IPEM conferences

RPA Update 2021

24th June 2021- Online (BST)

10.00 – 10.10	**Introduction**
10.10 – 10.30	**The Definition of Effective Sources. An Update on: Variation of Radiation Dose with Distance from Radiotherapy Linac Bunker Maze Entrances** Matthew Gardner, formerly of University Hospitals Birmingham NHS Foundation Trust, UK.
10.30 – 10.50	**Potential Pitfalls of Linear Accelerator Bunker Refurbishment** Colin Jennings, Rosemere Cancer Centre, Lancashire Teaching Hospitals, UK.
10.50 – 11.00	Questions
11.00 – 11.20	**Break**
11.20 – 11.40	**Skin Contamination in Nuclear Medicine – the 'Never Event' that unfortunately happens! – A New Model and dose estimates for a range of radionuclides, including the alpha emissions of Ra223.** William Thomson, City Hospital, Birmingham
11.40 – 12.00	**Nuclear Medicine contingency plans and the practicing thereof** Kat Dixon, University Hospitals Dorset, UK.
12:00 – 12:10	Questions
12.10 – 12.30	Breakout session 1
12.30 – 13.30	**Lunch**
13.30 – 13.50	**Evaluating the practical impact of Instantaneous dose rate on designation of Controlled Areas.** Andrew Bridges, University Hospitals of Leicester NHS Trust, UK.
13.50 – 14.10	**Needle stick injury in the Radiopharmacy - a Case Study** Emily Seymour, Velindre Cancer Centre, Velindre University NHS Trust, Cardiff, Wales.
14.10 – 14.30	**Community Diagnostic Hubs** Cathy Wybrow and Kim Robertson, NHS England and NHS Improvement.
14.30 – 14.40	Questions
14.40 – 15.00	**Break**
15.00 – 15.30	**HSE Update** James Taylor, HSE
15.30 – 15.50	**CIDI**
15.50 – 16.00	Questions to the regulators
16.00 – 16.20	Breakout session 1
16.20 – 16.30	Final questions & Closing

Organised by IPEM's Radiation Protection Special Interest Group

The Definition of Effective Sources. An Update on: Variation of Radiation Dose with Distance from Radiotherapy Linac Bunker Maze Entrances

[1]Mike C Thorne, [2]Matthew Gardner, [3]William Mundon, [3]Thomas Pawsey, [4]Benjamin Davis, [4]Stuart Green

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[1] Mike Thorne and Associates Limited, UK.

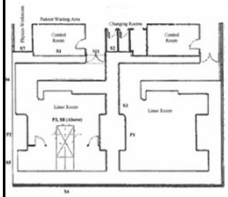
[2] formerly of RRPPS, Department of Medical Physics, University Hospitals Birmingham NHS Foundation Trust, UK.

[3] formerly of the School of Physics and Astronomy, University of Birmingham, UK.

[4] Department of Medical Physics, University Hospitals Birmingham NHS Foundation Trust, UK.

1

Introduction



- Radiotherapy linac bunker entrances often feature mazes which take advantage of the loss in energy of scattered radiation to avoid the need for shielded doors.
- The design is complex, with part of the calculations often being based on the assumption of the Inverse Square Law (ISL).
- The ISL states that, for a point source, the intensity of radiation is inversely proportional to the square of the distance from the source, which can be expressed mathematically as:
  - $Intensity \propto \frac{1}{Distance^2}$
  - Alternatively expressed: ${I_1}{d_1}^2 = {I_2}{d_2}^2$
  - I = intensity, d = distance at positions 1 and 2 respectively

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Introduction – Previous Study

- We previously conducted a study investigating the ISL on linac bunker entrances:
  - Published in Journal of Radiological Protection[1]: https://doi.org/10.1088/1361-6498/aba99a
  - Presented at the Medical Physics and Engineering Conference (MPEC) 2020[2]
- Based on measurements of Instantaneous Dose Rates (IDRs) at various distances from linac bunker maze entrances.
- The Inverse Square Law (ISL) should be used with caution to correct doses measured at distance from radiotherapy bunker maze entrances.
- Whilst no simple relationship exists, values were identified which can be used as guiding principles for distance correction.
- For instance; it was found that the dose rate at 1m outside the maze entrance is approximately 50% that at the maze entrance to within a standard error of 5%.
- This was extensively tested for a range of maze designs, beam energies & linac orientations and validated at 1m using uniformity measurements.

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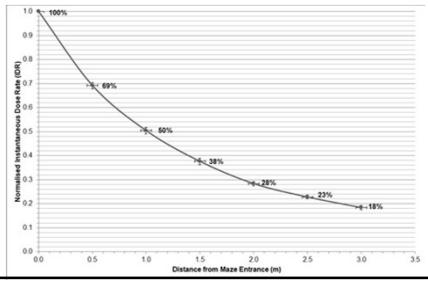
Previous Results: Variation of Instantaneous Dose Rate with Distance from the Maze Entrance at a Fixed Point[1,2]



- Variation in normalised Instantaneous Dose Rate (IDR) with distance from Linac bunker entrances averaged across all rooms, gantry angles and energies.
- Error bars in IDR are based on standard error.
- The results give standard deviations typically of 5-10% and standard errors of approximately 1%.

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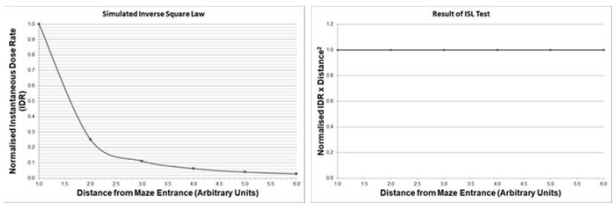
Previous Analysis: Variation of Instantaneous Dose Rate with Distance from the Maze Entrance at a Fixed Point [2]

Testing adherence to the ISL – a simulated ISL gives a flat line when IDR is multiplied by distance^2.



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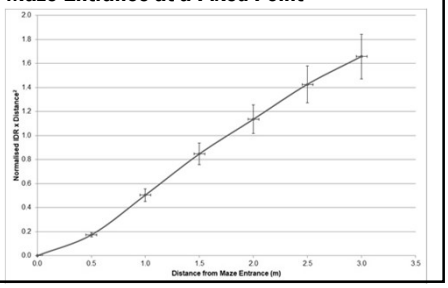
Previous Results: Variation of Instantaneous Dose Rate with Distance from the Maze Entrance at a Fixed Point[1,2]

- Our measured data analysed to test adherence to the Inverse Square Law (ISL) by multiplying normalised IDR by distance squared.
- If the data were adhering to the ISL a flat line would be expected.



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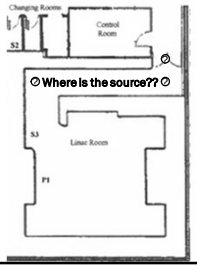
Introduction – New Insights



- Thanks to Mike C Thorne for contacting us after publication.
- Considered applying geometrical considerations of an effective source at some distance within the maze.
- This could allow a modification to the ISL assumption to be derived which means it can be applied for radiotherapy bunker maze entrances.

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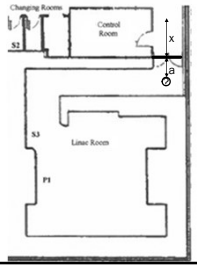
Methods



- Consider the dose rates at distances, x, from the maze entrance
- Assume an effective source at a distance, a, within the maze
- Then the dose rate, *I*:

$$I \propto \frac{1}{(a+x)^2} \; \boldsymbol{not} \; \frac{1}{x^2}$$

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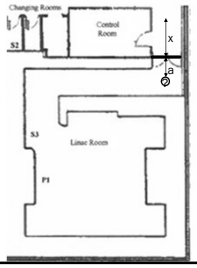
Methods



- This can be expressed:
  - $I(x+a)^2 = I_0 a^2$
  - I_0 = *dose rate at maze entrance*
  - $\therefore \; \frac{I}{I_0} = \frac{a^2}{(x+a)^2}$

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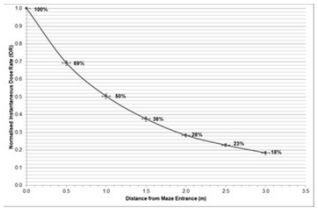
Results

- From our original study[1,2]:
  - At x = 3m, I/I_0 = 0.18
  - $\therefore \; 0.18 = \frac{a^2}{(3+a)^2}$
  - You can rearrange this into a quadratic:
  - $\mathbf{0.82a^2 - 1.08a - 1.62 = 0}$
  - Who remembers the formula for solving a quadratic??



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Results: Solving Quadratic Equations

$$General\ Quadratic: \; ax^2 + bx + c = 0$$

$$Solutions: \; x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Our Quadratic: $\mathbf{0.82a^2 - 1.08a - 1.62 = 0}$
a = distance from the maze entrance to the virtual source

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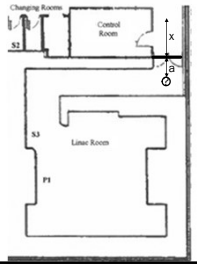
Results



- Two solutions, a = 2.2m and a = -0.9m.
- Only 2.2m is sensical.
- Implies that there is an effective source approximately 2.2m inside the maze –we published in a follow-up letter[3].
  - Arrived at using data from a range of bunker designs, gantry angles and energies.
  - $\frac{I}{I_0} = \frac{2.2^2}{(x+2.2)^2}$
  - Can compare predicted I/I_0 with our measured results[1,2]

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Results – Comparison of Predicted and Measured Results

Distance from Maze Entrance, x (m)	Fractional Dose Rate ($\dot{H}/\dot{H}_0$)	
	Predicted by this Analysis[3]	Measured Previously[1,2]
0.0	1.00	1.00
0.5	0.67	0.69
1.0	0.47	0.50
1.5	0.35	0.38
2.0	0.28	0.28
2.5	0.22	0.23
3.0	0.18	0.18

- The difference between the predicted and measured values is within 3% on average

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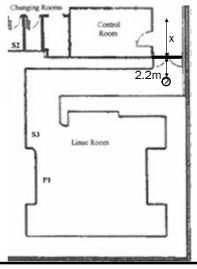
Conclusions



- The solution to the quadratic equation indicates that for radiotherapy bunker mazes the effective source is approximately 2.2m within the maze.
- Taking this as the position of the source and applying the ISL gives good agreement (within 3% on average) with the measured results from the previous study.
- The ISL could still be used for distance corrections, with a modification to account for the position of an effective source 2.2m within the maze entrance.
- But caution should be applied as in reality the source is not a point but is spatially extensive.

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References

1) Gardner, M., Mundon, W., Pawsey, T., Davis, B. & Green, S. (2020). *Variation of Radiation Dose with Distance from Radiotherapy Linac Bunker Maze Entrances*. Journal of Radiological Protection 40(4), 1039-1047. https://doi.org/10.1088/1361-6498/aba99a.

2) Gardner, M., Mundon, W., Pawsey, T., Davis, B. & Green, S. (2020). *Variation of Radiation Dose with Distance from Radiotherapy Linac Bunker Maze Entrances*. Medical Physics & Engineering Conference (MPEC), September 2020, Online.

3) Thorne, M.C., Gardner, M., Mundon, W., Pawsey, T., Davis, B. & Green, S. (2021). *On the definition of effective sources. Comment on article: variation of radiation dose with distance from radiotherapy linac bunker maze entrances by Gardner et al (2020)*. Journal of Radiological Protection 41(2), 472-473. https://doi.org/10.1088/1361-6498/abebf3

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Potential Pitfalls Of Linac Bunker Refurbishment

Colin Jennings

Deputy Head of Radiotherapy Physics

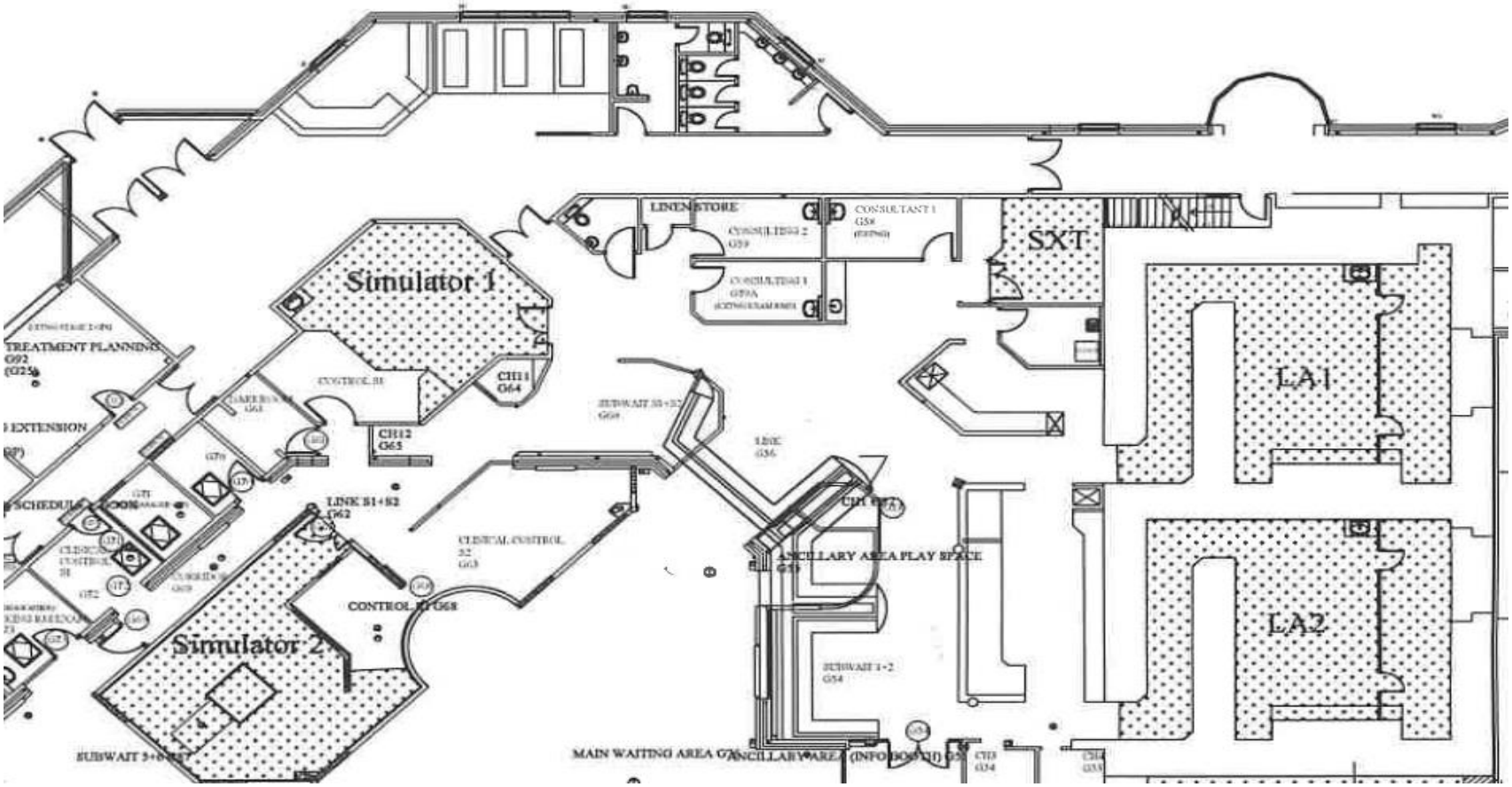
Lancashire Teaching Hospitals NHS
NHS Foundation Trust

Overview

- Rosemere Cancer centre, then and now
- Expansion and Refurbishment process
- Challenges faced during expansion and refurbishment
  - New Linac types
  - Shielding material changes
  - Movement of linac isocentre within bunkers
  - Room Access changes
  - Door Interlocks and External Interlocks
- Conclusions/Recommendations

