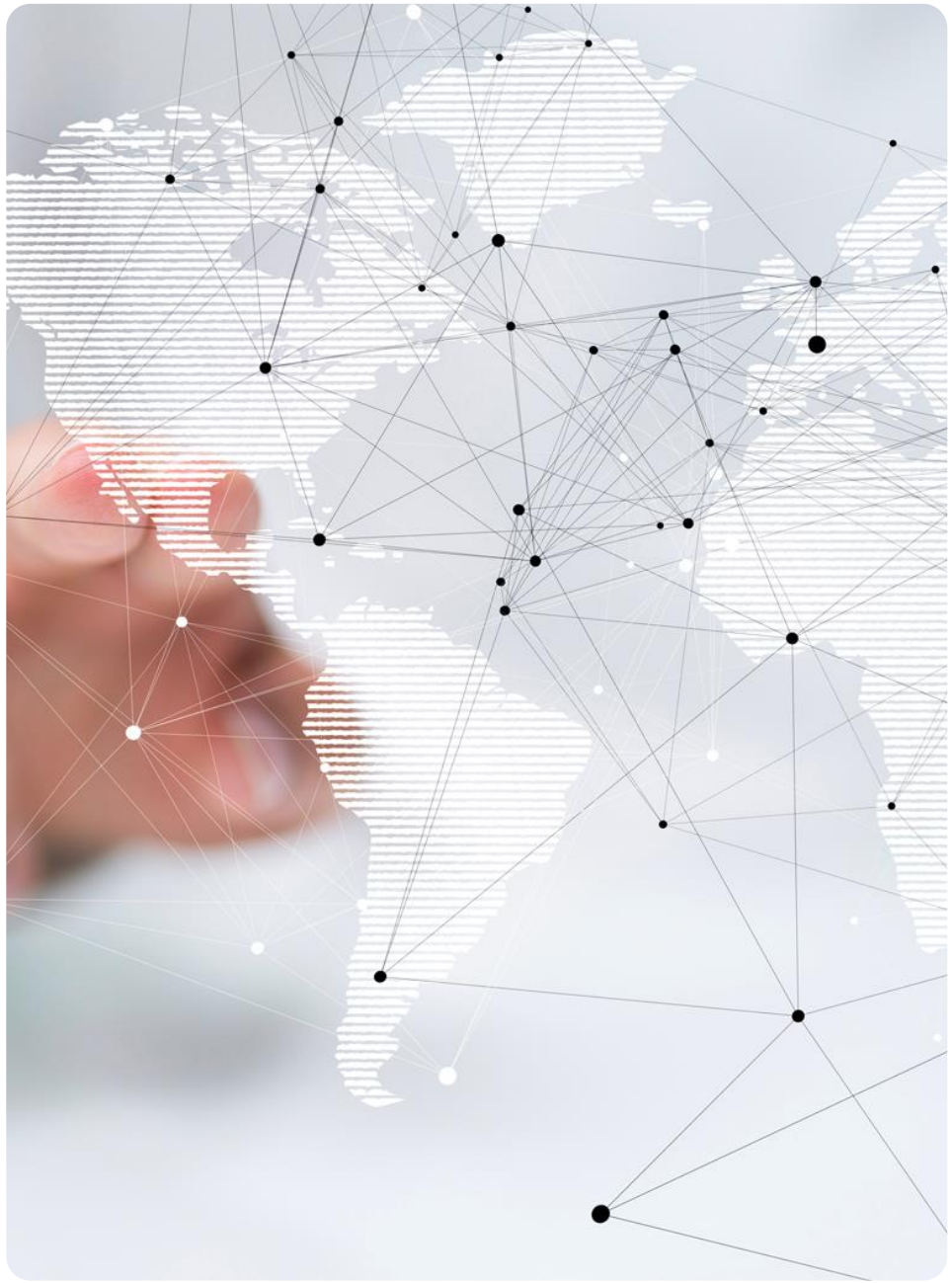

Agenda

1. Introduction
2. Theory
   - History of contrast, scanners and injectors
   - Technology to the rescue
   - Benefits of Contrast Optimisation
3. Practice
   - Customer audit
   - Injection parameter
   - Iodine loading
   - Weight based optimisation
4. Conclusion

INTRODUCTION

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Contrast Media, a brief history

1897

First reported use of contrast in a GI study. Bismuth was the contrast agent used. Highly toxic!

1910

Barium Sulphate becomes more common

1920s

Sodium Iodide, used to treat syphilis, begins to be used as a contrast agent. Iodine was found to be radio opaque to x-rays and becomes the basis for all modern CM

1927

Intro-venous Iodine Salts used for the first time

Contrast Media, the evolution

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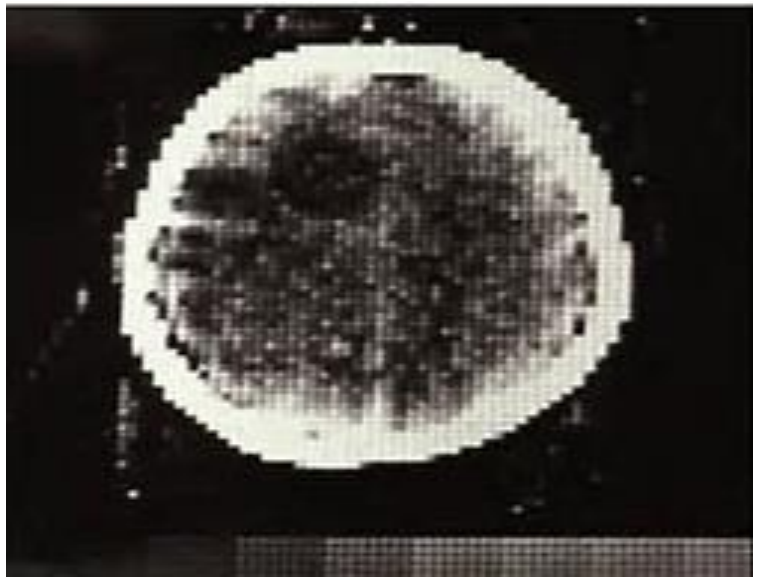
Scanners, the evolution

Single slice CT scanners

- Simple procedures with low throughout
- Large and complex image cache
- Varied image quality across scanners

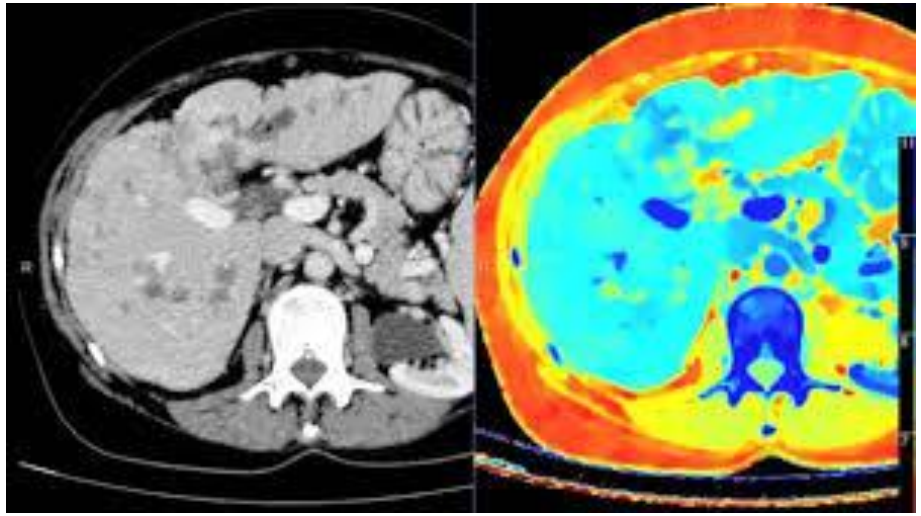


CT evolving- simple procedures

- Single slice CT scanners- slow
- Simple procedures- low throughput
- Hand injections of HOCM- no pressure injectors- lots of reactions
- Timings for TAP's- 30 seconds delay!!!! 100mls+ contrast
- Timings for A and P's approximately 60-70 seconds!!!- 100mls+ contrast.

