

THE USE OF ELECTRONIC STAFF DOSIMETERS IN DRIVING PRACTICE IMPROVEMENT:

PHILIPS CARDIAC IGT STUDY DAY – 30TH SEPTEMBER 2019

Andy Rogers, Lead Interventional MPE
Sian Vaughan, Bio-informatics Trainee

Medical Physics and Clinical Engineering,
Nottingham University Hospitals NHS Trust



MUST DECLARE THAT PHILIPS INITIALLY FUNDED THE KIT
BUT NOW PART OF NUH MMS



Outline of my talk

- Why electronic?
- Introduction to our specific technology
- How we currently use the data
- Current promising avenues of further research



Why electronic dosimeters?

- Don't require changing every month
- Real time
- Open up additional 'big brother' possibilities! (the big win!)



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Introduction to the specific technology

- Utilising the RaySafe i2/i3 dosimeter
- Integrated into Philips Allura/Azurion – time issue
- Philips DoseAware Xtend – enables wifi hubs to capture dose data over network
- Integrated with Philips DoseWise
- Get Staff + Patient RDSR
- Event-level data
- **Reference dosimeter**



Current data utilisation



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Trainee feedback project

- Downloaded DoseWise dose/event data
- Merged with CIS data
 - Procedural stuff [stents/contrast volume]
 - Operator status [first/second]
- Produced HTML report
- Emailed to 2/4 trainees
- Meeting between 2/4 trainees, consultant & me for discussion
- Provide 'gold standard' report for comparison



The Report



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Part 1 – Summary ‘activity’ data

Metrics

Metric Table (For Nov 2018)

Metrics for all Procedures Performed in this Month

	Procedure Type	
	Cardiac Angio Coronary Stenting (K499A);	Cardiac Angio Coronaries Only (K633B);
Total Number of Matched Procedures between CVIS and DoseWise	17	5
Total Number of Procedures the Operator wore their Badge	17	4
Median Operator Dose per Procedure (mSv)	0.00558	0.00632
Median Contrast Volume Used per Procedure (ml)	110	70
Median Patient DAP per Procedure (Gycm ²)	21.2	12.9
Mean Number of Acquisition Runs per Procedure	26.7	9.6
Mean Number of Frames per Acquisition Run	57.6	78.7
Percentage of Events where the Operator Dose is Above 10% of the Reference Dose	1.29	3.33
Median Screening Time per Procedure (s)	341	174