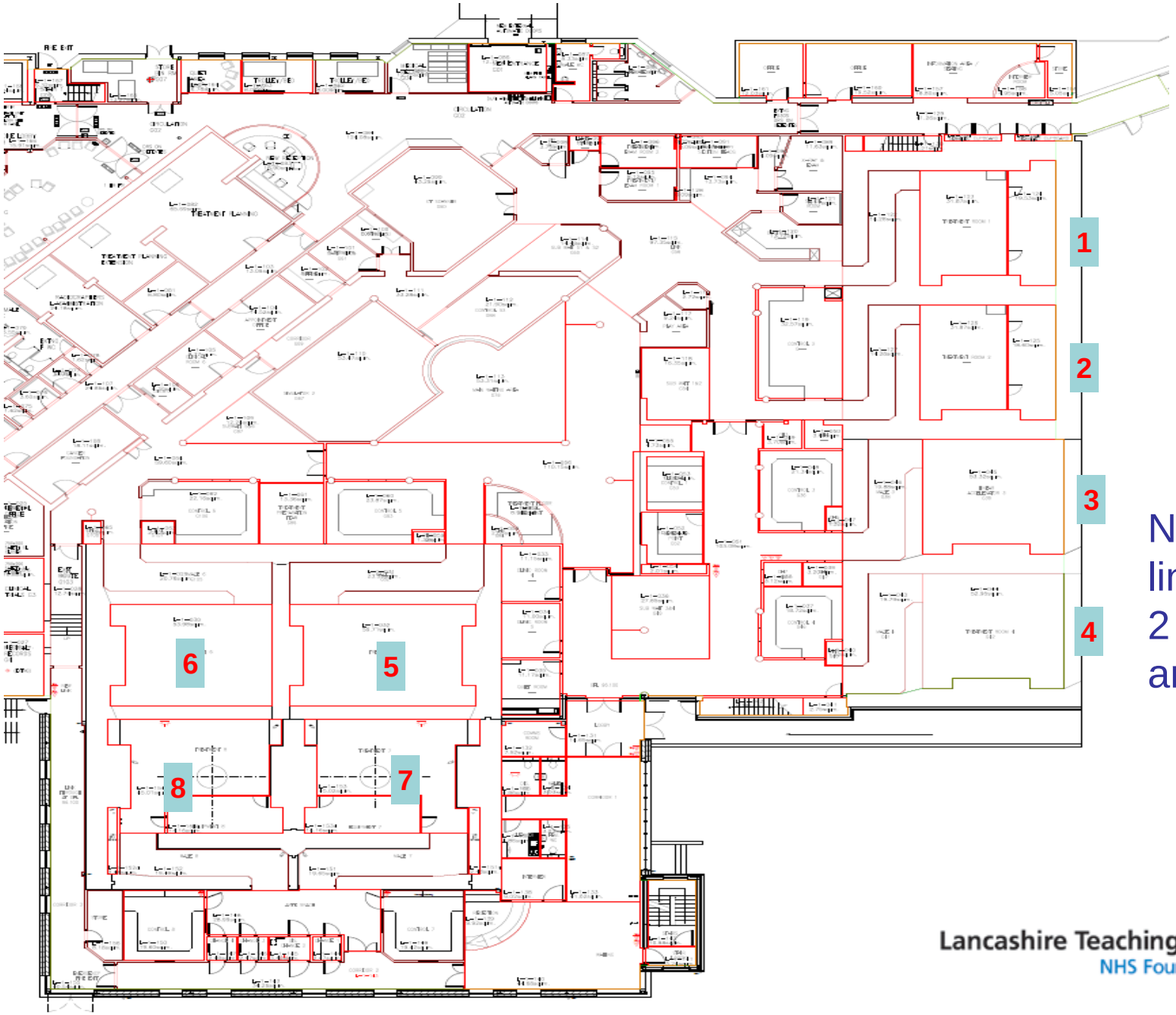
Rosemere Cancer Centre – then and now

- Radiotherapy Centre opened in Feb 1997 with 2 linac bunkers, SXT and a Simulator



- Linac bunkers - Small Christie design
- Cannot fit bed down maze
- Linacs delivered through hole in back wall
- Possible to get access to unshielded roof void – Castell Key system

Rosemere Cancer Centre – then and now



Now have 8 linac bunkers, 2 CT scanners and SXT

Lancashire Teaching Hospitals NHS
NHS Foundation Trust

Challenges faced during expansion and refurbishment

- 15 linac installs and 7 bunker refurbishments
- New Linac types:
  - Increased maximum field size
  - Increased energy (10MV) and Dose rate (FFF)

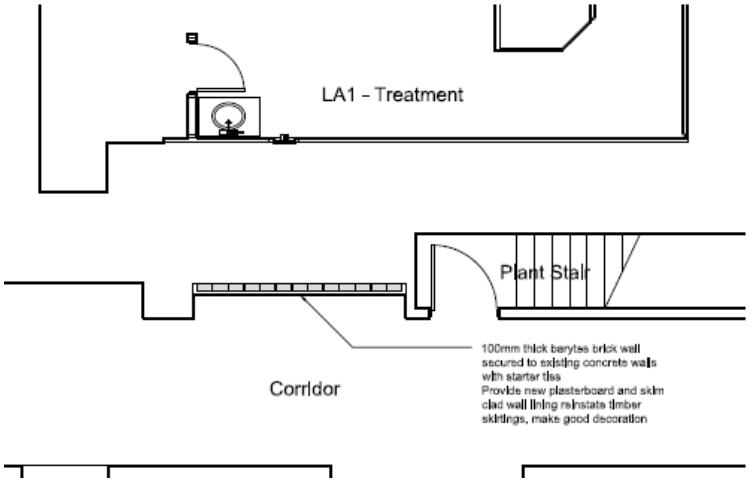
Elekta Beam Modulator,
SL15 Linac
6MV only, max 5Gy/min
Max 16x21cm field

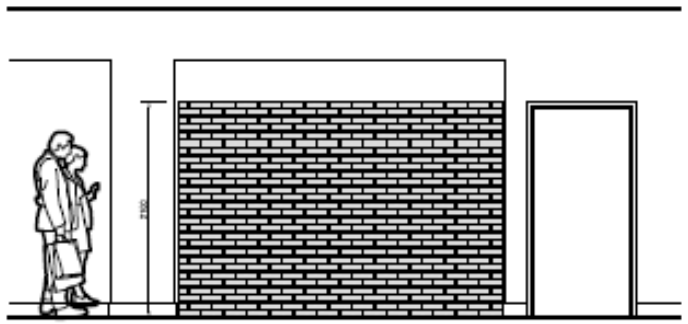
Elekta Versa HD linac
6 & 10MV, max 22Gy/min
Max 40x40cm field

Challenges faced during expansion and refurbishment

New Linac types:

- Original LA1 bunker designed for 6MV and 16x21cm only?
  - Original plans not available
- Need to ensure Primary barriers big enough for increased field size
- Need to dose rate survey and, if necessary, add extra shielding for 10MV and/or increased dose rate





Wall Elevation

- Original IDR in corridor ~14 microSv/hr
- With 10cm Barytes Brick ~5microSv/hr

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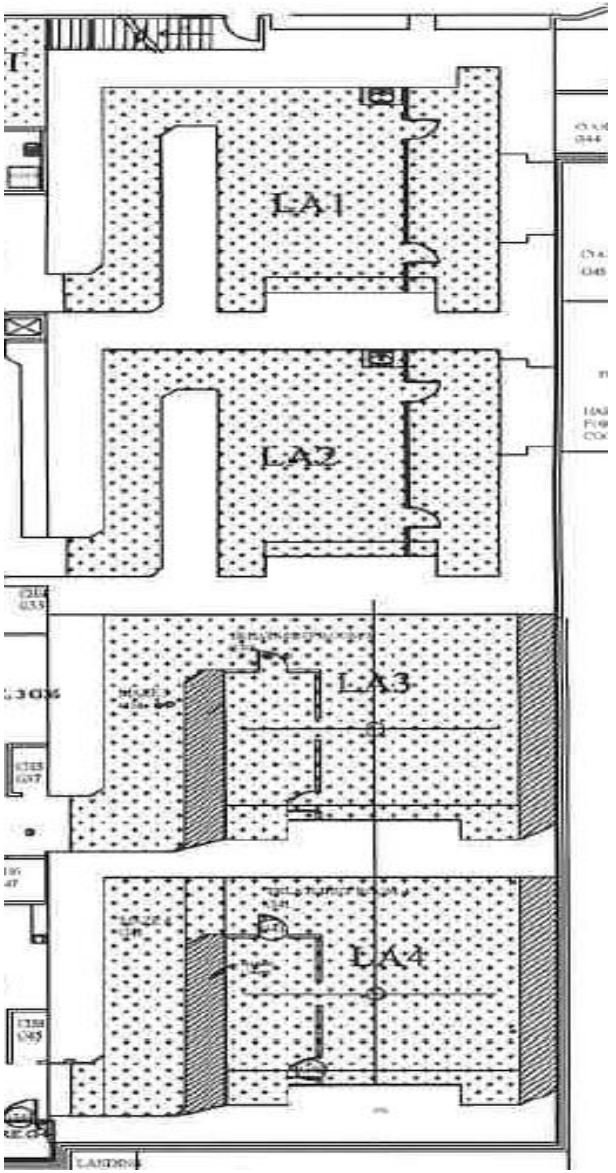
NHS Foundation Trust

Challenges faced during expansion and refurbishment

- Shielding material changes
  - Needed larger treatment room but keep outside wall line the same
  - Used Magnetite concrete to reduce footprint of bunker

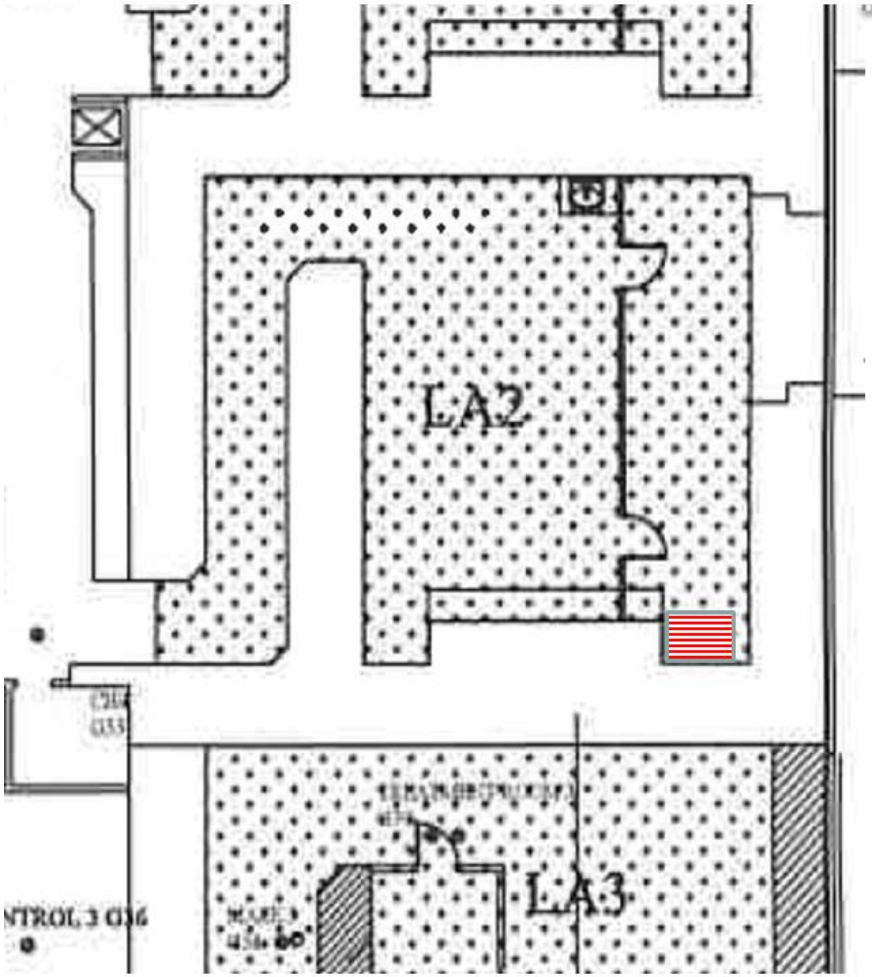
Magnetite – Concrete containing aggregate with high iron content.
Density ~3,900Kg/m3 compared to std concrete ~2,350kg/m3 (~66% higher density)

Subsequent linac bunkers maze wide enough for hospital bed
Isocentre shifted towards ‘T’, required additional primary barrier length in LA2



Challenges faced during expansion and refurbishment

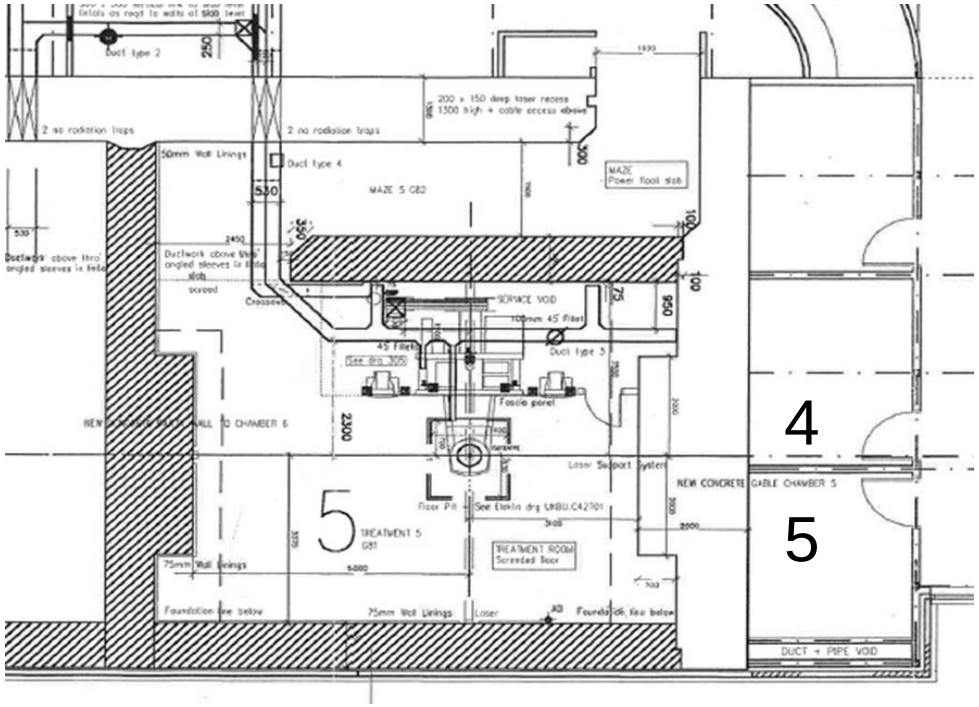
- Shielding material changes
  - Increased primary barrier length achieved using linac counter weights

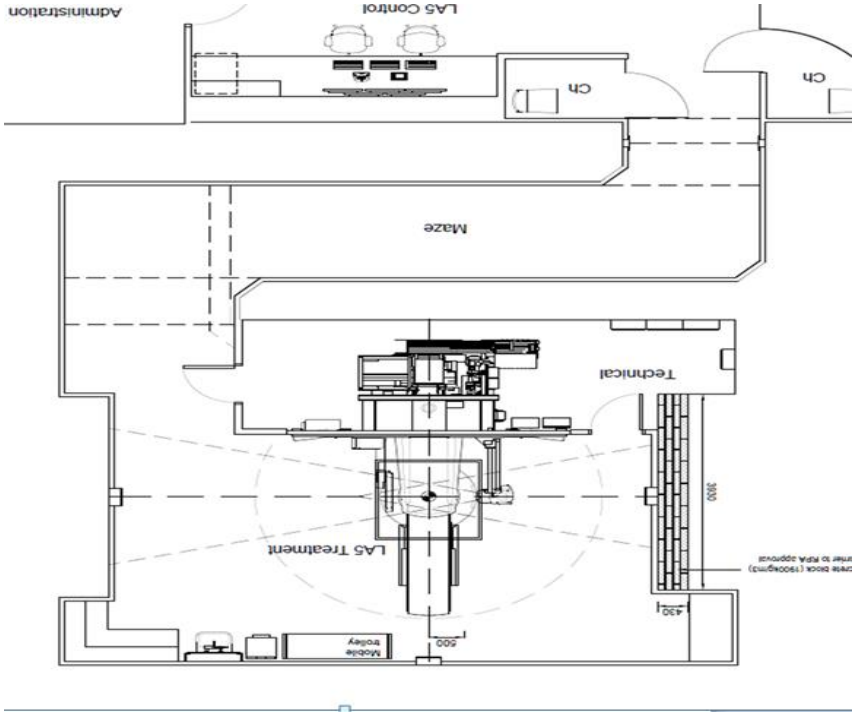


2.5m high stack of steel plates

Challenges faced during expansion and refurbishment

- Movement of linac isocentre within bunkers
  - Linac installed offset by 1m as wanted to use it for TBI treatment and increase max field size
  - Increased dose rate in clinic Rooms 4&5 – Supervised area
  - When refurbished, re-centred linac in room.