CT scanners continually evolving

- More procedures coming into CT department - CT Colons, Cardiac imaging multi phasic organ imaging, trauma's, etc.
- Pressure injectors – LOCM (low osmolar contrast media), less reactions
- Complex software and algorithms for specialities like Cardiac
- Timings and volumes for TAP (Thorax, abdomen and pelvis) – 30 seconds delay – still the same as single sliced scanners
- Timings and volumes for A and P (abdomen and pelvis) approx. 60-70 seconds - no changes
- Use Bolus tracking

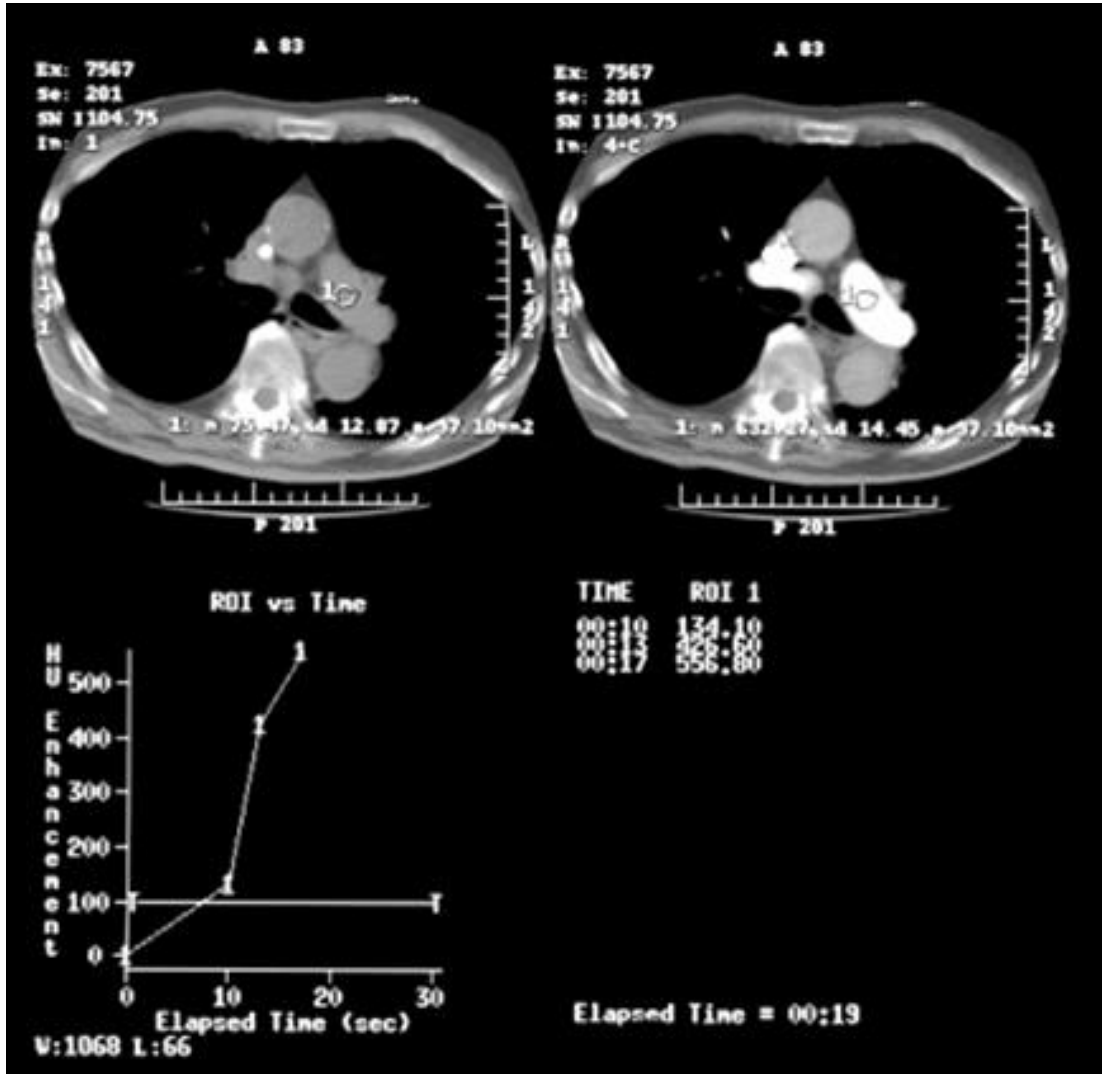


Contrast injectors, the evolution

- **Hand injections of HOCM (High Osmolar Contrast Media)**
  - No pressure injectors
  - Increased reactions using HOCM
- **Modern contrast injection system(Low Osmolar CM)**
  - High pressure
  - Allow dilution
  - Saline chasing

Technology, timing is critical to capturing the contrast

- **Timing is critical…**
  - Speed of scanner will impact on contrast dynamics
  - In general slower acquisition requires longer injection times and a greater volume
  - Rapid acquisition uses shorter injection times and less volume
  - Injection duration should not be longer than acquisition



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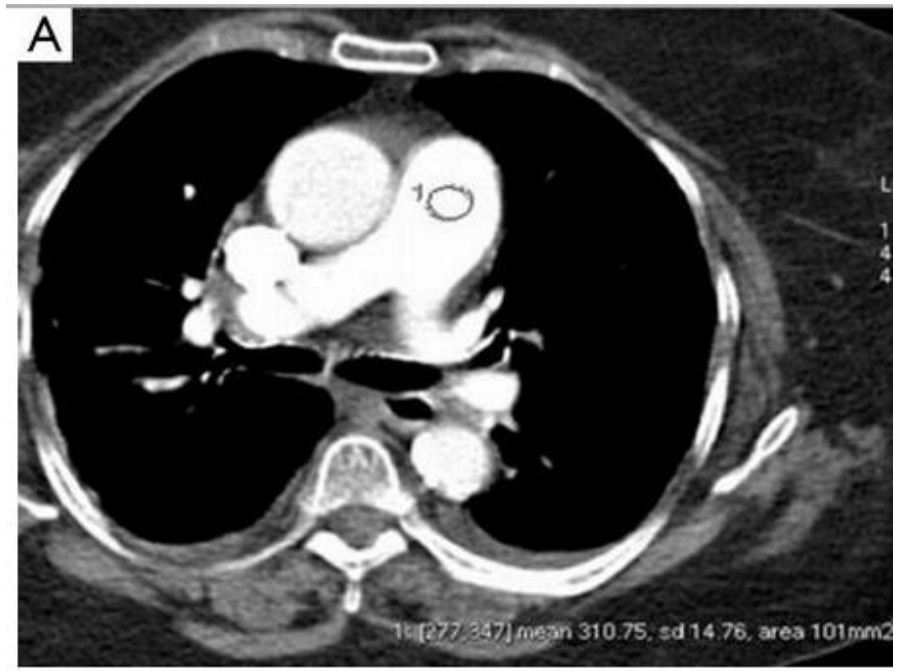
Technology, how does kVp alter the image