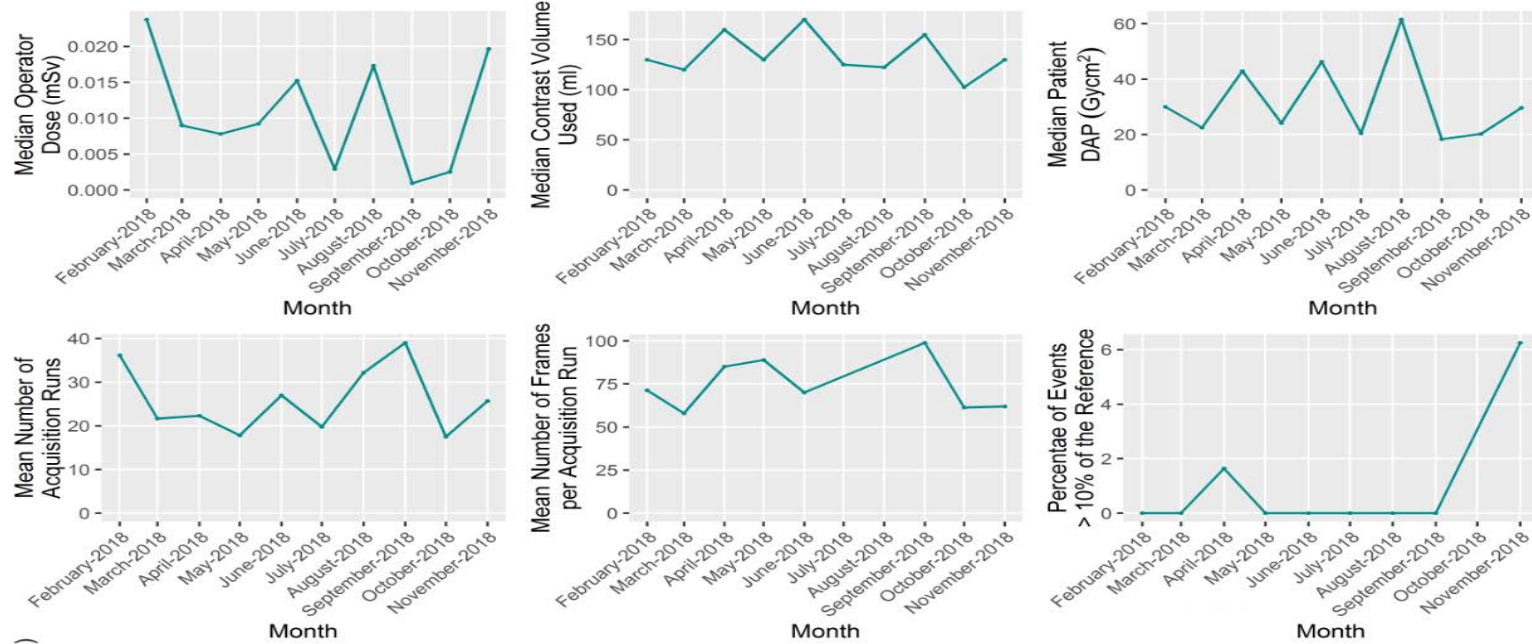
Number of Stents Used in PCI Procedures

Number of Stents	1	2	3
Times Used	10	3	4

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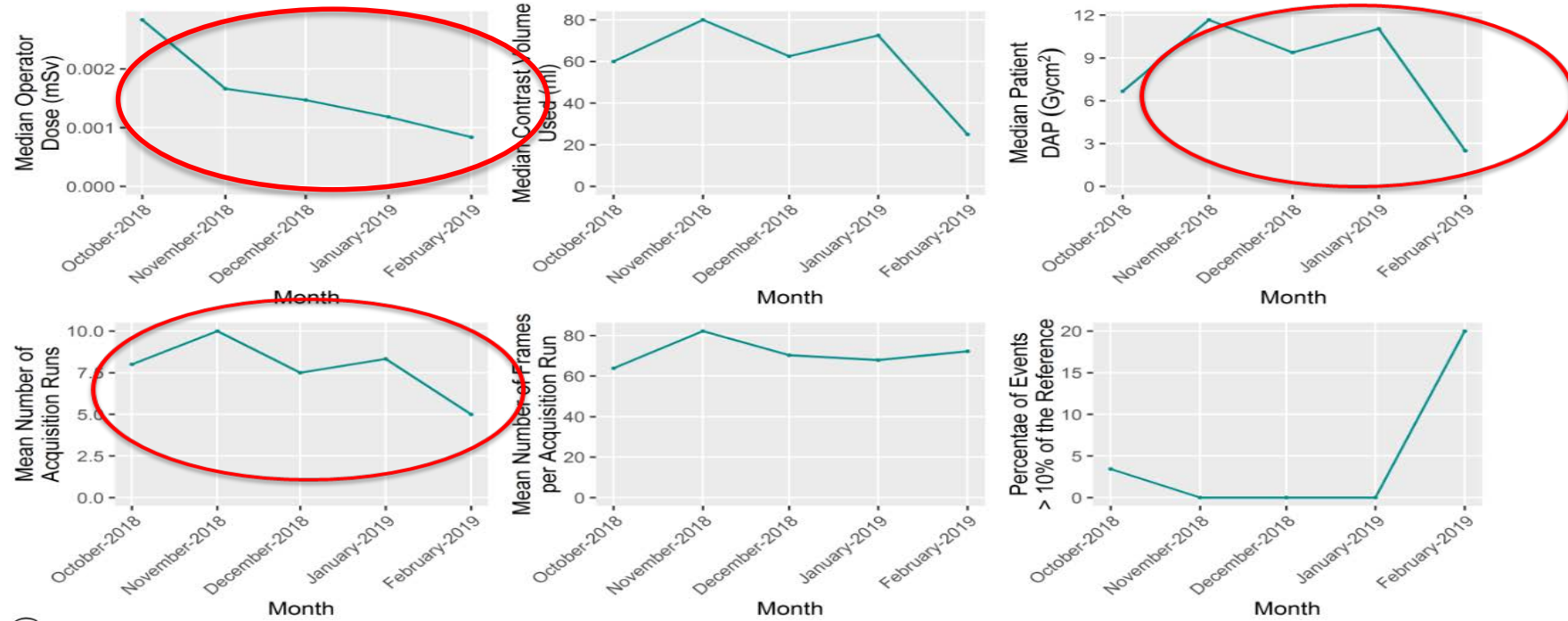
Part 2 – Trend data [Gold]

Metric Graphs (Up to the end of Nov 2018)