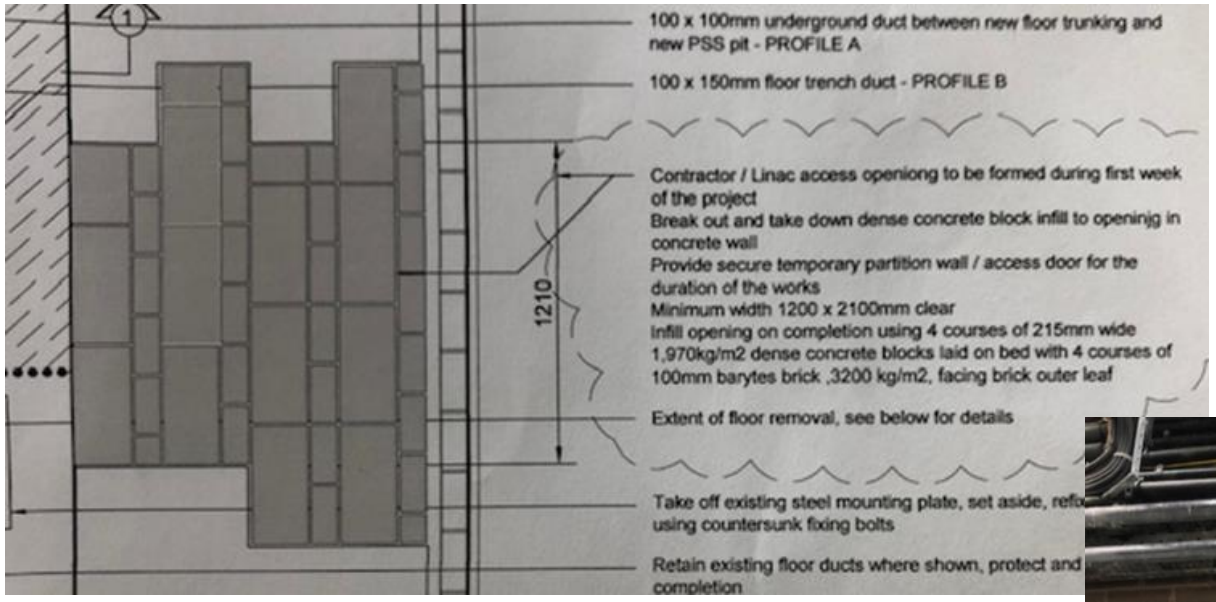


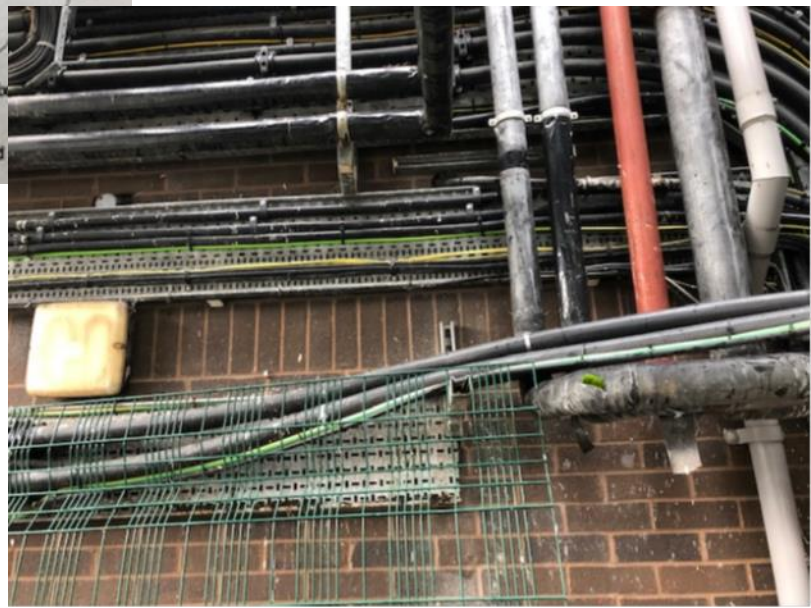


- 40% reduction in IDR, however still required 43cm additional shielding to ‘B’ side
- Lengths of primary barrier checked – still adequate

Challenges faced during expansion and refurbishment

- Room Access changes:
  - Back wall blockages – no longer access
  - Maze too narrow for linac delivery
  - Demolish maze and rebuild around linac

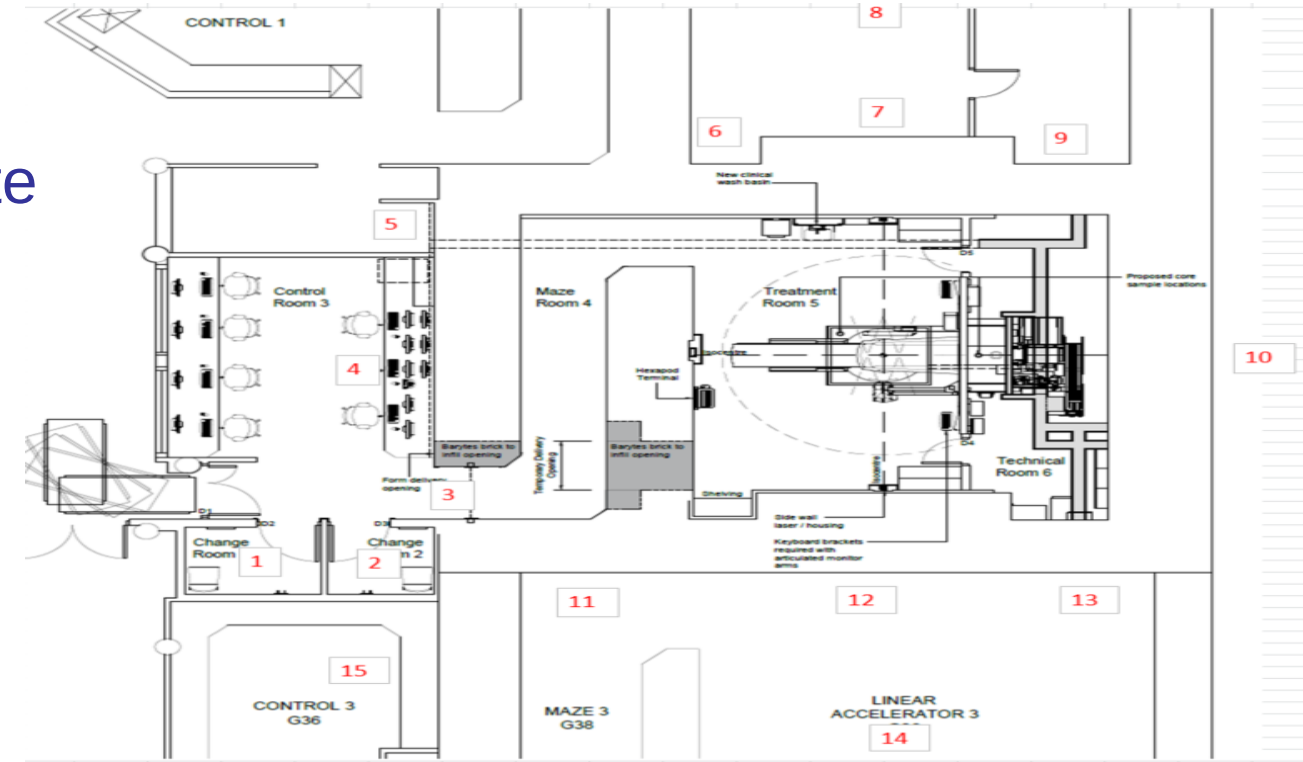




  - Demolish maze wall and widen entrance for linac delivery
  - Re-build following delivery
  - Extra ~£50,000 + 2 weeks building work

Room Access changes

- Pre-works dose rate survey to establish baseline values.



Measurement type 1 (no scatter)

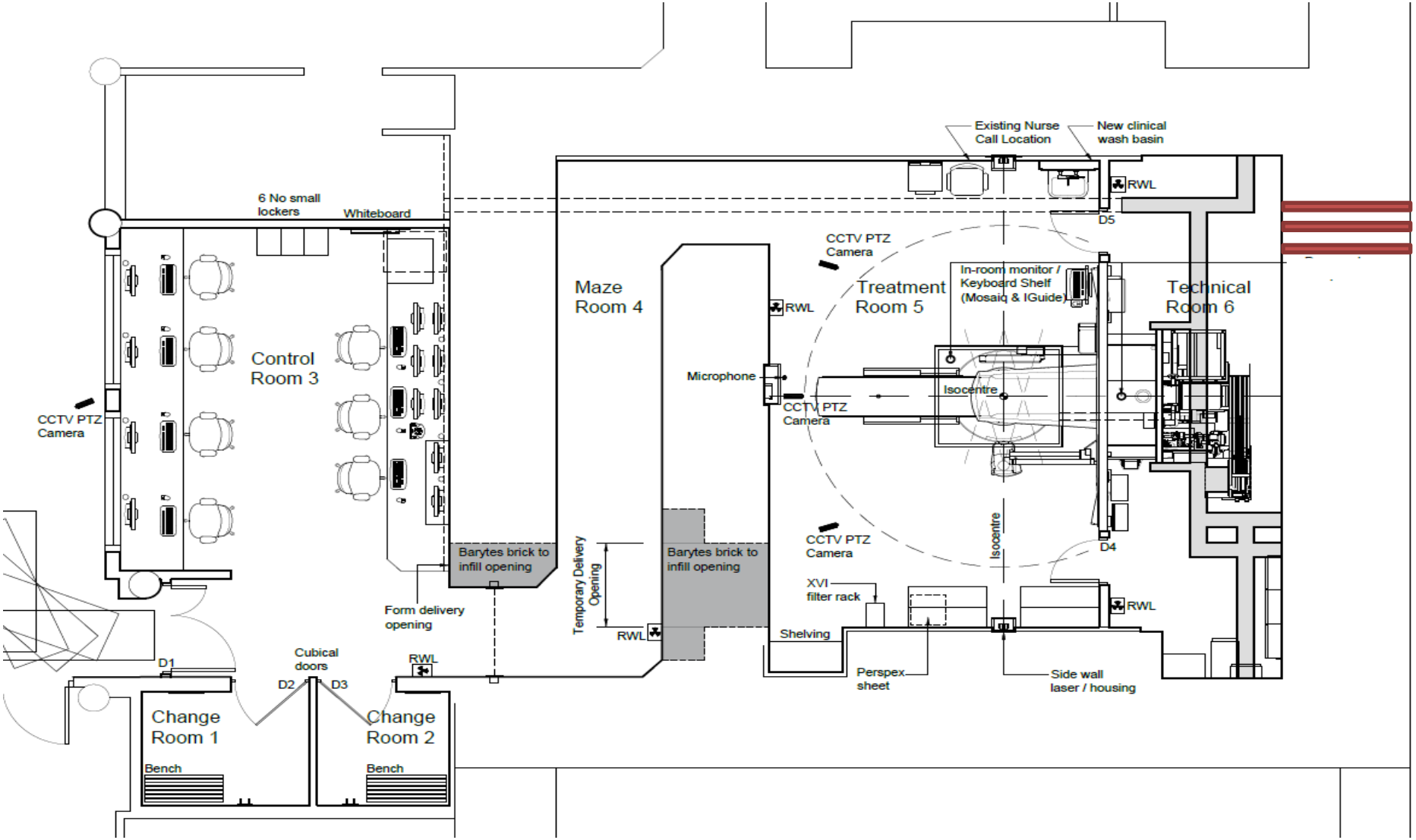
Position	40x40cm Field, coll=45 no scatter					
	Gantry 90	Gantry 90	Gantry 180	Gantry 180	Gantry 270	Gantry 270
	6MV	10MV	6MV	10MV	6MV	10MV
1	0.3	0.3	--	--	0.3	0.3
2	0.4	0.3	--	--	0.3	0.3
3	2.2	1.5	--	--	0.4	0.8
4	0.4	0.3	--	--	0.3	0.4
5	0.3	0.3	--	--	--	--
6	1.0	2.0	--	--	--	--
7	16.0	36.0	--	--	--	--
8	5.3	14.0	--	--	--	--
9	0.8	1.2	--	--	--	--
10	--	0.3	--	--	--	--
11	--	--	--	--	0.3	0.3
12	--	--	--	--	15.0	33.0
13	--	--	--	--	0.3	0.3
14	--	--	--	--	8.0	14.0
15	--	--	--	--	0.3	0.3
16	--	--	--	--	--	--

Measurement type 2 (with scatter)