120kV - 310 HU (Hounsfield Units)



100kV- 513 HU

Lower kV- closer to the k-edge of Iodine, so it will appear brighter if no other changes are made

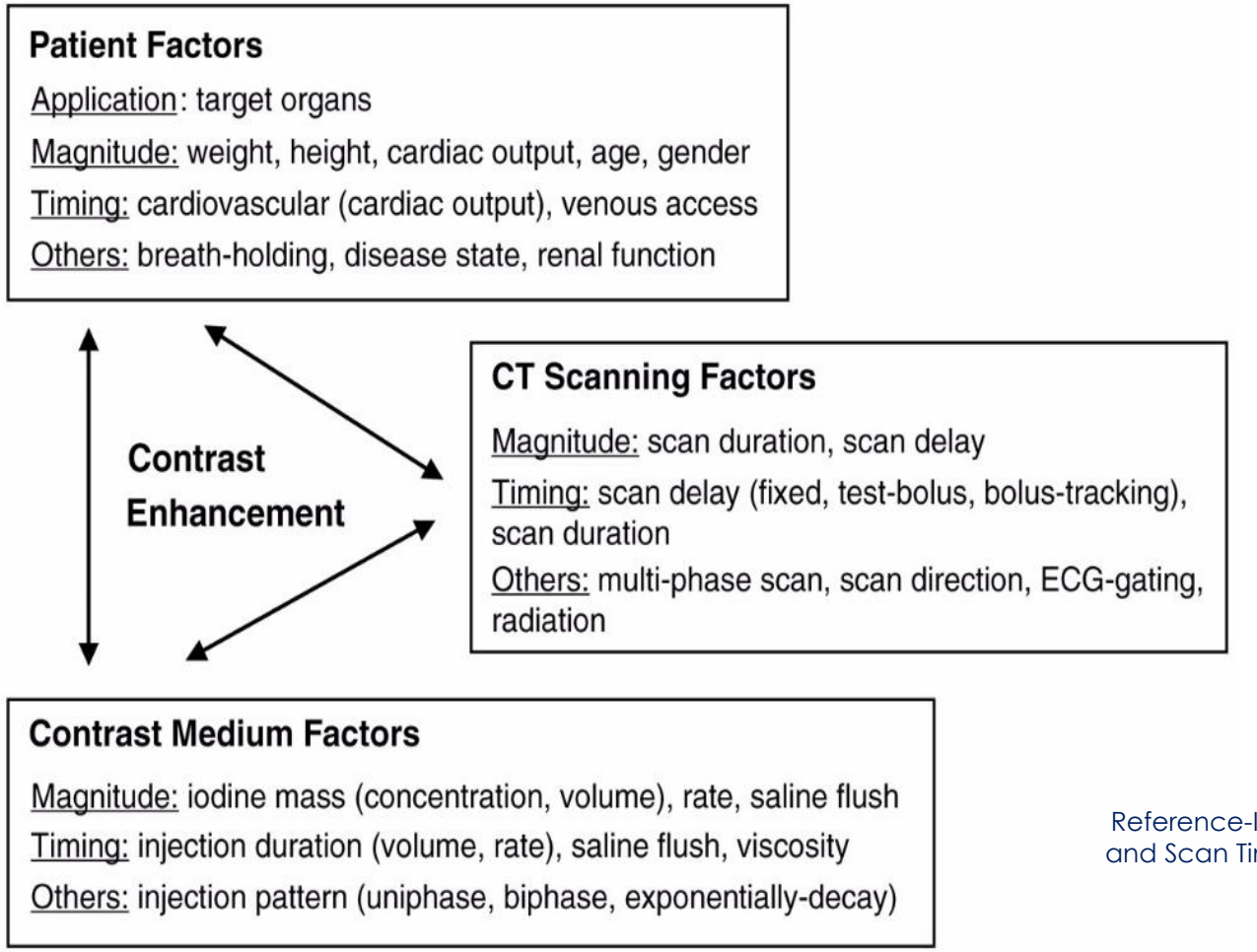
Images courtesy of L D'Arcy, Clinical Specialist, Wexford General Hospital

Benefits of optimisation, let's consider them…

- **Patient benefits**
  - CIN (contrast induced nephrotoxicity)
  - ADR (adverse drug reaction)
- **Department/ clinic**
  - Time savings – changing between concentrations and types
- **Training**
- **Cost savings**
- **Environmental savings**

Recap of the Optimisation story, what we have learnt

Considerations to optimise CT…



Reference-Intravenous Contrast Medium Administration and Scan Timing at CT: Considerations and Approaches
Kyongtae T. Bae

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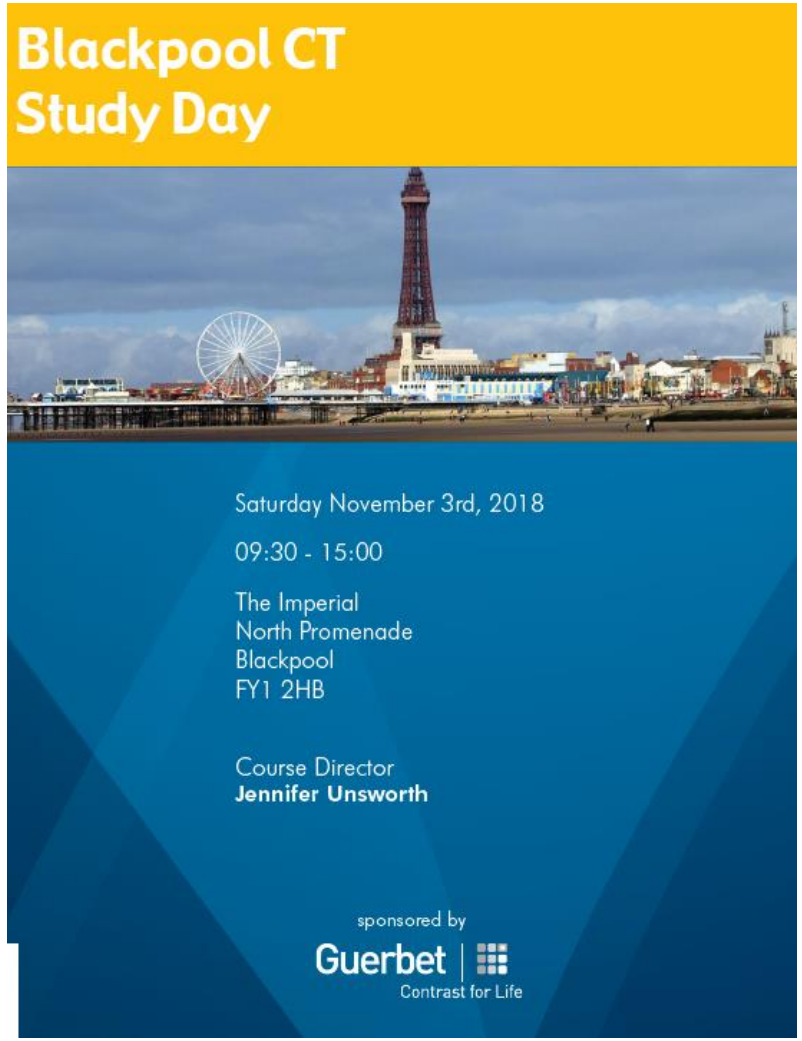
Audit on Weight Based Dosing from a group of 50 UK radiographers (2018)