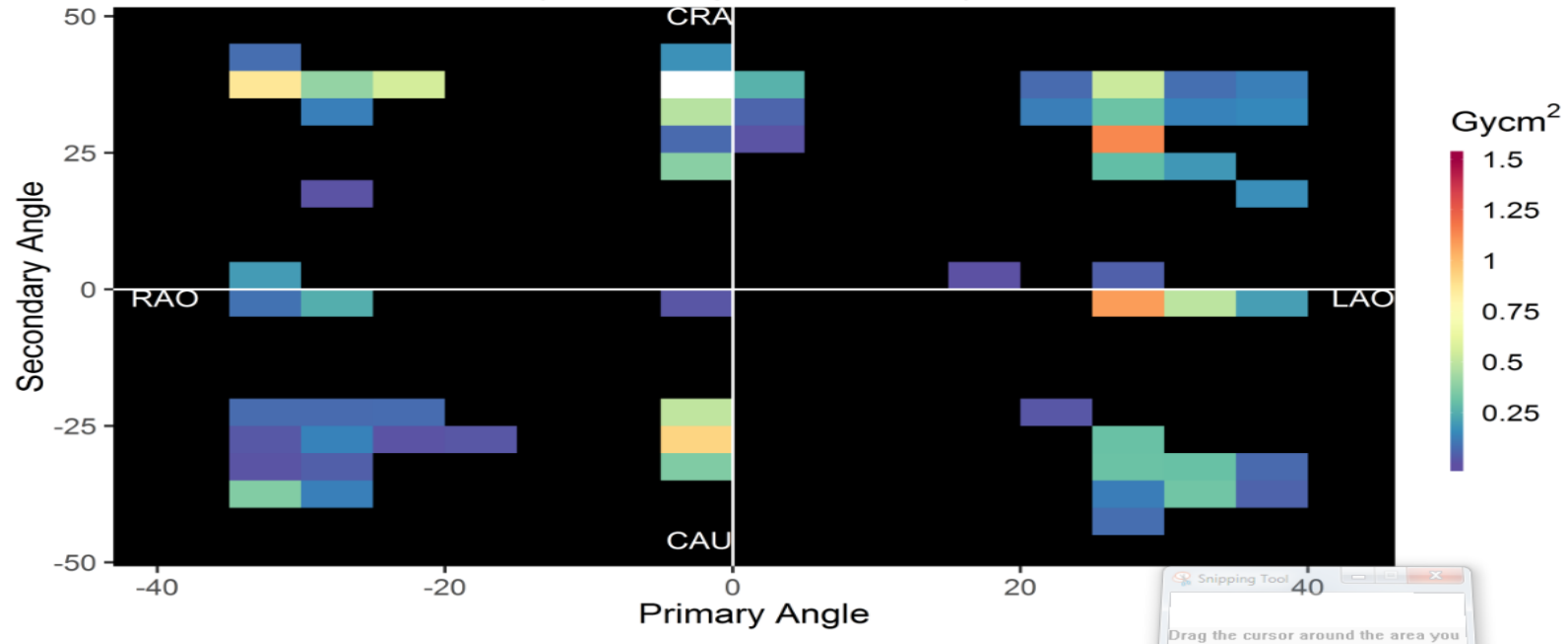
Part 2 – Trend data [Trainee]

Metric Graphs (Up to the end of Feb 2019)