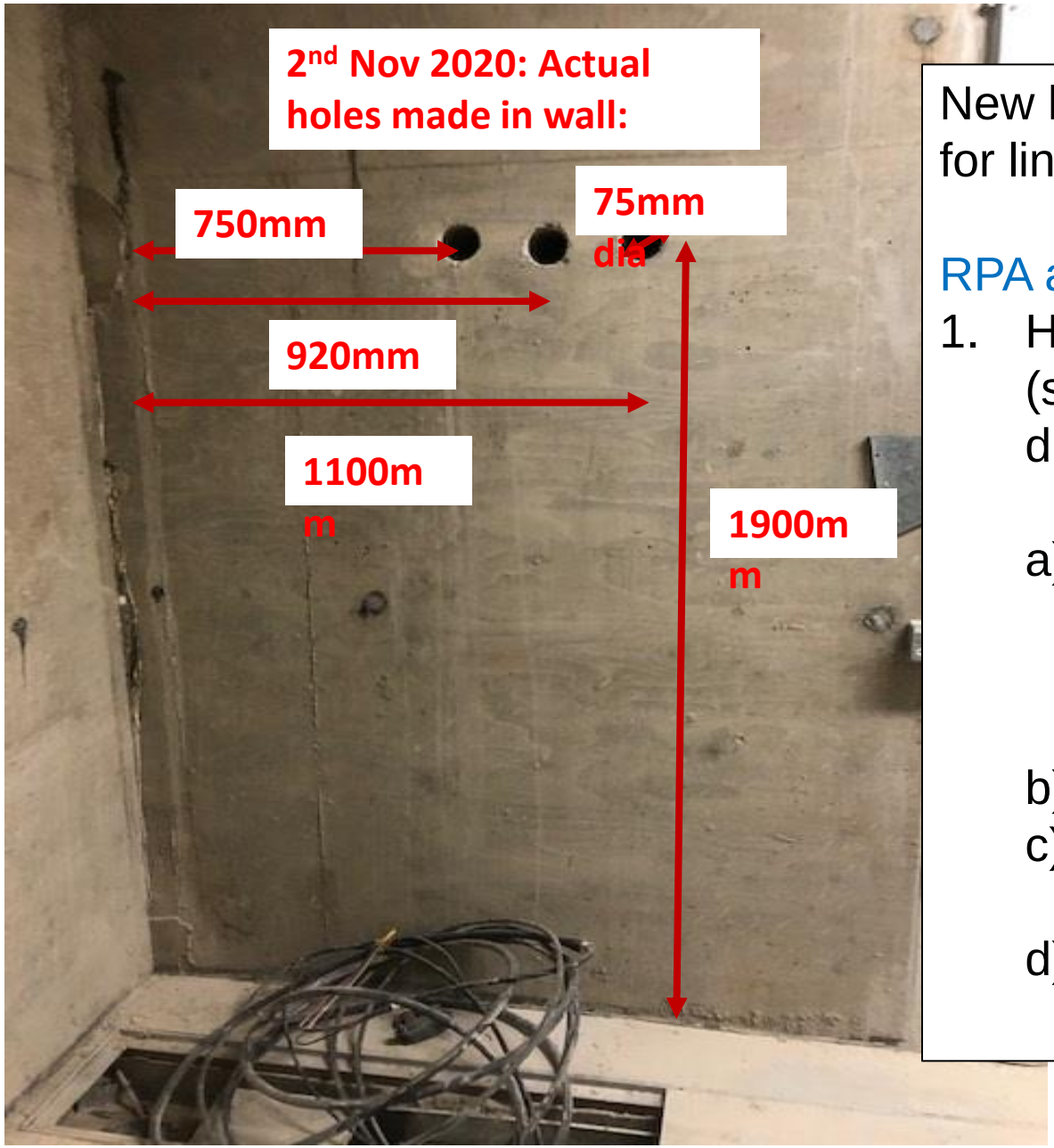
Position	20x20cm Field, with scatter*					
	Gantry 90	Gantry 90	Gantry 180	Gantry 180	Gantry 270	Gantry 270
	6MV	10MV	6MV	10MV	6MV	10MV
1	0.3	0.3	--	--	0.3	0.3
2	0.3	0.3	--	--	0.3	0.3
3	1.0	1.4	--	--	0.8	1.0
4	0.3	0.3	--	--	0.3	0.3
5	0.3	0.3	--	--	--	--
6	0.3	0.6	--	--	--	--
7	8.0	18.0	--	--	--	--
8	1.5	6.0	--	--	--	--
9	0.3	0.6	--	--	--	--
10			--	--	--	--
11	--	--	--	--	0.3	0.3
12	--	--	--	--	6.0	16.0
13	--	--	--	--	0.3	0.3
14	--	--	--	--	1.0	5.0
15	--	--	--	--	0.3	0.3
16	--	--	--	--	--	--

Room Access changes

- Demolish maze wall and widen entrance for linac delivery (large items)
- Re-build following delivery and complete rest of works
- Rest of linac delivery later and install



Room Access changes



New holes in secondary barrier for linac/room cooling pipes

RPA advice:

1. Holes in bunker wall (secondary barrier – 60mm dia x 2 plus 50mm dia x 1)

    a) No line of sight toward source or toward primary barrier (ideally 90deg to primary barrier)
    b) High (>2m) and horizontal
    c) As far from isocentre as possible
    d) Away from external roof access ladder

Room Access changes

- Major demolition work
- Diamond tipped chainsaw to cut wall into large slabs
- Large slabs broken up on night shift over ~5 nights

Room Access changes

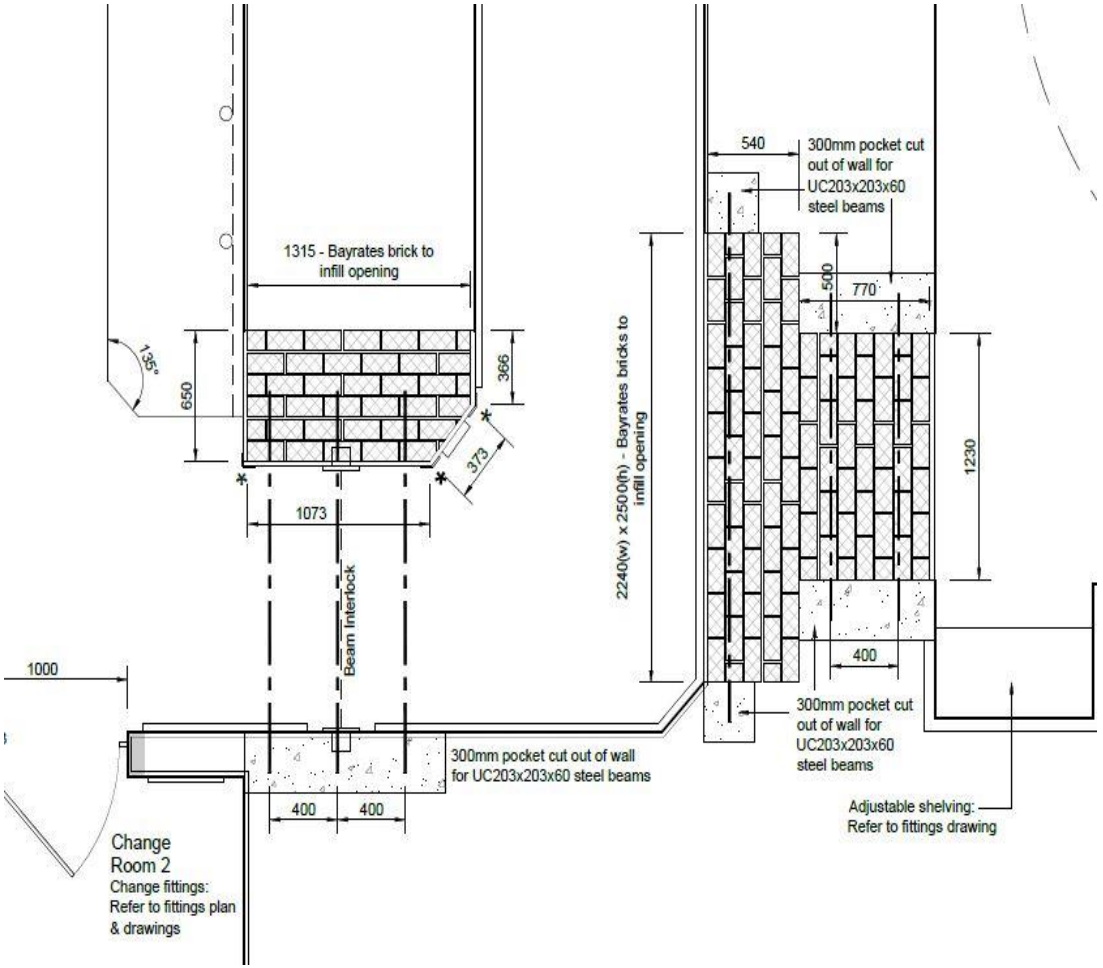
- First part of linac delivery on 5th Dec 2020

Room Access changes

- First part of linac delivery on 5th Dec

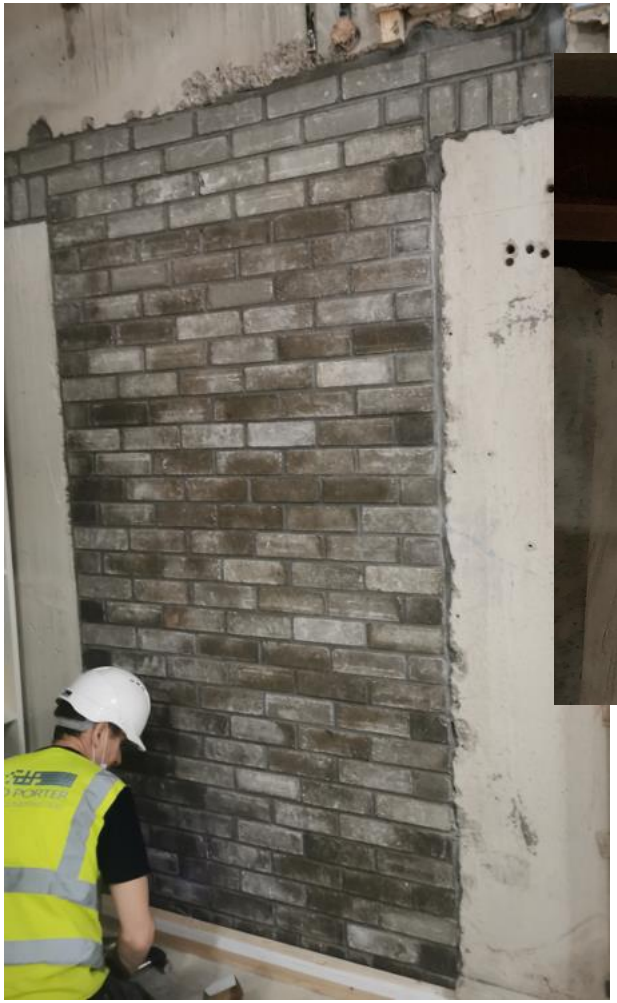
Room Access changes

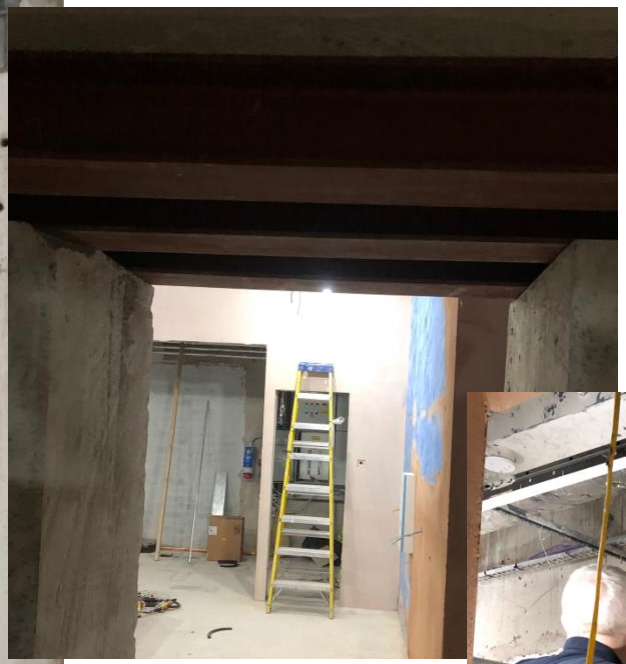
- Following first delivery large items bolted together and then linac wrapped to protect it during rest of building works.
- Need to install RSJ steel and infill with high density bricks

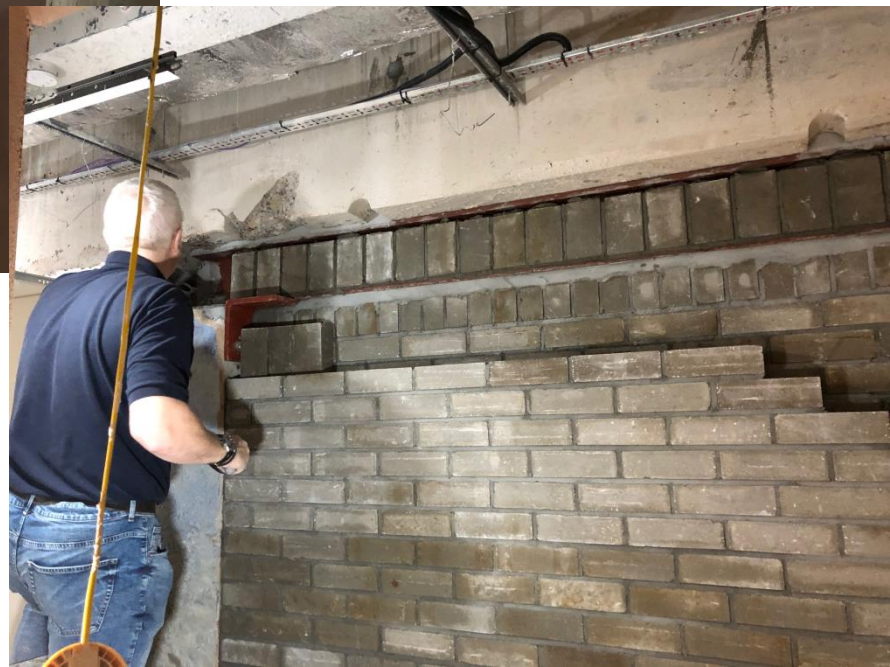


Room Access changes

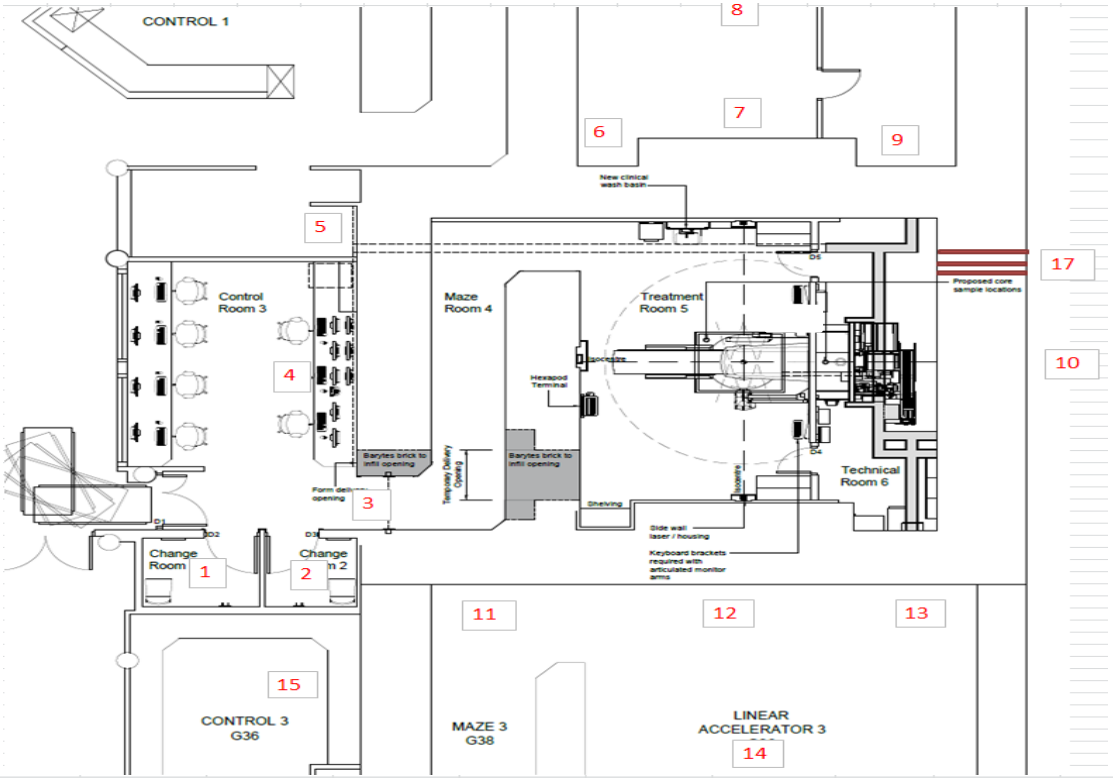
- Bricks joints staggered horizontally and vertically
- High density mortar used
- Pack as many bricks as possible into gaps and between RSJs







Linac Install – Final Dose Rate Survey



Results comparable with initial dose rate survey (non-FFF)

Flattened Beams

Measurement type 1 (no scatter)

Position	40x40cm Field, coll=45 no scatter					
	Gantry 90	Gantry 90	Gantry 180	Gantry 180	Gantry 270	Gantry 270
	6MV	10MV	6MV	10MV	6MV	10MV
1	0.2	0.2	--	--	0.2	0.2
2	0.2	0.3	--	--	0.3	0.2
3	1.8	2.3	--	--	0.6	2.0
4	0.1	0.2	--	--	0.2	0.2
5	0.1	0.2	--	--	0.2	0.2
6	1.8	3.5	--	--	--	--
7	16.0	84.0	--	--	--	--
8	6.0	23.0	--	--	--	--
9	0.5	2.0	--	--	--	--
10	0.2	0.2	--	--	--	--
11	--	--	--	--	0.2	0.2
12	--	--	--	--	16.8	60.0
13	--	--	--	--	0.3	0.5
14	--	--	--	--	4.9	21.0
15	--	--	--	--	0.2	0.2
16	--	--	--	--	--	--
17	4.5	3.5	--	--	--	--

Measurement type 2 (with scatter)

Position	20x20cm Field, with scatter*					
	Gantry 90	Gantry 90	Gantry 180	Gantry 180	Gantry 270	Gantry 270
	6MV	10MV	6MV	10MV	6MV	10MV
1	0.2	0.2	--	--	0.2	0.2
2	0.2	0.2	--	--	0.3	0.2
3	1.0	1.3	--	--	0.9	2.0
4	0.2	0.2	--	--	0.2	0.2
5	0.2	0.2	--	--	--	--
6	0.2	1.5	--	--	--	--
7	8.8	32.0	--	--	--	--
8	1.8	9.0	--	--	--	--
9	0.2	0.8	--	--	--	--
10	--	--	--	--	--	--
11	--	--	--	--	0.2	0.2
12	--	--	--	--	5.5	24.0
13	--	--	--	--	0.2	0.2
14	--	--	--	--	1.5	12.0
15	--	--	--	--	0.2	0.2
16	--	--	--	--	--	--
17	--	--	--	--	--	--

Challenges faced during expansion and refurbishment

- Door Interlocks and External Interlocks

Critical Exam Findings:

1. Door Interlock Issue

– Can start LMO timer, exit room, press confirm button, re-enter room, press confirm and beam on – Known ‘feature’

2. Confirm button not working

– Confirm button not wired correctly so not required to be pressed for beam on

3. Linac isolator switch not working

– In ‘on’ position linac is off and in ‘off’ position linac is on!