- **UK customer audit survey**
  - Number of responses over 2 days = 50
  - Split of weight based dosing
    - YES = 22%
    - **NO = 78%**



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Possible roadblocks from the audit on Weight Based Dosing

Reasons for NOT implementing

- Maintaining a diagnostic scan
- Cardiac output
- Time consuming to weigh each patient
- Bed based patients - difficult to weigh
- Stock level of contrast
- Difficult to standardise
- If the department is busy it might be difficult to implement
- PGD(patient group directive) - Radiologist involvement
- Contrast only provided in certain volumes
- Expensive
- Comparable studies for patients

Contrast optimisation, look at the scanner.

- Modulation of kVp and mAs
- Accurate positioning. Patient in the centre of the bore
- Bolus tracking not timing bolus.

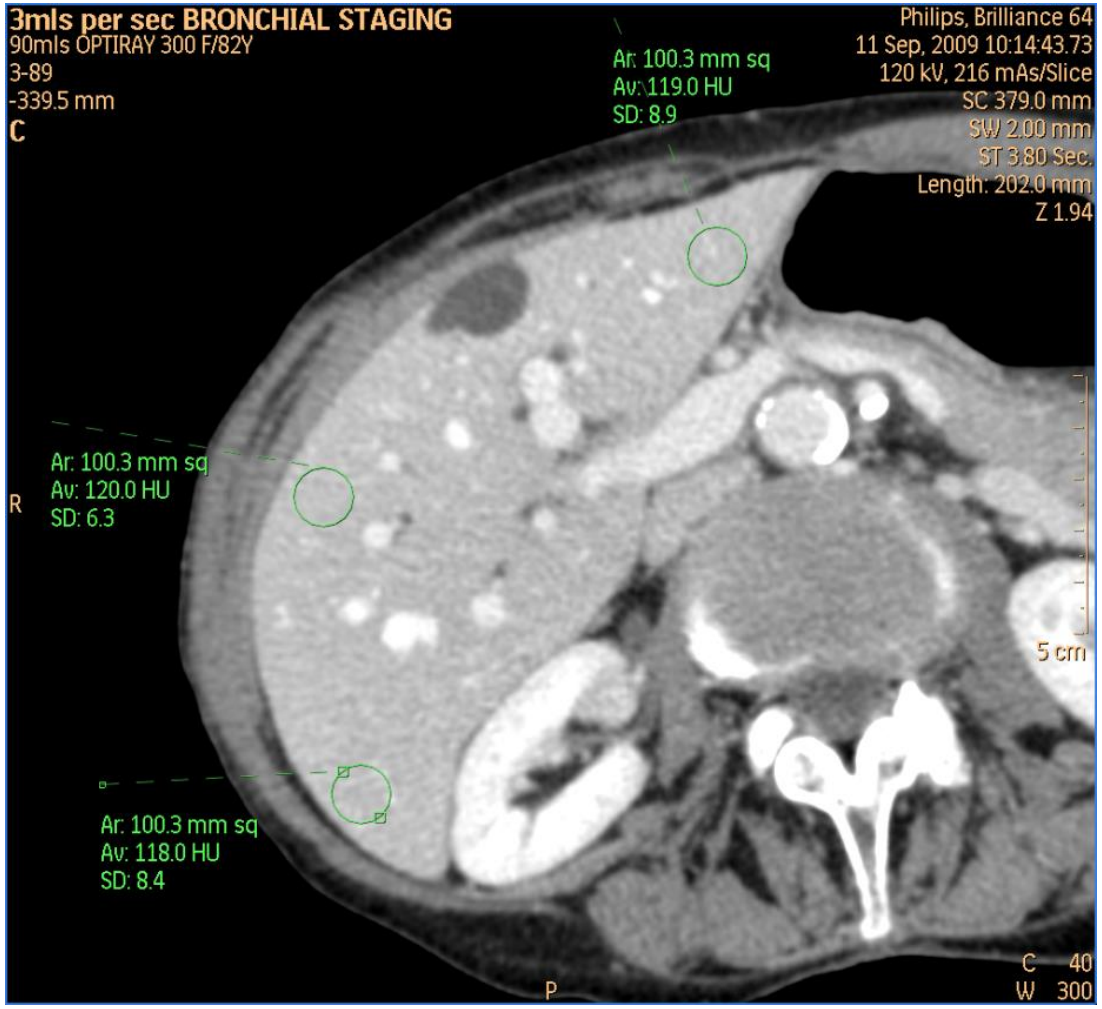
Then move to the Contrast/ protocol optimisation. Iodine load

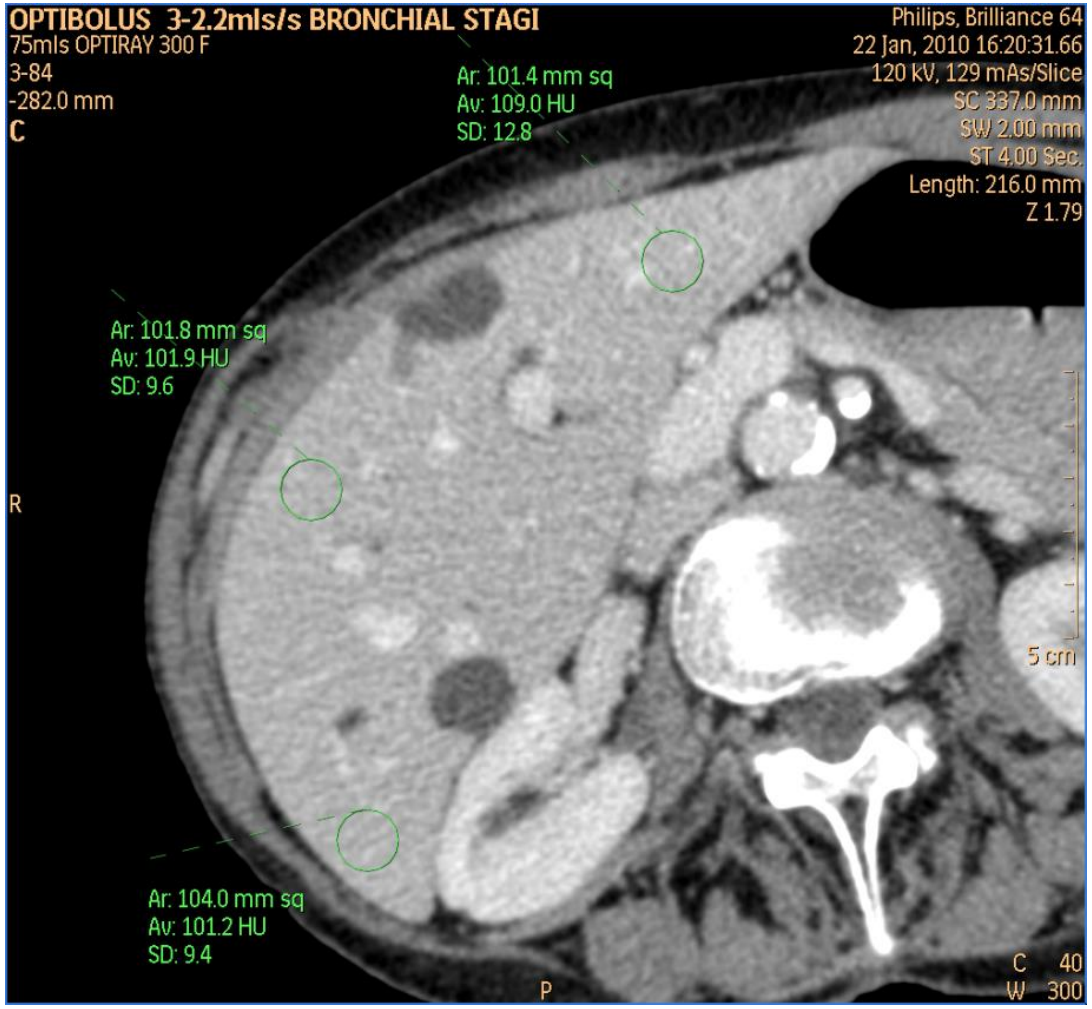
Total iodine load vs volume of contrast

- First part of protocol optimisation: calculated by concentration of the contrast medium multiplied by the volume given
  - Important when optimising protocols to ensure the patients do not receive more, or too little contrast than current protocols

- 370 mg I/mL, 75 mL of contrast: total iodine load to the patient = 27.75g
- 350 mg I/mL, 79mL of contrast: total iodine load to the patient = 27.65g

Reduction of iodine load to the same patient. 100mL on the left vs 75mL on the right. No reduction in diagnostic efficacy





Images courtesy of C Monaghan. Liverpool Heart and Chest Hospital

Contrast optimisation, iodine delivery rate.

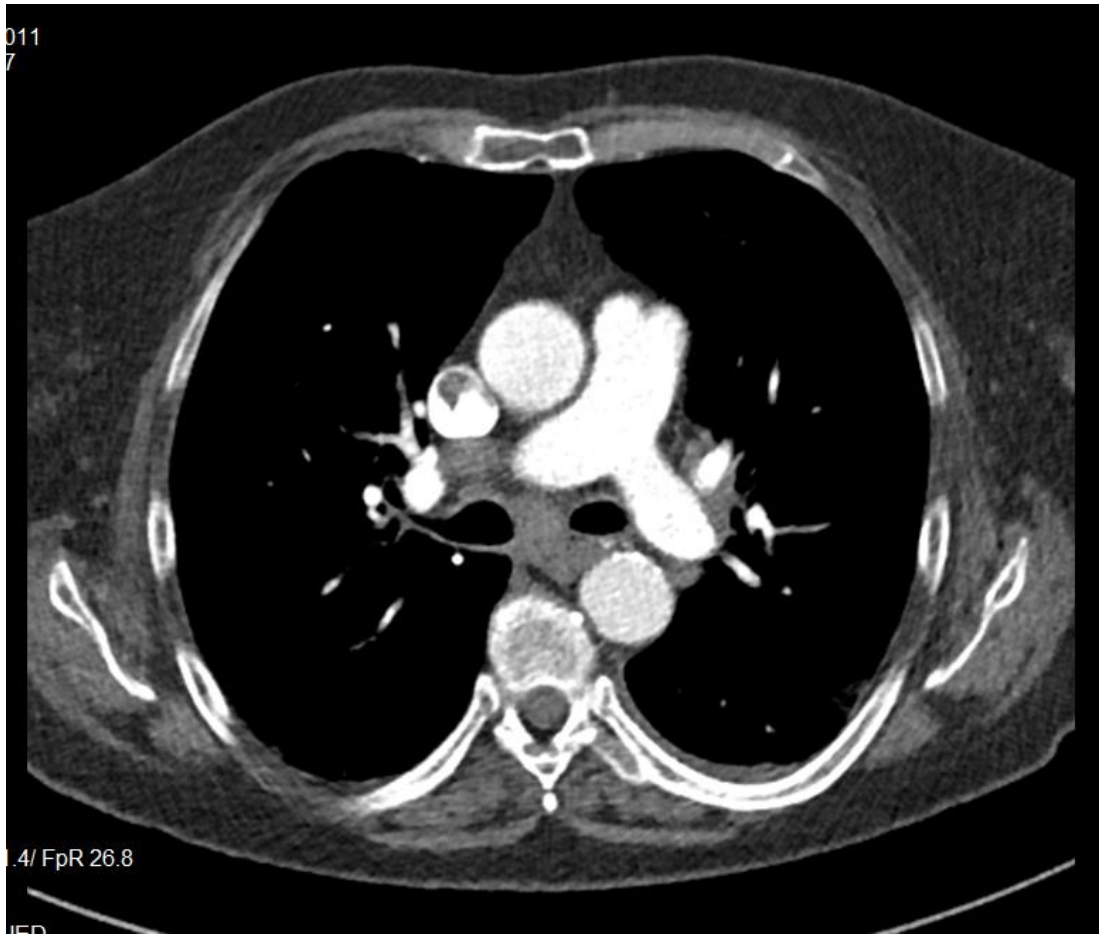
Iodine delivery rate vs contrast flow rate

- Calculated by concentration of the contrast medium multiplied by the its flow rate
- Using different contrast concentrations to mimic each other this formula can be used for all current protocols

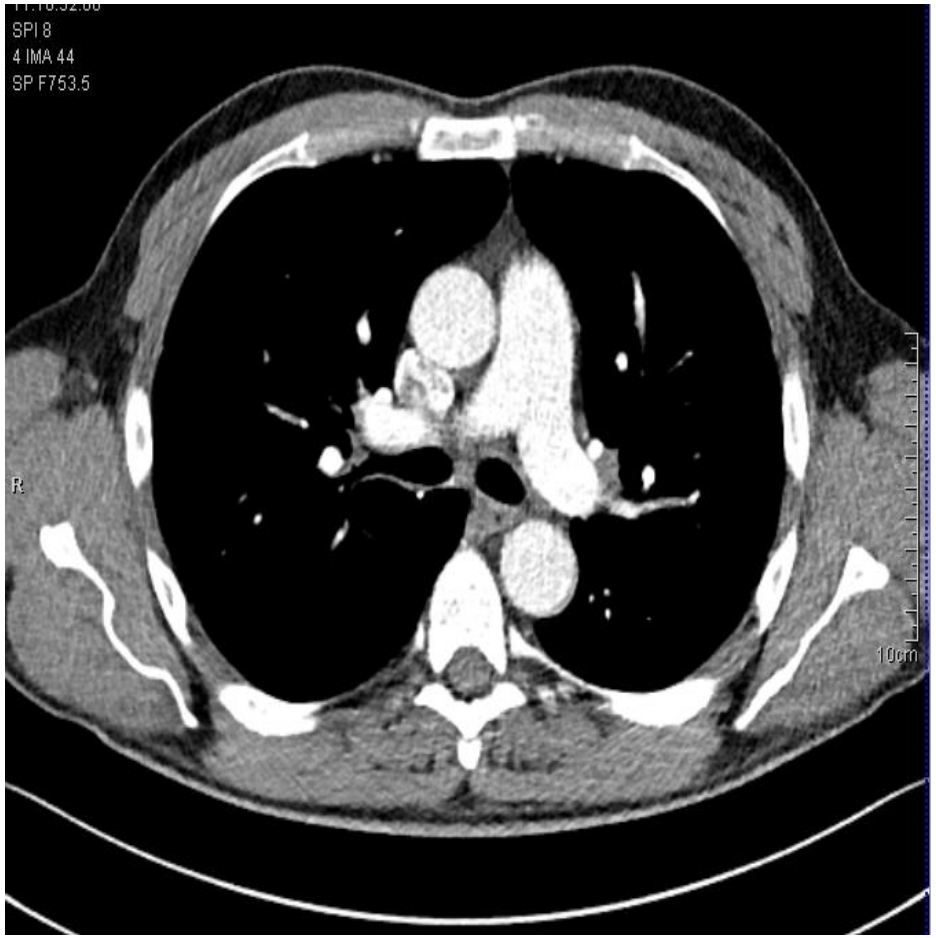
- 370 mg I/mL at 5mL/s
  - 0,37 x 5 = 1,85g of iodine per second
- 350 mg I/mL at 5,3mL/s
  - 0,35 x 5,3 = 1,855g of iodine per second