- Door Interlocks and External Interlocks

1. Castell key not working
   - Roof void above LA1 and LA2 treatment rooms require 3 keys to access
   - Each key is unique and should stop respective linac from irradiating
   - Key is locked in position when active
   - Found that Castell key had no affect, with removed can still beam on

Castell key not working

– Manufacturer attended on 23/3/21:

- Found that Castell key interlock is an item part value in software (ip230, Ext Terminate)
- Values 19 and 20 (upper and lower limits) were set incorrectly (default values) so not active
- Even when set correctly (active) interlock can be masked out in software (through Service Mode)
- Once masked out no longer appears on inhibit list
- Same behaviour found on LA1 also

Potential Risk Posed:

– Estates Dept attend to do maintenance on AHU in roof void above LA1/LA2
– They remove Castell keys from LA1 and LA2
– Physics/Eng arrive at linacs and (not realising someone is in void) switch them on
– Physics/Eng log into service mode and want to run long beams
– Various inhibits are shown (incl Ext Term) but Physics/Eng choose to action mask them out to avoid delays

– Physics/Eng irradiate the Estates person with **potentially lethal dose** of radiation (treatment room ceilings are not shielded)

- Door Interlocks and External Interlocks

Castell key is wired into CITB at External Terminate contacts

- Even though hardwired, needs item part value setting correctly in software
  - i230 p19&20=0
  - Can be action masked out in **Service mode** (in clinical mode all inhibits restored and cannot run beam).

- Raised serious concerns with Manufacturer as current install process does not require any testing of external interlocks or mentions setting of ipv.

- Manufacturer in process of updating install manuals and looking at re-config of Castell keys into Rm Door 1circuit (cannot be overridden) (FCO in draft)

Conclusions/Recommendations

- Rosemere opened in 1996 with 2 linac bunkers and has evolved massively
- Each linac build is slightly different – different challenges when refurbish

- Lots of issues:
  - High IDR (FFF) – EL2,3,4,5,6,7
  - Magnetite walls – EL3,4,5,6
  - Small rooms/mazes – EL1,2
  - Isocentre position changes – EL5, EL3
  - Changes to room access – EL1,2
  - Door I/L ‘feature’ – All linacs
  - Castell Key issues – EL1,2

Thanks for Listening

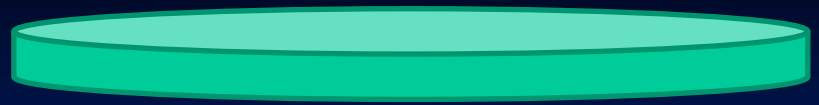
Questions ????

Skin Contamination in Nuclear Medicine – the ‘Never Event’ that unfortunately happens! A New Model and dose estimates for a range of radionuclides, including the alpha emissions of Ra223

Bill Thomson and Greg James

Physics and Nuclear Medicine
City Hospital , Birmingham

RPA 2020



Used VARSKIN 6.2.1

Compared Delacroix Droplet model to a new realistic droplet

Examined protection of gloves

Looked at skin contamination doses, highlighting high potential doses

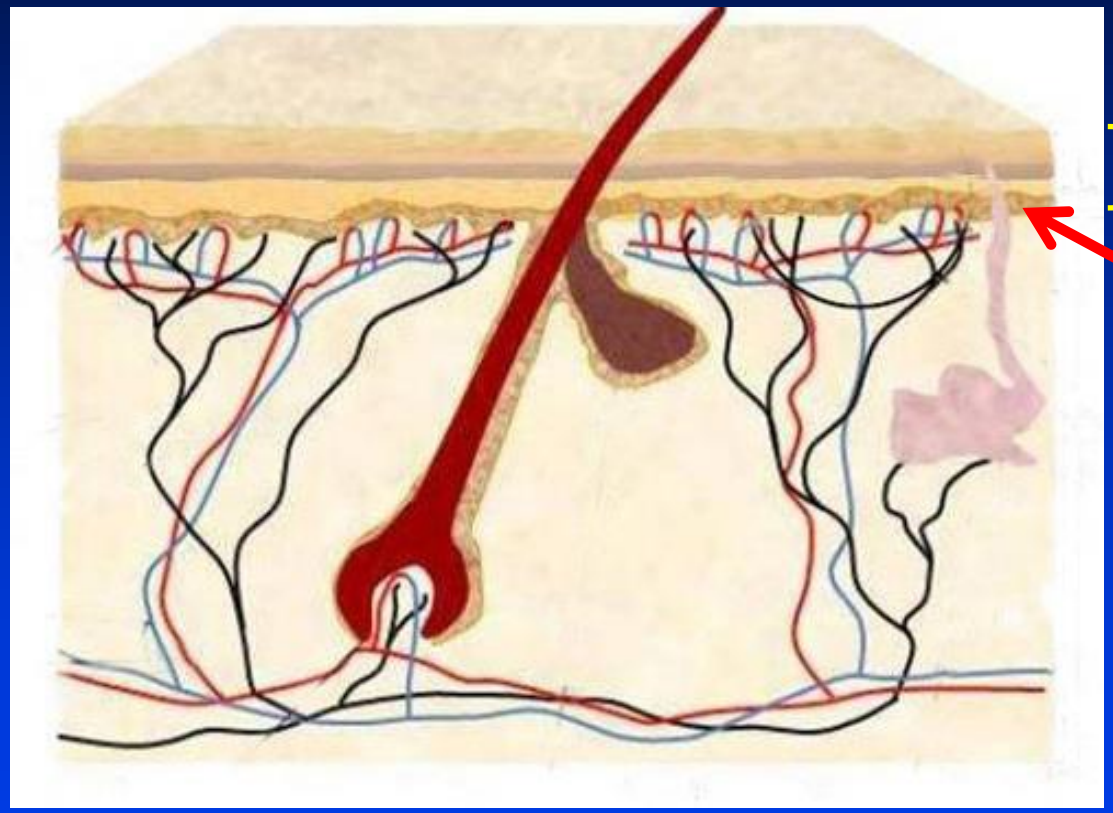
MA Bolzinger et al 2010 Int. J. Pharm. 402: 44 P

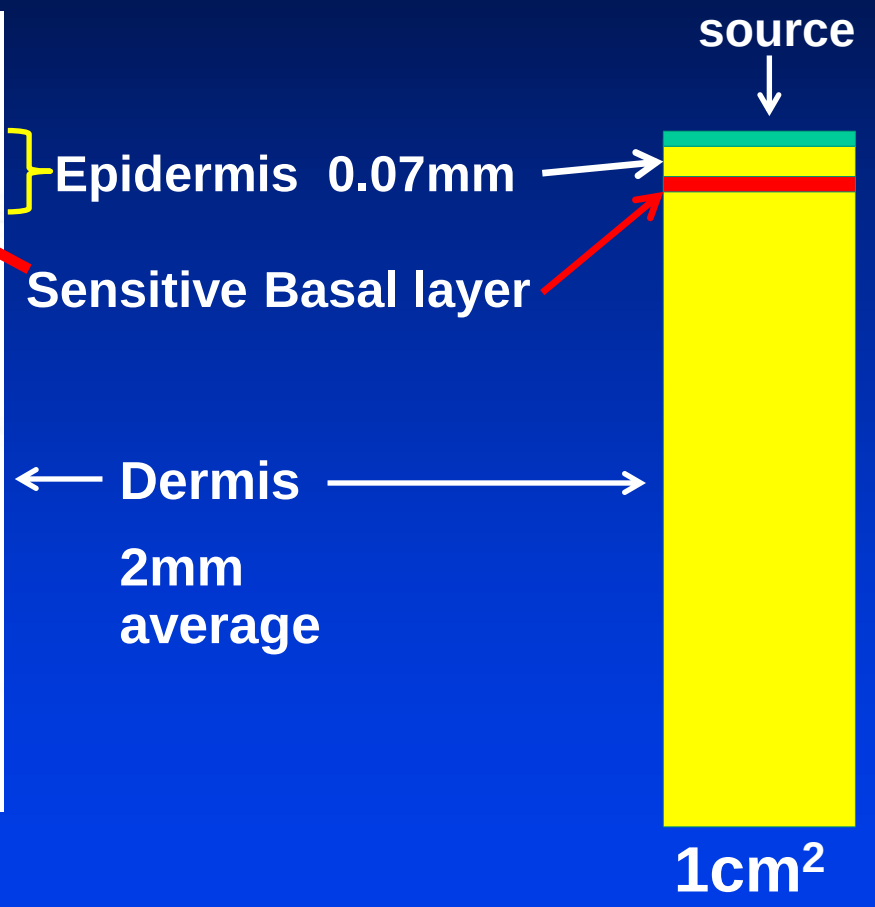
Covens et al 2013 J. Radiol. Prot. 33: 381

David Hamby ; VARSKIN

Skin Dose - Hp(0.07)

Dose to the Basal layer of cells - average over 1cm^2

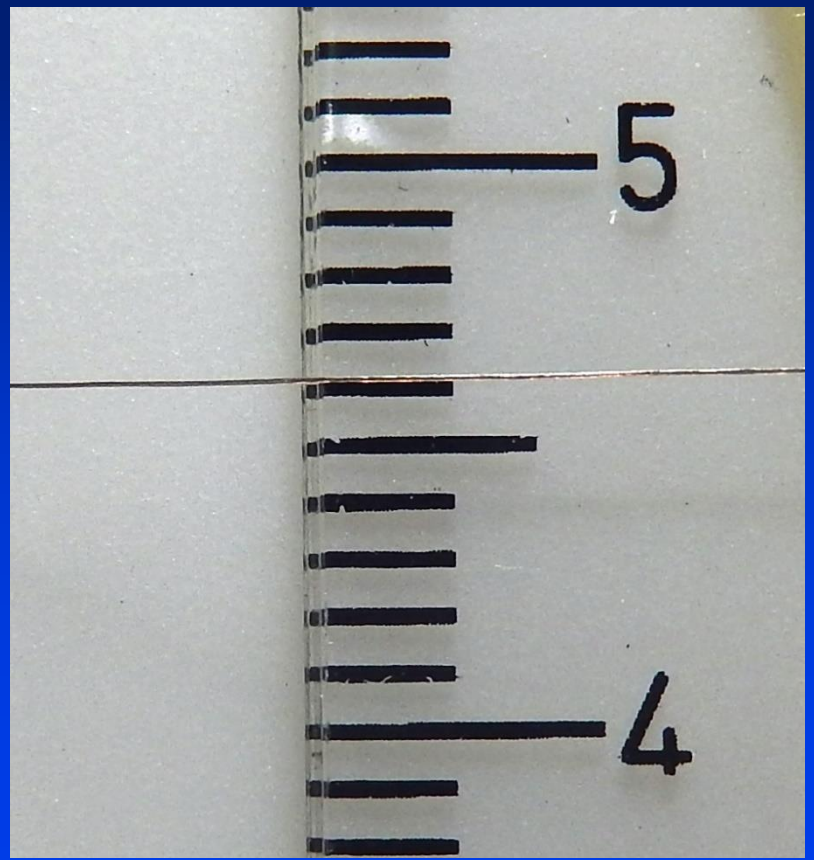




Skin thickness

Average epidermal thickness 70um - thickness of a human hair

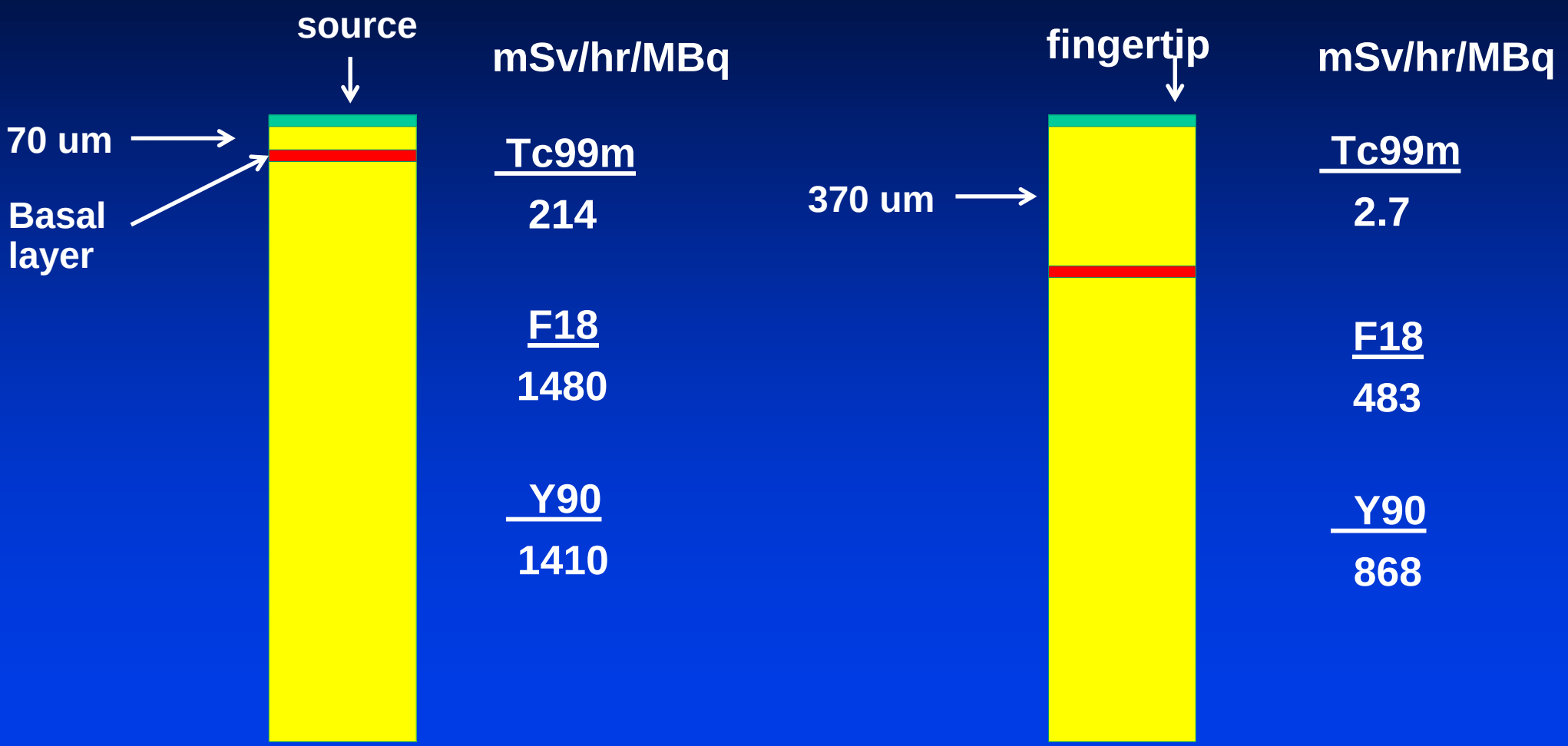
For the finger pulp, 370um - thickness of a black marker line



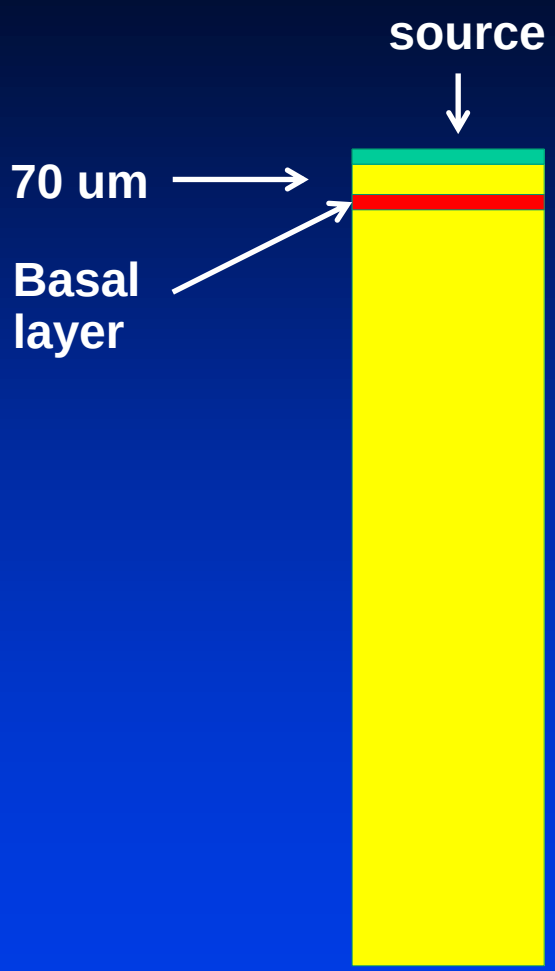
Radionuclides - Discussed

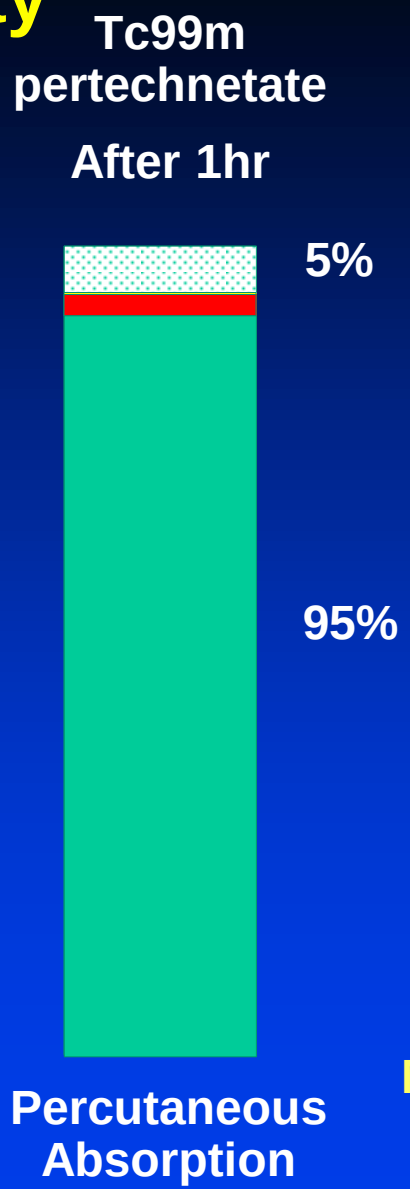
		range
	Electron / Beta /Positron	Tissue (mm)
Tc99m	120keV (11%)	0.3mm
F18	634keV (97%)	1.7mm
Y90	2.28MeV (100%)	9.2mm

Skin Dosimetry - Delacroix and VARSKIN concept



Skin Dosimetry - reality





Radiopharmaceutical flows through the basal layer to the dermal layer.

Vascular clearance from the dermal layer

6 – 12 hrs biological T1/2

Dosimetry effect?

MA Bolzinger et al 2010 Int. J. Pharm. 402: 44

P Covens et al 2013 J. Radiol. Prot. 33: 381

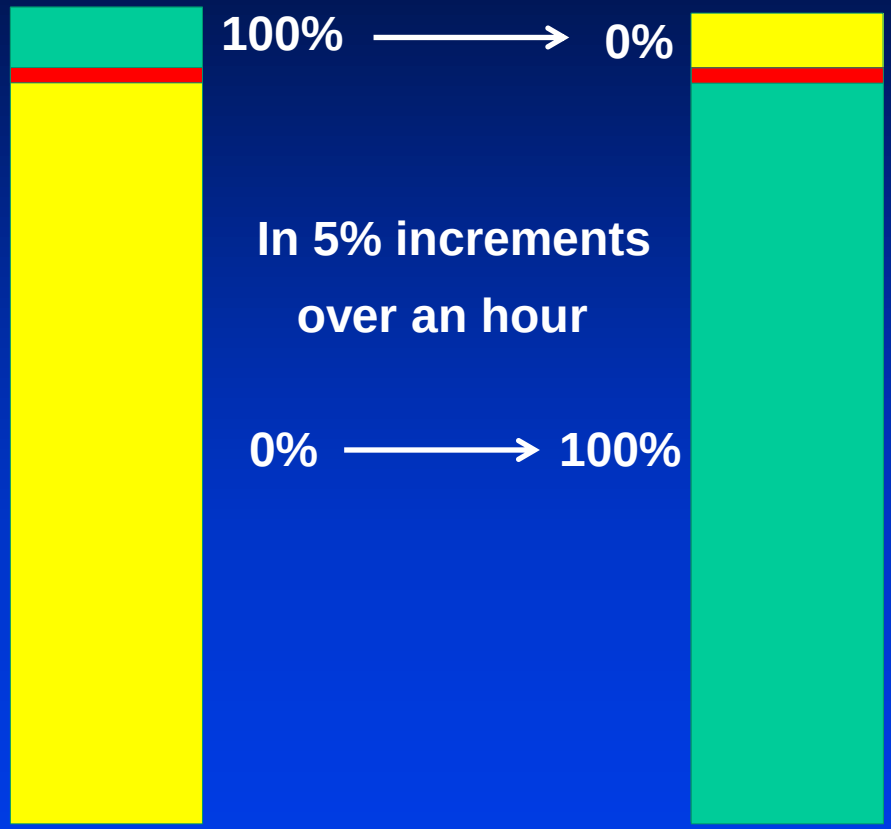
Skin Dosimetry - reality

MA Bolzinger et al 2010 Int. J. Pharm. 402: 44

P Covens et al 2013 J. Radiol. Prot. 33: 381

Tc99m pertechnetate

After 1hr



VARSKIN used to give dose from the cylinder in epidermal and dermal layers

Combined in Excel assuming linear 5% increments of change over 1 hour

→ Vascular clearance from dermal layer

6 - 11hr biological half-life

‘Integrated’ Doses mSv/MBq
(10hr biological half-life assumed)

	Tc99m	F18	Y90	I23	Lu177	I131
‘Old’ surface model	1170	3350	17970	2440	16290	17880
New model	380	2300	15290	8570	6800	8214
% difference	33%	69%	85%	350%	42%	46%
MBq for 500mSv	1.3	0.22	0.033	0.06	0.073	0.06
(new model)						

Ra223

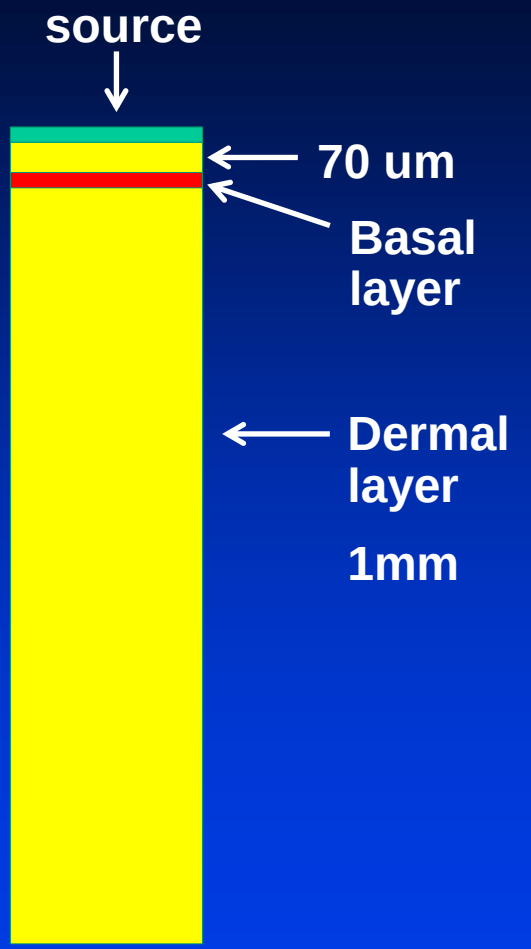
Currently , VARSKIN does not have alpha dosimetry

However, range of alpha approx 50um

So, alphas not considered relevant to dose estimates

P Covens et al Nuc.Med. Commun. 2012 33:102

Ra223



Ra223

6620 mSv/MBq

(assumes 10hr biological t1/2)

GEANT4

IF – any percutaneous absorption

Alpha dose considered

QF – x20

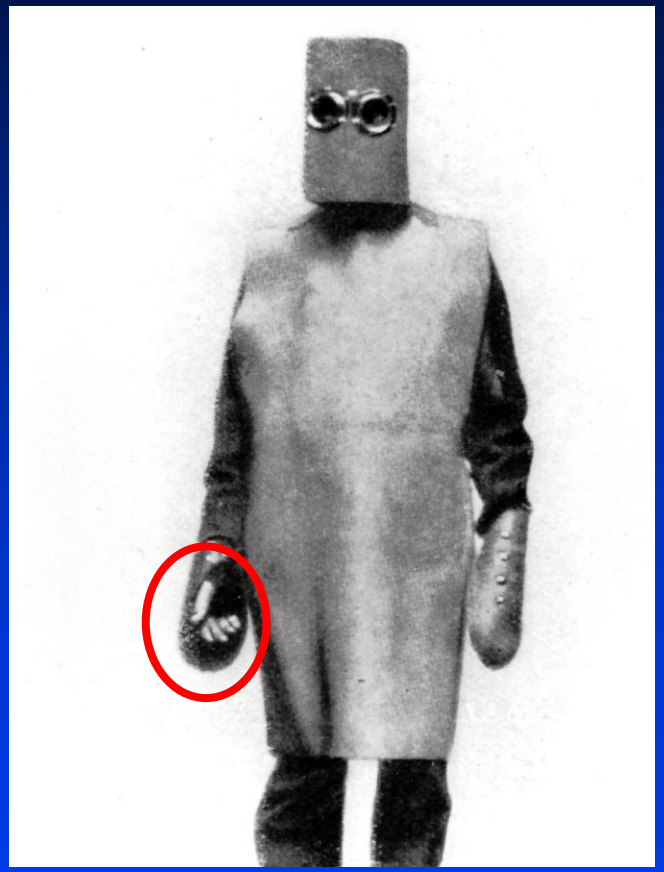
7099000 mSv/MBq

POSSIBLY!

Abrasions / cuts?

- M Charles ; "**Skin dose from Ra-226 contamination – Web PDF** "

PPE for Injections



Process for decontamination

Speed essential , but without causing further spread

If on gloves, try to estimate area and position while removing glove. Retain for gamma camera measurement of activity

Check nothing on skin – if yes, immediately wash thoroughly (Fairy liquid seems to work well !) .

Any remnant, try to get accurate estimate with gamma camera . Also, repeat measurement later to give effective half-life.

Summary

- Surface dose models (Delacroix) may not apply.
- Percutaneous absorption may not increase doses however.
- Staff Education!
- Staff need to understand activity , area , time essential for incidents
- Also need to understand the high doses from even low activity levels of skin contamination
- “COVID-type” PPE may be needed

More Info !

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Practicing nuclear medicine contingency plans

Dr Kat Dixon
Head of Nuclear Medicine
University Hospitals Dorset

NHS University Hospitals Dorset NHS Foundation Trust

1

2

Nuclear medicine contingency plans

- Loss of a radioactive source
- Major spill of radioactivity
- Removal of contamination from the body
- Fire in the Nuclear Medicine Department
- Flood in the Nuclear Medicine Department
- Fire or flood in the Hot Lab

3

Radioactive transport contingency plans

- Breakdowns and accidents while carrying radioactive goods
- Protection of the environment
- Fire
- Security and theft while carrying radioactive goods

NB these are not Emergency Plans…

4

Why do we need to practice?

- IRR17, Reg 13(2c):

Where appropriate, rehearsals of the arrangements in the plan are carried out at suitable intervals

- IRR17 ACOP, paragraph 246(h):

Implementation of lessons learnt from testing the plan.

- But basically so we know what we are doing!

5

Practice scenarios 2021

1. Loss of radioactive source - Se-75 capsule
2. Transport of radioactive material - fire in vehicle
3. Significant radioactive spill in nuc med corridor
4. Fire in nuc med reception waste bin

6

7

1. Loss of radioactive source - Se-75 capsule

- The scenario: SeHCAT patient returns for imaging after capsule earlier in the day, but no activity is seen on the scan. The patient, when questioned, looks shifty and then legs it out of the department
- The actors: reception staff played the part of patients in the waiting room, one of whom needed to leave urgently.
- Those present: no physicists

8

9

Outcome

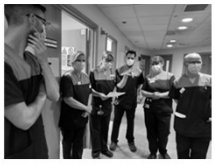
- Department searched and patients prevented from leaving
- Had to be prompted to consult contingency plans in local rules
- Patients are more compliant if you explain calmly what is happening
- Some monitors are better for searching for lost sources than others

10

2. Transport of radioactive material, fire in vehicle

- The scenario: department car caught fire on the way to Bournemouth Hospital while transporting SLN injections. Radiographer got out okay but did not exit the vehicle with anything other than their mobile phone. Phones nuc med in panic.
- The actors: superintendent phoning from another room
- Those present: no physicists

11



12

Outcome

- Copy of transport contingency plans should be kept with local rules
- Discussed who would help if no NM physicists available

13

3. Radioactive spill, in corridor

- The scenario: Radium vials dropped in nuc med corridor and two smashed and spilt.
- The actors: Radiographer performing the drop. Reception staff playing the part of waiting patients. One really interested in what is going on, another one needing to go to the toilet.
- Those present: a physicist!

14

15

Outcome

- Very few scenarios where spill considered major
- Staff used to minor spills so very calm for a bigger one of a less usual isotope
- However patients can be a hindrance if spill occurs in more visible area
- Discussed use of 'back-up' radioactive toilet

16

4. Fire in nuclear medicine reception waste bin

- The scenario: fire in nuclear medicine reception waste bin which then spreads
- The actors: none.
- Those present: everyone.