Two different patients. 70mL of contrast with no bolus tracking vs 35mL with bolus tracking

70mL



35mL



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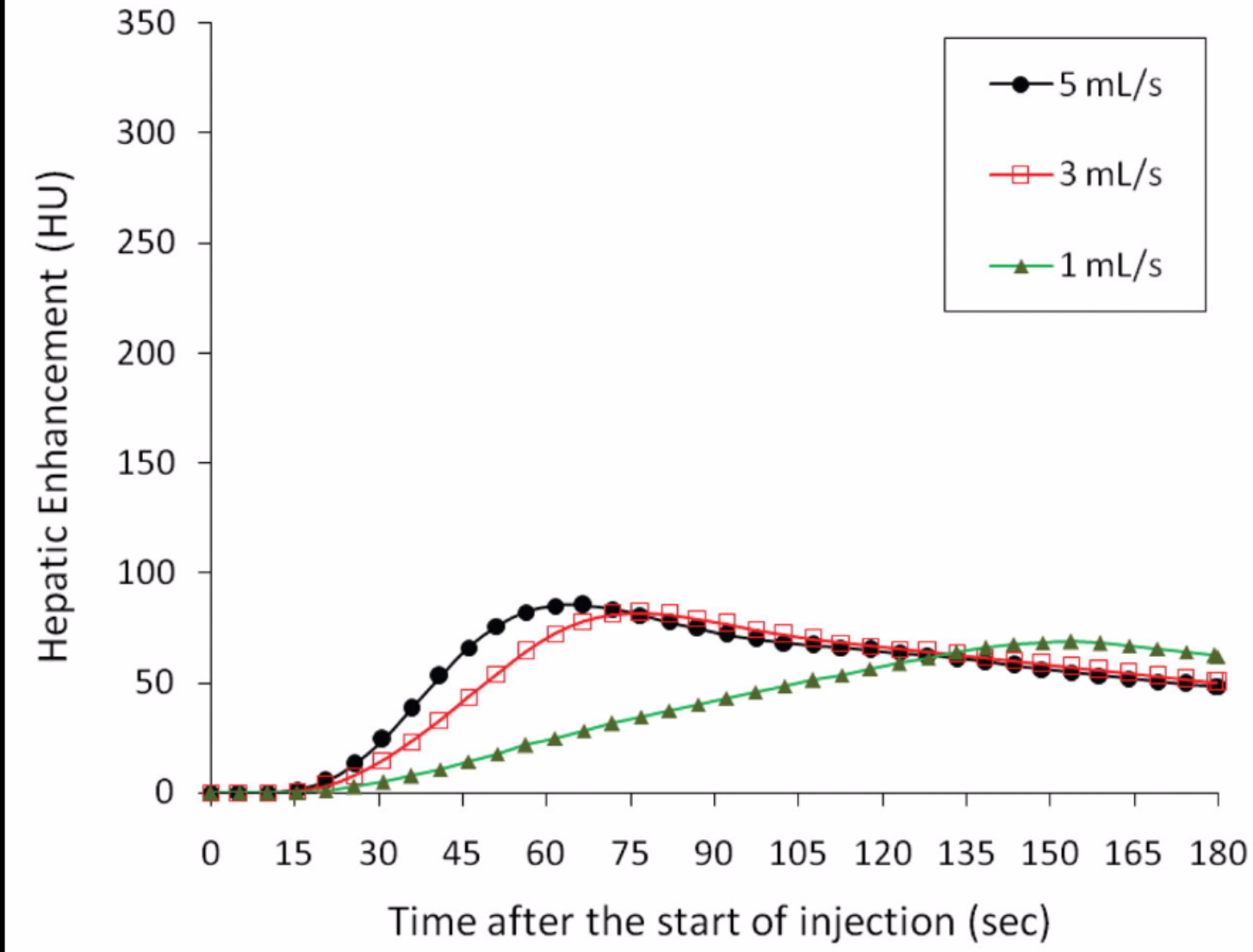
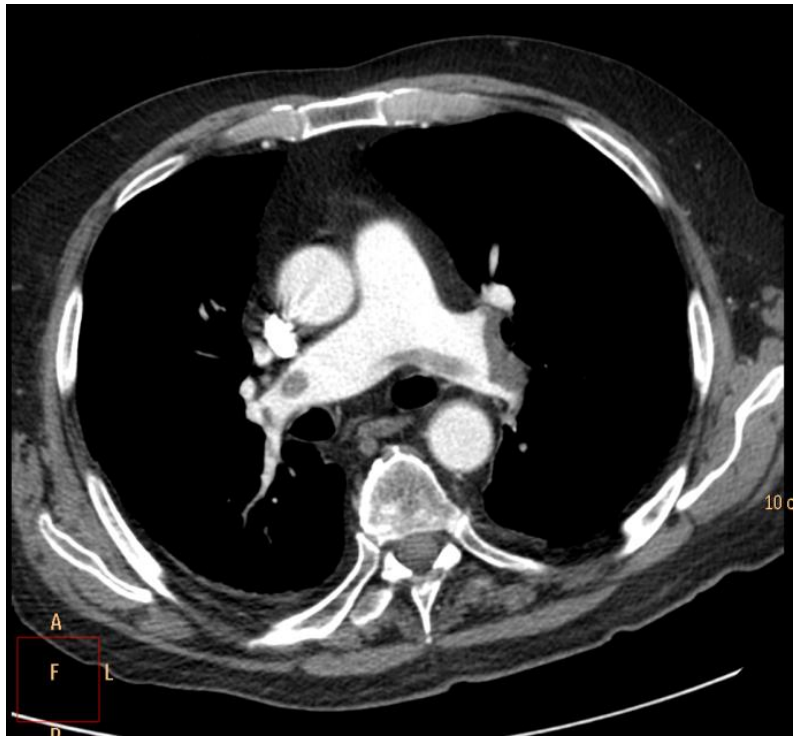
Iodine Delivery Rate



Contrast Optimisation – CTPA with a reduced iodine load but maintaining iodine delivery rate. Using a new protocol by lowering the volumes of contrast. 100mL to 75mL of Optiray 300



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Contrast optimisation – taken from a UK CT Dept.