17

18

Outcome

- Now know location of all fire extinguishers
- Some members of staff are braver than others
- Confirmation of new muster point since new hospital entrance built
- Need to preserve life rather than safely store radioactive sources
- Possible consequences of this for fire fighters and how we could assist

19

20

Thank you to the actors of the Nuclear Medicine Department at Poole Hospital

Oscar's all round

21

Development of Community Diagnostic Hubs in England – Key Considerations

Radiation Protection Association
24 June 21

NHS England and NHS Improvement

1

Diagnostics: Recovery and Renewal was approved by the NHS England & NHS Improvement Board on 1st October 2020

Professor Sir Mike Richards was commissioned by NHSEI in 2019 to undertake a review of NHS diagnostic capacity. The report, *Diagnostics: Recovery and Renewal*, establishes the need to **both increase diagnostic capacity** and for a **new model of diagnostic service provision.**

The subsequent strategic ambitions for NHS diagnostic services are to deliver services that **provide the right tests, at the right time, in the right place** for patients, and have sufficient capacity to **meet growing demand** ensuring **equality of access**, **reduction in health inequalities** and **highly professional services.**

Richards' recommendations were approved by the NHSEI Board on 1st October 2020 and have subsequently been subsumed into the National Diagnostics Implementation Plan. Priorities for the National Diagnostic Programme are summarised below.

New Service Delivery Model	Equipment	Workforce	Digitisation & Connectivity	Delivering the change-enablers
Separate Acute and Elective Diagnostics where possible, including: • **Establish CDHs**; increasing emergency/acute capacity. • Establish new pathways to minimise visits to acute hospitals. • Continue implementation of diagnostic networks, including imaging, pathology, endoscopy & cardio-respiratory.	• Expand diagnostics capacity to meet increasing demand & catch up with OECD countries. • Replace all imaging equipment over 10 years old • Equipment/facilities & staffing surveys for endoscopy and cardio-resp. services. • Upgrade pathology and genomics equipment and facilities.	• Expand workforce across all diagnostic pillars along with support roles. • More training places and skill mix changes, alongside new roles that cross traditional boundaries to support expansion and backfill posts. • Establish training schools and academies.	• Improve IT connectivity & digitisation to drive efficiency, care across boundaries and support remote reporting. • Develop a standardised universal test list across all diagnostic disciplines.	• Provide and develop managerial and clinical leadership at National, Reginal and Local/network level. • Undertake a comprehensive review of data requirements • Review commissioning, tariffs and contracting arrangements. • Collect standard data/information

CDHs have key interdependencies with the broader diagnostic strategy including: implementation of diagnostic networks, expansion of diagnostic equipment, workforce expansion, and improving IT & digitisation

The CDH Programme and the wider workstreams of the National Diagnostics Transformation programme will have to, overtime, adapt to a changing landscape of medical and technological innovations.

2

2

The Vision and Purpose of CDHs

Vision Statement:
CDHs will deliver **additional, digitally connected, diagnostic capacity** in England, providing patients with a **coordinated set of diagnostic tests** in the community, in as few visits as possible, enabling an accurate and fast diagnosis on a range of a clinical pathways.

Type	Aim
Primary aims: The reason why CDHs are set up	To **improve population health outcomes** by reaching earlier, faster, and more accurate diagnoses of health conditions.
	To **increase diagnostic capacity,** through investing in new facilities and equipment and training new staff or new partnerships and innovative models of delivery, contributing to recovery from COVID-19 and reducing pressure on acute sites.
	To **improve productivity and efficiency** of diagnostic activity by streaming provision of acute and elective diagnostic services where it makes sense to do so; redesigning clinical pathways to reduce unnecessary steps, tests or duplication.
	To **contribute to reducing health inequalities** driven by unwarranted variation in referral, access, uptake, experience and outcomes of diagnostic provision.
	To deliver a **better, more personalised, diagnostic experience for patients** that by providing a single point of access to a range of safe, quality diagnostic services in the community.
	To **support integration of care** across primary, community and secondary care and the wider diagnostics transformation programme.
Cross-Cutting aims of the wider NHS that CDHs will be able to contribute to	To **improve staff development and satisfaction** by offering new roles, development opportunities, training excellence and an opportunity to work in flexible and innovative ways.
	To **make every contact count** and deliver health promotion and/or signpost to other services where it is meaningful and impactful to do so.
	To utilise CDHs as **test sites** for quality improvement, research, innovations and service evaluations.
	To contribute to **NHS Net Zero ambitions**, through enabling fewer outpatient attendances and reducing patient journeys to acute hospital sites.
	To act as **anchor institutions**, consciously supporting positive social, economic and environmental impacts locally, through procurement and spending power, workforce and training, to advance the welfare of the populations they serve.

33

3

DRAFT Core components of a CDH service offer to include

Component of CDH service offer:

OUTREACH	RECEIVE AND PROCESS REFERRALS	BOOKING & PREPARATION	CONSULTATION	COORDINATED TESTING	REPORTING	DIAGNOSIS & PRESCRIPTION	ONWARD REFERRAL
(Patient Experience described through 1st statements)							
I receive information that I can understand clearly on my health, symptoms to look out for, suggestions of any services I may want to access and clarity on how to access these. The services that are suggested to me can be accessed in a way that is convenient and acceptable for me. I am signposted to places to ask questions or find out more.	I attend a healthcare appointment and am advised I need some tests to further understand my health needs. The person I speak to explains what tests will be done and where I can go to have the tests done. This experience is the same whether I am in a GP, Acute Hospital, including A&E, Community Hospitals, Urgent Treatment Centres, or if I have called NHS 111	I am contacted by the CDH booking service and can book a time that is convenient for me. I receive pre-diagnostic test information, helping to inform and prepare me for my appointment(s) to undergo the suggested tests. I have a single number and/or email to contact with questions. I feel comfortable to come to a CDH.	I arrive at the CDH and am checked in at reception and informed of what to expect from my visit. I am reminded of what tests I will have today or if required as part of my patient journey, I will have an initial consultation with a clinician (e.g. if on a vague symptom cancer pathway) who will inform me what tests I will have during this visit.	I am navigated through the set of diagnostic tests I need to have. I receive all required tests in as few visits as possible and to as few sites as possible.	I am given clarity over what happens now my tests have been completed. Where the test can be interpreted on site, the member of staff explains what the test result shows. Where further interpretation is needed, the member of staff explains to me that the test results will be interpreted and reported back to the person who referred me to the hub. I will be contacted to book a follow-up appointment with this clinician.	Where possible, the person who carries out my diagnostic tests, tells me what the results of my tests mean and give me a follow up/ treatment plan and if appropriate a prescription to collect at a pharmacy.	I am advised on what further care is needed and provided with an onward referral or treatment decision. This is clearly explained to me and the choices and considerations laid out clearly.

Core component that CDH must provide on every pathway

Component that CDH could provide on **some pathways or localities depending on local need**

4

4

CDH Facilities

The following factors will **influence the design** of CDH facilities across a region:

- **Endoscopy** services need to be delivered at an appropriate scale to ensure efficient use of resources and therefore should be included as needed in larger CDH models.
- The effective delivery of some pathways may require the **co-location of non-diagnostic service components**, such as outreach activities, consultation and therapeutic services including minor procedures and interpretation of tests. This will require larger or different estate configurations that won't be appropriate for all CDHs.
- CDH services will be **structured and clustered in alignment with local population needs** which will differ across systems. All regional CDH designs should be made with consideration to wider public service plans for the population – such as Local Authority public transport plans

Three 'CDH facility' archetypes have been identified, which may help inform regions and systems what range of CDH facilities they may need to consider for their locality. There is no need to limit design of facilities to one of the archetypes listed below- a **blend** can be considered as long as the minimum requirements of a CDH are met.

1 **Standard Model**	A CDH that provides **the minimum diagnostic tests, except for endoscopy, and any other diagnostic test deemed a priority locally**. Only diagnostic testing is required to be carried out in this archetype; however, provision of consulting rooms should be considered if there is an opportunity for streamlining and providing more efficient overall patient pathways.
2 **Large Model**	A large CDH that offers all **minimum services and endoscopy**, **and potentially provides some of the optional components in the diagnostic pathway** e.g. consultation. Delivery of endoscopy needs to be embedded within a Regional Network aligned to training academies.
3 **Hub & Spoke Model**	The central hub must include all minimum diagnostic tests to support a coordinated service for patients that requires multiple tests. **CDH 'spokes' provide further capacity to 'hubs'** for specific tests through a **satellite location, mobile unit or pop-up**. Spokes can be used to meet specific service needs (e.g.to reach certain populations or increase local capacity for specific tests). The spokes can help integrate CDH models with other community diagnostic expansion (e.g. primary care diagnostic services) or to deliver care at home where this helps to progress the intended aims of the programme. Spokes should also be considered in areas that can support local recovery from COVID-19. There must be digital connectivity and interoperability between the different facilities comprising the hub and spoke model.

5

5

CDH Service Offer: Minimum Required Tests

NB: There is a clear need for local decision-making on what diagnostic tests to include in a CDH. Regions and systems should look at local need to identify what tests beyond the minimum requirements to include in their CDH design. For some systems, there may be a strong reason to not undertake a test that is nationally considered a minimum requirement. In this circumstance, systems will be required to justify their rationale to regions.

Draft minimum requirements for CDHs

		All CDHs	Large CDHs
Imaging	• CT • MRI • Ultrasound • Plain X-Ray	✓	
Physiological Measurement	• Electrocardiogram (ECG) including 24 hour and longer tape recordings of heart rhythm monitoring • Ambulatory blood pressure monitoring • Echocardiography (ECHO) • Oximetry • Spirometry, including reversibility testing for inhaled bronchodilators • FeNo, exhaled carbon monoxide &full lung function tests • Blood gas analysis via POCT • Simple Field Tests (e.g. six min walk) • Issuing of multichannel equipment for recording home 'limited' sleep studies	✓	
Pathology *(CDHs take samples – not responsible for analysing them other than POCT)*	• Phlebotomy • Point of Care Testing • Simple Biopsies • NT-Pro BNP • Urine testing • D-dimer	✓	
Endoscopy	• Gastroscopy • Colonoscopy • Flexi sigmoidoscopy		✓

Potential optional diagnostic tests appropriate for inclusion in a CDH

Diagnostic Modality	Test	
Imaging	Mammography Elastography (e.g. Fibroscan)	DEXA scan PET scan CT colonography
Physiological Measurement	Simple pH monitoring Simple sleep studies Urodynamics Electrophysiological tests	Audiology services Non-complex neurophysiology services
Endoscopy	Colon capsule endoscopy Transnasal endoscopy	Cystoscopy Hysteroscopy Colposcopy

Diagnostic tests that are not appropriate for delivery through a CDH

Endoscopic Retrograde Cholangiopancreatography
Complex sleep studies that include monitoring of ECTG
Bronchoscopy and endobronchial ultrasound (EBUS)
Complex interventional procedures including biopsies of internal organs
Trans-oesophageal and Stress ECHO
Cardiopulmonary exercise tests
Some challenge tests
Complex sleep studies that include monitoring of ECG

Please note: this is a **non-exhaustive list** of optional and non-appropriate tests CDHs should be COVID secure sites

6

6

Clinical Pathways for Consideration

Clinical Area	Pathways
Cardiorespiratory/ cardiovascular health	• Breathlessness • Post-Covid syndrome • Heart failure • Valve disease • Transient ischaemic attack (TIA) • Deep vein thrombosis (DVT)
Cancer	• Integration with Rapid Diagnostic Centres for all cancer pathways • Unexplained weight loss pathways • If screening services are included in a local CDH design, then screening and symptomatic pathways for cancer can be streamlined
Musculoskeletal Conditions	• The provision of diagnostic tests through a CDH for MSK conditions should follow the National priorities, governance pathways and/or guidance driven by the Best MSK health programme
Urology	• CDHs could provide capacity for areas that do not have urology units in place. It is recommended that urology pathways co-locate diagnostic services, consultation and minor/non-complex procedures in one place

Clinical Area	Pathways
Gynaecology	• Menstrual disorders, postmenopausal bleeding, abdominal bloating or pelvic mass and those with abnormal findings on cervical screening could all benefit from initial diagnostic assessment in a CDH
Maternity Services	• Antenatal screening - increasing the capacity for more women to access a fourth ultrasound during their pregnancy would reduce the need for growth measurement and improve the indication for foetal concerns
Ear, Nose and Throat Services	• Otology services • ENT imaging • Upper airway endoscopy
Health Check and Screening Services	• Systems should consider the role CDHs have to play in increasing NHS health check and screening capacity. In particular, the opportunity to include screening for: Abdominal aortic aneurysm (AAA); NHS Diabetic eye; NHS Cancer screening services

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Digital connectivity

Digital connectivity is key to the success of CDHs, particularly in relation to the access and transfer of clinical information and data. It is essential that there is good interoperability between diagnostic pillar IT systems, all locations within a CDH and relevant organisations with the local health and care system. Implementing CDHs also provides an opportunity to utilise the latest and upcoming digital innovations.

Overarching Principles

- Relevant standards must be followed with compliance to NHS security & access controls, data storage and data transfer (including DICOM, HL7, National Interim Clinical Imaging Procedures code-set)
- CDHs should have facilities to deliver workforce training through a variety of digital means, for example virtual procedures and supervision, online training.
- Patient identification using the NHS number validated through PDS look-up must be used including for all (clinical) data transfers. Clear data flows to other relevant services must be in place as a pre-requisite for CDHs going live.
- Providers of CDH facilities need to adapt during the lifetime of a contract given the fast-moving nature of the IT landscape. Digitally enabled diagnostic equipment should be prioritised to facilitate efficiency.
- The storage mechanism of patient information, including making results and images available between providers, should be considered, noting integration of multiple IT systems, settings, and providers in NHS and independent sector.
- CDH, perhaps supported by Academic Health Science Networks, should consider how best to make use of digital and technological innovation to manage and improve patient care, for example emerging use of Artificial Intelligence, ensuring processes are in line with patient and clinical safety.

Component-Specific Principles

RECEIVE AND PROCESS REFERRALS	BOOKING & PREPARATION	COORDINATED TESTING	REPORTING
CDHs should have the IT capability to receive, manage, and respond to requests & referrals	CDHs should have a single access point booking service system that supports patient choice as needed	CDHs should consider the most appropriate appointment scheduling process, considering direct and indirect requests/referrals, and multiple test locations	IT systems will need to consider how result information is integrated into patient records
Requests & referrals should be received electronically by April 2022	CDHs should explore IT solutions to identify and deal with missed appointments		IT systems will need to consider how diagnostic reports can be shared with relevant stakeholders
CDHs will need to be connected to NHS e-referral system and have cancer tracking systems in place	CDHs should explore IT solutions to facilitate the pre-appointment process and communication		Reporting results should be partnered with processes to flag urgent results, and closed-loop systems to ensure acknowledgment

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Workforce

Increasing diagnostic capacity will require an increase in staff and new ways of working to provide safe diagnostic services. The CDH model provides opportunity to embed the values of the NHS People Plan, with appropriately skilled, well supported staff working in flexible ways and able to benefit from excellent training at a CDH. We have identified **key principles and enablers** for systems to support workforce and skill development.

	Skills for CDHs	Training	Workforce deployment
Principles	• Staffing skill mix should be optimised to drive the effective use of multi skilled roles and development opportunities. • CDHs should act as "incubators" of workforce innovation and enhanced multidisciplinary working • Collaboration across providers, system, regional and national partners to develop competency-based roles. • Coordinated workforce planning of clinical and non-clinical roles at regional and system level.	• All CDHs contribute to provide training and continuous development. • Training should be coordinated at regional or system level and make use of existing networks • Training should evolve to support multidisciplinary working, guided by engagement with professional bodies and regulators. • Training should flexible and easily accessible to support development at all career points.	• Staff rotation between CDHs, acute, and primary care where appropriate, developed at system level to coordinate skills and service continuity. • Flexible working for clinical and non-clinical roles Effective staff management and support for all staff, in line with the People Promise. • Changes to deployment co-produced with staff
Enablers	• Effective job planning paired with skill-mapping to increase flexibility. • Increased use of support roles and upskilling to enable staff to safely optimise practice. • Use of Health Education England workforce redesign tools: STAR and Clinically-Led Workforce and Activity Redesign. • Senior support available on or off site with integrated IT.	• Contractual arrangements and incentives to training and continuous professional development. • Coordinated planning and delivery, linked to wider diagnostic training, across provider, system and region. • Engaging with universities and AHSNs • Making training accessible, e.g. through protected time, onboarding and clear career progression	• Digital staff passports to remove duplication in training. • Using the enabling staff movement between NHS organisations toolkit • Consistent approach to terms and conditions, common protocols, standardised reporting and quality assurance mechanisms. • Skill-matched job-planning • Integrated roster systems and remote IT access

Anchor approach | **Workforce diversity** | **Improving staff development and satisfaction**

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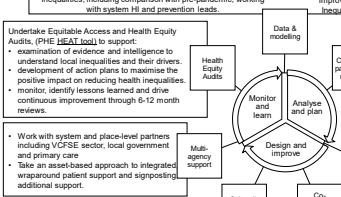
CDHs and Health Inequalities

Design: identify and prioritise diagnostic pathways with most variable access and outcomes for those facing greatest inequalities, including comparison with pre-pandemic, working with system HI and prevention leads.