- The easiest, SINGLE variable to alter in a busy NHS department is volume
- REDUCED by 10mL with a (minimum) 16mL flush
- It is up to each hospital to create their own weight based table governed by their unique situation, i.e. contrast type, concentration, scanner

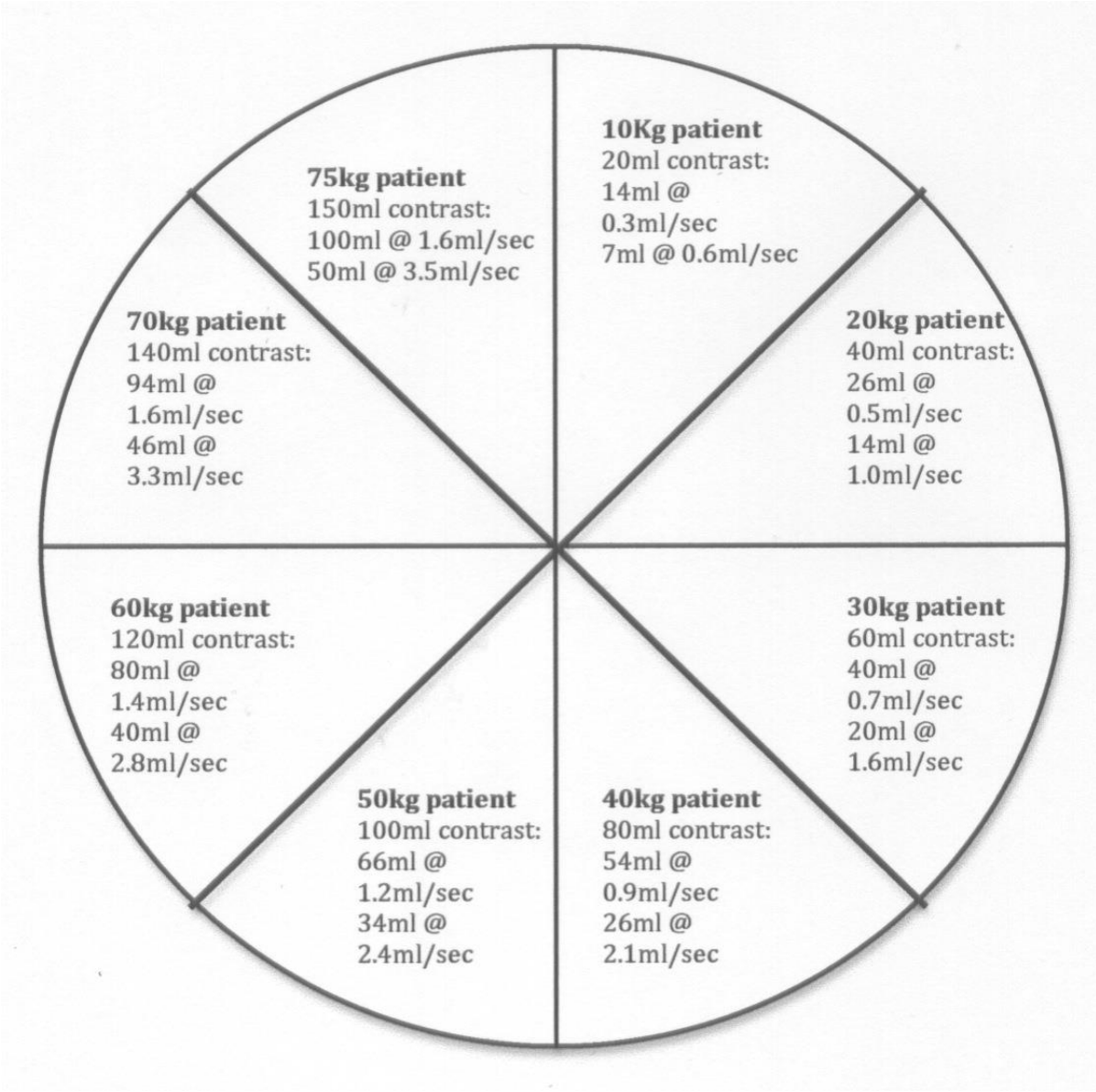
Contrast Injection Protocols For Body Imaging with portal venous phase

Patient Weight	80 kVp	100 kVp	120 kPv
Up to 50 kg	55 mL	50 mL	60 mL
50 to 60 kg	55 mL	60 mL	70 mL
60 to 70 kg	60 mL	70 mL	80 mL
70 to 80 kg	75 mL	80 mL	90 mL
80 to 90 kg	80 mL	90 mL	100 mL
90 to 100kg	90 mL	100 mL	110 mL
100 to 120 kg	100 mL	110 mL	120 mL
120 to 150kg	110 mL	120 mL	150 mL
Over 150 kg	120 mL	150 mL	180 mL

Using Optiray 350 at Yeovil

Contrast optimisation, complex protocols tailored by weight

- **Bastion Trauma protocol:**
  - By altering all 3 variables some very accurate and complex protocols can be written.
  - Optiray 300 mg I/mL