Evaluation and monitoring: contribute to and improve collection of ethnicity and deprivation data. Analyse & evaluate data to improve access, experience and outcomes. Link with Health Inequalities Improvement Dashboard and elective recovery

Undertake Equitable Access and Health Equity Audits, (PHE HEAT tool) to support:
- examination of evidence and intelligence to understand local inequalities and their drivers.
- development of action plans to maximise the positive impact on reducing health inequalities.
- monitor, identify lessons learned and drive continuous improvement through 6-12 month reviews.



- Engage wide range of local stakeholders, incl. patients with lived experience to gain insights into health inequalities in referral, access, update, experience and outcomes of diagnostic provision
- Design of CDH services based on qualitative and quantitative evidence to identify unmet need

- Work with system and place-level partners including VCFSE sector, local government and primary care
- Take an asset-based approach to integrated wraparound patient support and signposting additional support.

- **Accessible information**: Achieve "I statements", proactive outreach, accessible formats, avoiding digital exclusion and understand drivers of exclusion
- **Accessible services:** accessible locations, flexible opening hours, co-located with other services, collect data on who is referred and accesses
- **Accessible support:** adaptability and flexibility for personalisation of services and to provide reasonable adjustments.

Proactive approaches to over come cultural and communication barriers:
- Coproducing comms tailored to local communities, considering cultural norms and events
- Flexibility in provision and distribution of information
- Acting to avoid digital exclusion.

- Involve people with lived experience, diverse voices, underserved communities, and those experiencing poverty
- Draw on existing networks: staff, wider partners in health and social care, directors of public health, local authorities VCFSE sector
- Maintain records of individuals and organisations involved in co-production and how they have been involved.

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Estates

Guidance has been developed to support systems to identify appropriate sites for CDH and to outline the process to select a site and design CDH facilities. All CDH sites should meet the primary consideration listed below and systems should be able to explain how they have factored these considerations into their decisions.

Primary Considerations: Sites should:
- Be **separately located from emergency diagnostic facilities** preferably away from an acute site where elective diagnostic tests can be done safely. If located on an acute campus, the CDH should be located in a separate building without passing through emergency facilities. Where this is not possible, the CDH should be accessible through a separate entrance.
- Be **configurable to meet specifications of the required diagnostic services** (e.g. negative pressure in areas doing pulmonary function testing) and support functions (e.g. waste management), in line with the minimum requirements for CDHs and reflecting local priorities
- Provide sufficient **capability to manage infection and ensure a COVID-19-minimum environment**, such as through implementing one-way systems to aid social distancing.
- Be located in areas which: 1. Are **easily accessible** through good public transport and private vehicles, particularly for specific population groups experiencing health inequalities, 2. Have sufficient **car parking facilities** for patients, carers and staff, 3. **Facilitate activities needed** by the CDH (e.g. for transport of phlebotomy or pathology samples)
- Be enabled with **network connectivity, internet access and sufficient devices** to allow staff to access relevant information to carry out their duties
- **Be accessible for extended hours** (e.g 14 hours a day, 7 days a week)
- Contribute to CDH **cross-cutting aims**, including: Improving staff development and satisfaction through support for local diagnostic workforce strategy (e.g. facilities for training and on- or off-site clinical supervision), delivery of NHS Net Zero ambitions across the system and support the role of the CDH as an anchor institution
- **Support the Equalities and Health Inequalities** agenda (including reasonable adjustments under the Equality Act 2010) and be aligned to the service Equalities and Health Inequalities Impact Assessment (EHIA), with particular consideration for those groups whose health inequalities have been exacerbated by COVID-19.
- Provide **safe clinical and flexible facilities** that are Health Technical Memorandum (HTM), Health Building Note (HBN) and National Patient Safety Alert compliant. CDH buildings should meet health and safety and accessibility guidance, including any reasonable adjustments likely to be required by patients and staff.

Other Considerations:
- Achieving value for money
- Longer-term impact
- Speed of deployment
- Coordination with local and regional priorities and estates plans
- Staff and patient engagement
- Ownership & lease terms

Designing a CDH
- Systems should use Modern Methods of Construction (MMC), to reduce design time, improve procurement efficiency and support the Net Carbon Zero agenda
- MMCs include the use of standard designs including Repeatable Rooms; a selection of RRs are currently accessible, with further RRs anticipated in the future

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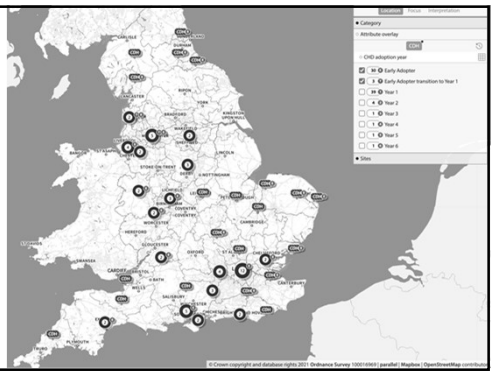
Location of Early Adopter Sites

Region	Number
EoE	3
London	7
Midlands	6
South West	4
South East	2
North West	7
NE&Y	6

By 15 July we are expecting submissions for year 1 sites



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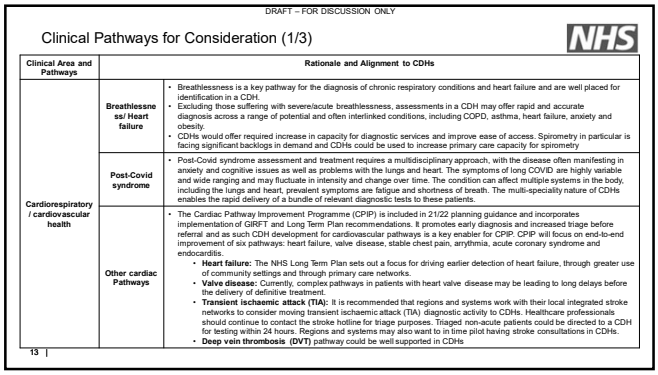

DRAFT – FOR DISCUSSION ONLY

Clinical Pathways for Consideration (1/3)

Clinical Area and Pathways		Rationale and Alignment to CDHs
Cardiorespiratory / cardiovascular health	Breathlessness/ Heart failure	• Breathlessness is a key pathway for the diagnosis of chronic respiratory conditions and heart failure and are well placed for identification in a CDH. • Excluding those suffering with severe/acute breathlessness, assessments in a CDH may offer rapid and accurate diagnosis across a range of potential and often interlinked conditions, including COPD, asthma, heart failure, anxiety and obesity. • CDHs would offer required increase in capacity for diagnostic services and improve ease of access. Spirometry in particular is facing significant backlogs in demand and CDHs could be used to increase primary care capacity for spirometry
	Post-Covid syndrome	• Post-Covid syndrome assessment and treatment requires a multidisciplinary approach, with the disease often manifesting in anxiety and cognitive issues as well as problems with the lungs and heart. The symptoms of long COVID are highly variable and wide ranging and may fluctuate in intensity and change over time. The condition can affect multiple systems in the body, including the lungs and heart, prevalent symptoms are fatigue and shortness of breath. The multi-speciality nature of CDHs enables the rapid delivery of a bundle of relevant diagnostic tests to these patients.
	Other cardiac Pathways	• The Cardiac Pathway Improvement Programme (CPIP) is included in 21/22 planning guidance and incorporates implementation of GIRFT and Long Term Plan recommendations. It promotes early diagnosis and increased triage before referral and as such CDH development for cardiovascular pathways is a key enabler for CPIP. CPIP will focus on end-to-end improvement of six pathways: heart failure, valve disease, stable chest pain, arrythmia, acute coronary syndrome and endocarditis. • **Heart failure:** The NHS Long Term Plan sets out a focus for driving earlier detection of heart failure, through greater use of community settings and through primary care networks. • **Valve disease:** Currently, complex pathways in patients with heart valve disease may be leading to long delays before the delivery of definitive treatment. • **Transient ischaemic attack (TIA):** It is recommended that regions and systems work with their local integrated stroke networks to consider moving transient ischaemic attack (TIA) diagnostic activity to CDHs. Healthcare professionals should continue to contact the stroke hotline for triage purposes. Triaged non-acute patients could be directed to a CDH for testing within 24 hours. Regions and systems may also want to in time pilot having stroke consultations in CDHs. • **Deep vein thrombosis (DVT)** pathway could be well supported in CDHs

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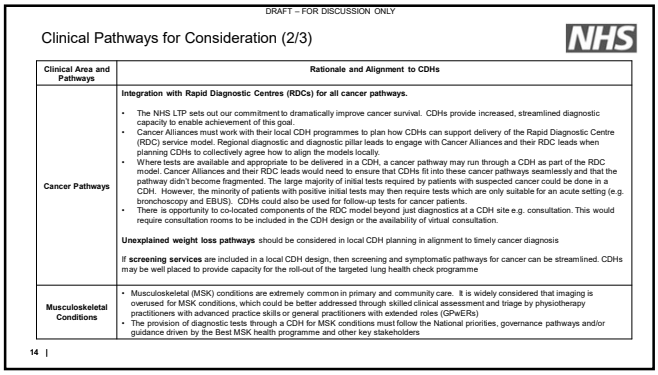

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Clinical Pathways for Consideration (2/3)

Clinical Area and Pathways	Rationale and Alignment to CDHs
Cancer Pathways	**Integration with Rapid Diagnostic Centres (RDCs) for all cancer pathways.** • The NHS LTP sets out our commitment to dramatically improve cancer survival. CDHs provide increased, streamlined diagnostic capacity to enable achievement of this goal. • Cancer Alliances must work with their local CDH programmes to plan how CDHs can support delivery of the Rapid Diagnostic Centre (RDC) service model. Regional diagnostic and diagnostic pillar leads to engage with Cancer Alliances and their RDC leads when planning CDHs to collectively agree how to align the models locally. • Where tests are available and appropriate to be delivered in a CDH, a cancer pathway may run through a CDH as part of the RDC model. Cancer Alliances and their RDC leads would need to ensure that CDHs fit into these cancer pathways seamlessly and that the pathway didn't become fragmented. The large majority of initial tests required by patients with suspected cancer could be done in a CDH. However, the minority of patients with positive initial tests may then require tests which are only suitable for an acute setting (e.g. bronchoscopy and EBUS). CDHs could also be used for follow-up tests for cancer patients. • There is opportunity to co-located components of the RDC model beyond just diagnostics at a CDH site e.g. consultation. This would require consultation rooms to be included in the CDH design or the availability of virtual consultation. **Unexplained weight loss pathways** should be considered in local CDH planning in alignment to timely cancer diagnosis If **screening services** are included in a local CDH design, then screening and symptomatic pathways for cancer can be streamlined. CDHs may be well placed to provide capacity for the roll-out of the targeted lung health check programme
Musculoskeletal Conditions	• Musculoskeletal (MSK) conditions are extremely common in primary and community care. It is widely considered that imaging is overused for MSK conditions, which could be better addressed through skilled clinical assessment and triage by physiotherapy practitioners with advanced practice skills or general practitioners with extended roles (GPwERs) • The provision of diagnostic tests through a CDH for MSK conditions must follow the National priorities, governance pathways and/or guidance driven by the Best MSK health programme and other key stakeholders

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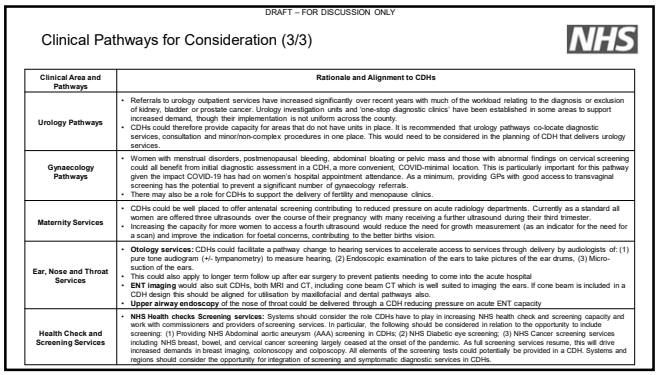

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Clinical Pathways for Consideration (3/3)

Clinical Area and Pathways	Rationale and Alignment to CDHs
Urology Pathways	• Referrals to urology outpatient services have increased significantly over recent years with much of the workload relating to the diagnosis or exclusion of kidney, bladder or prostate cancer. Urology investigation units and 'one-stop diagnostic clinics' have been established in some areas to support increased demand, though their implementation is not uniform across the county. • CDHs could therefore provide capacity for areas that do not have units in place. It is recommended that urology pathways co-locate diagnostic services, consultation and minor/non-complex procedures in one place. This would need to be considered in the planning of CDH that delivers urology services.
Gynaecology Pathways	• Women with menstrual disorders, postmenopausal bleeding, abdominal bloating or pelvic mass and those with abnormal findings on cervical screening could all benefit from initial diagnostic assessment in a CDH, a more convenient, COVID-minimal location. This is particularly important for this pathway given the impact COVID-19 has had on women's hospital appointment attendance. As a minimum, providing GPs with good access to transvaginal screening has the potential to prevent a significant number of gynaecology referrals. • There may also be a role for CDHs to support the delivery of fertility and menopause clinics.
Maternity Services	• CDHs could be well placed to offer antenatal screening contributing to reduced pressure on acute radiology departments. Currently as a standard all women are offered three ultrasounds over the course of their pregnancy with many receiving a further ultrasound during their third trimester. • Increasing the capacity for more women to access a fourth ultrasound would reduce the need for growth measurement (as an indicator for the need for a scan) and improve the indication for foetal concerns, contributing to the better births vision.
Ear, Nose and Throat Services	• **Otology services:** CDHs could facilitate a pathway change to hearing services to accelerate access to services through delivery by audiologists of: (1) pure tone audiogram (+/- tympanometry) to measure hearing, (2) Endoscopic examination of the ears to take pictures of the ear drums, (3) Micro-suction of the ears. • This could also apply to longer term follow up after ear surgery to prevent patients needing to come into the acute hospital • **ENT imaging** would also suit CDHs, both MRI and CT, including cone beam CT which is well suited to imaging the ears. If cone beam is included in a CDH design this should be aligned for utilisation by maxillofacial and dental pathways also. • **Upper airway endoscopy** of the nose of throat could be delivered through a CDH reducing pressure on acute ENT capacity
Health Check and Screening Services	• **NHS Health checks Screening services:** Systems should consider the role CDHs have to play in increasing NHS health check and screening capacity and work with commissioners and providers of screening services. In particular, the following should be considered in relation to the opportunity to include screening: (1) Providing NHS Abdominal aortic aneurysm (AAA) screening in CDHs; (2) NHS Diabetic eye screening; (3) NHS Cancer screening services including NHS breast, bowel, and cervical cancer screening largely ceased at the onset of the pandemic. As full screening services resume, this will drive increased demands in breast imaging, colonoscopy and colposcopy. All elements of the screening tests could potentially be provided in a CDH. Systems and regions should consider the opportunity for integration of screening and symptomatic diagnostic services in CDHs.

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