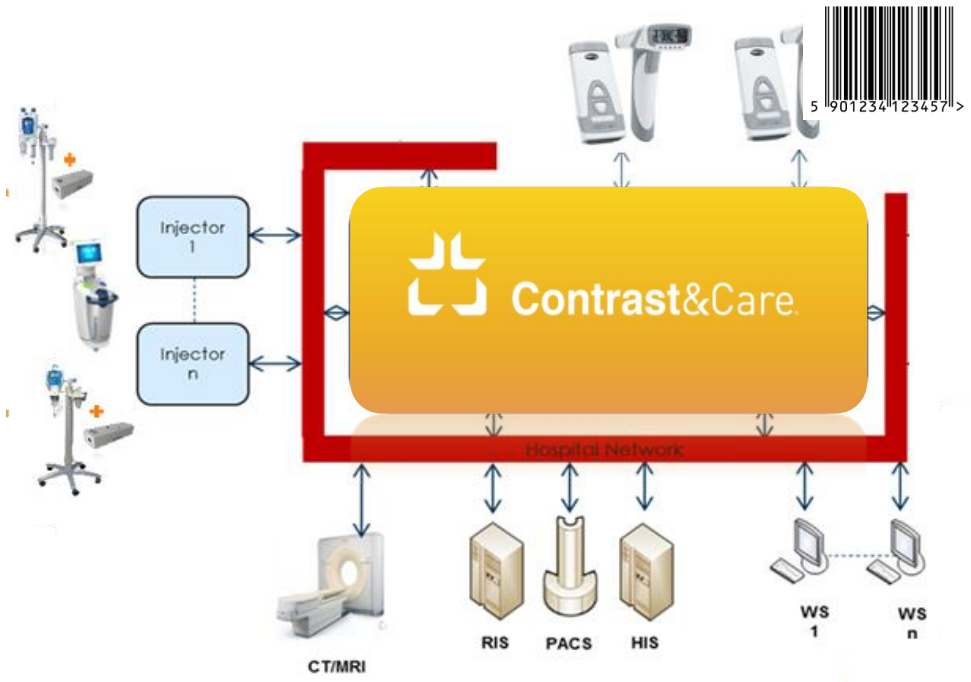
Injection Management Solution

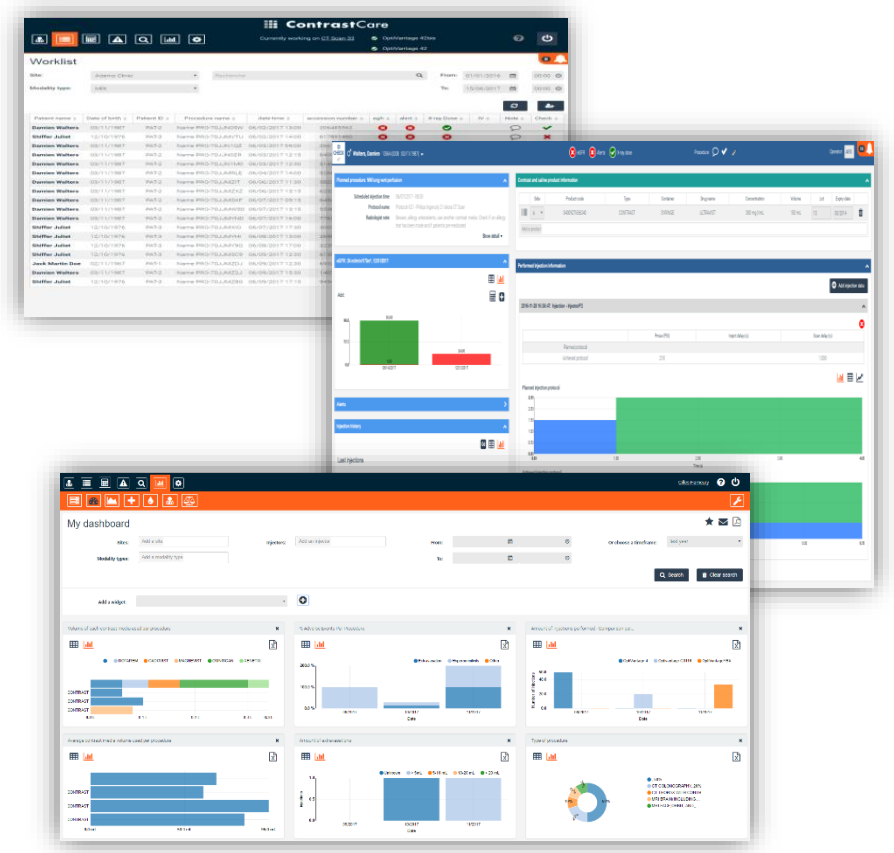
Contrast&Care®

Injection Management Solution to

collect, control, analyze, share

information on contrast media injection





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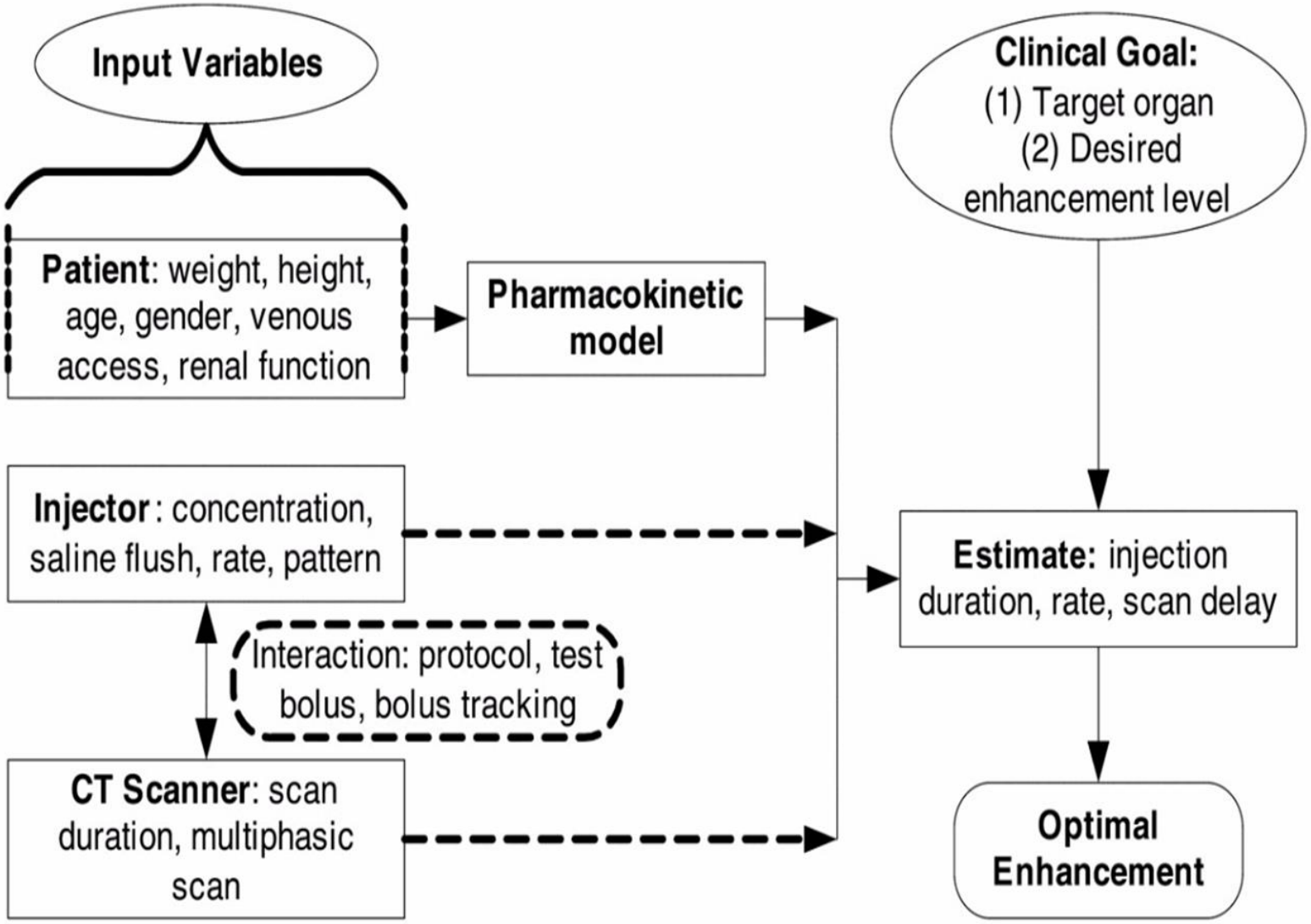
Tips for adopting weight based dosing

- Start slowly - don’t change too much too soon
- Choose your patients wisely
- Get into the habit of weighing each patient regardless of examination
- Get applications in if possible to discuss and optimise protocols
- Have some general guidelines and a PGD that will allow weight based dosing to be done
- Look at scanning parameters to optimise contrast – kpv
- Always consider Iodine load

Conclusions

- **Scanners**
  - Faster scanners = less contrast
  - Dose modulate why not contrast modulate?
- **Contrast dynamics**
  - Newer pump systems – allow saline flushing for all patients
  - Generally for organ imaging a by weight protocol is good
  - For CTPA depending on scanner speed set lower volumes can be used
  - Start with a given volume and reduce back gradually

Contrast optimisation, round up



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Contrast dynamics

- Like good comedy
- Its all about timing …….
- Its all about the delivery…..
- When its not right, its not funny

- Thank you….any questions?.

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THANK YOU

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