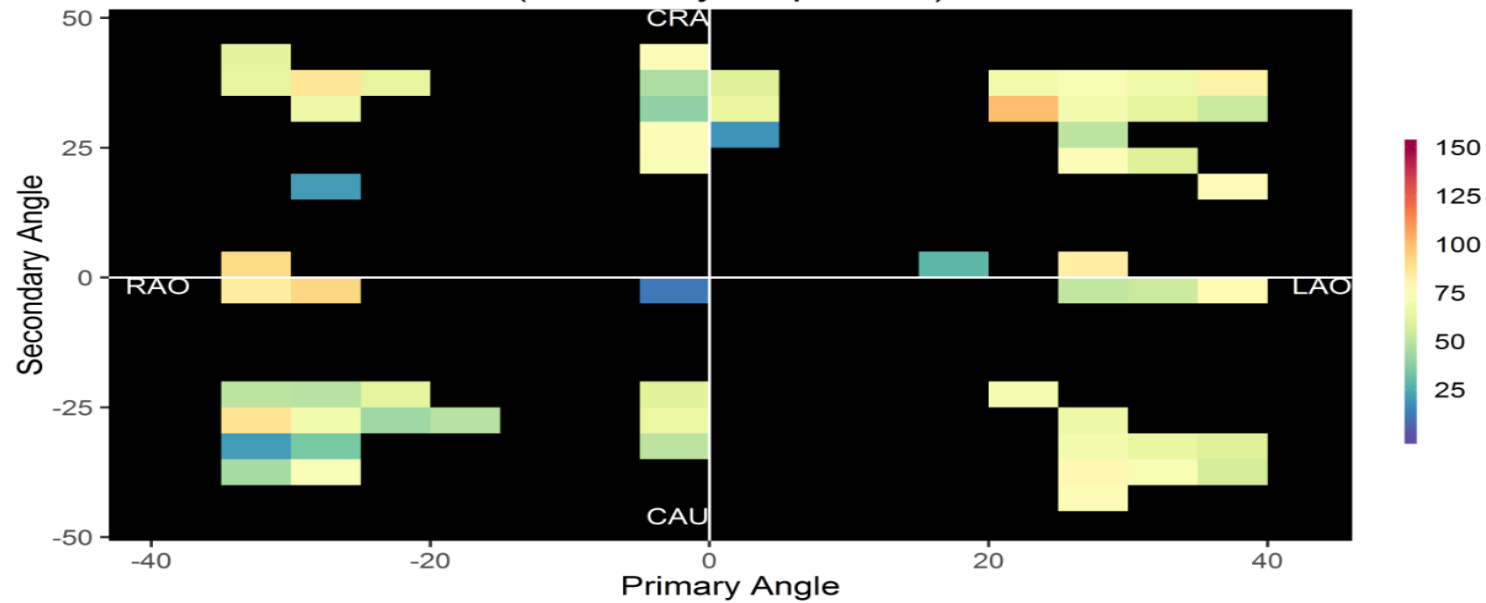
Part 3 – ‘Heat’ Maps

Heat Map of Average Patient DAP at each Angle per Procedure (Stationary Acquisition)



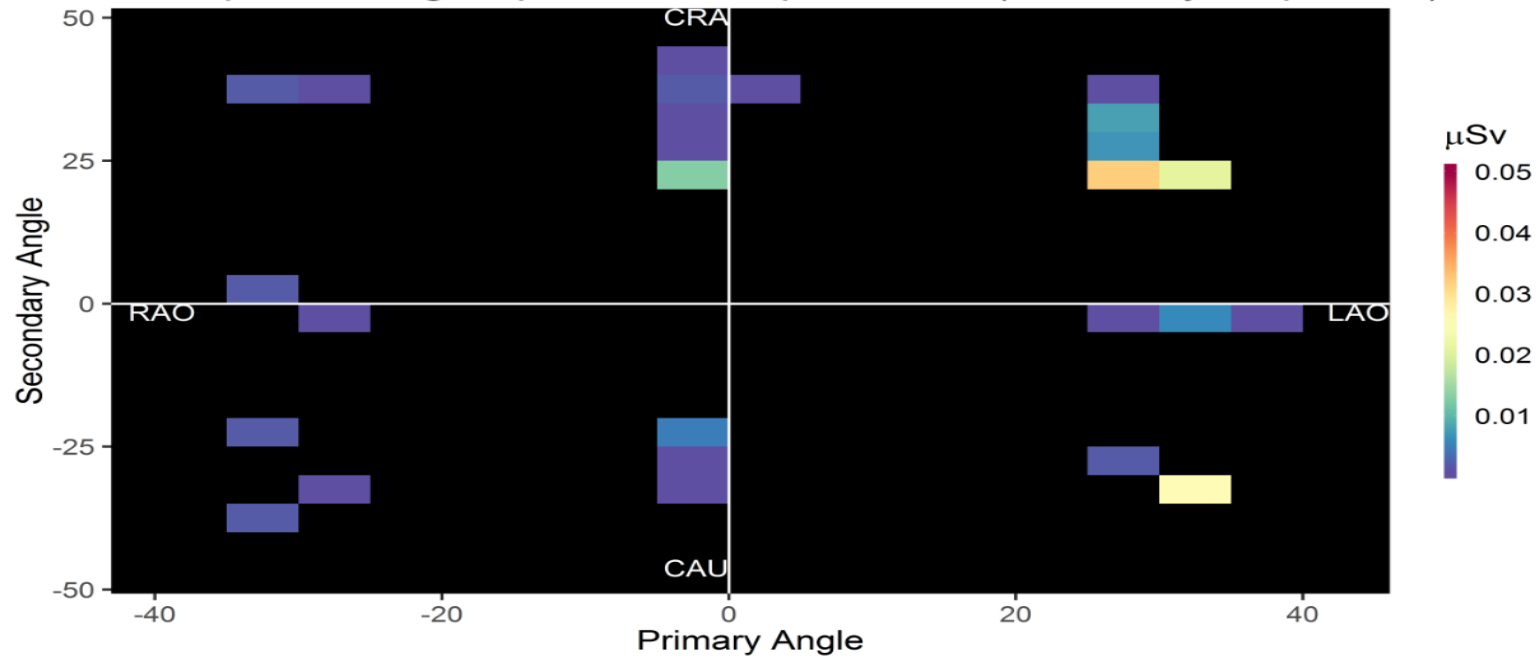
Part 3 – ‘Heat’ Maps

Heat Map of the Average Number of Frames per Run Performed at each Angle (Stationary Acquisition)



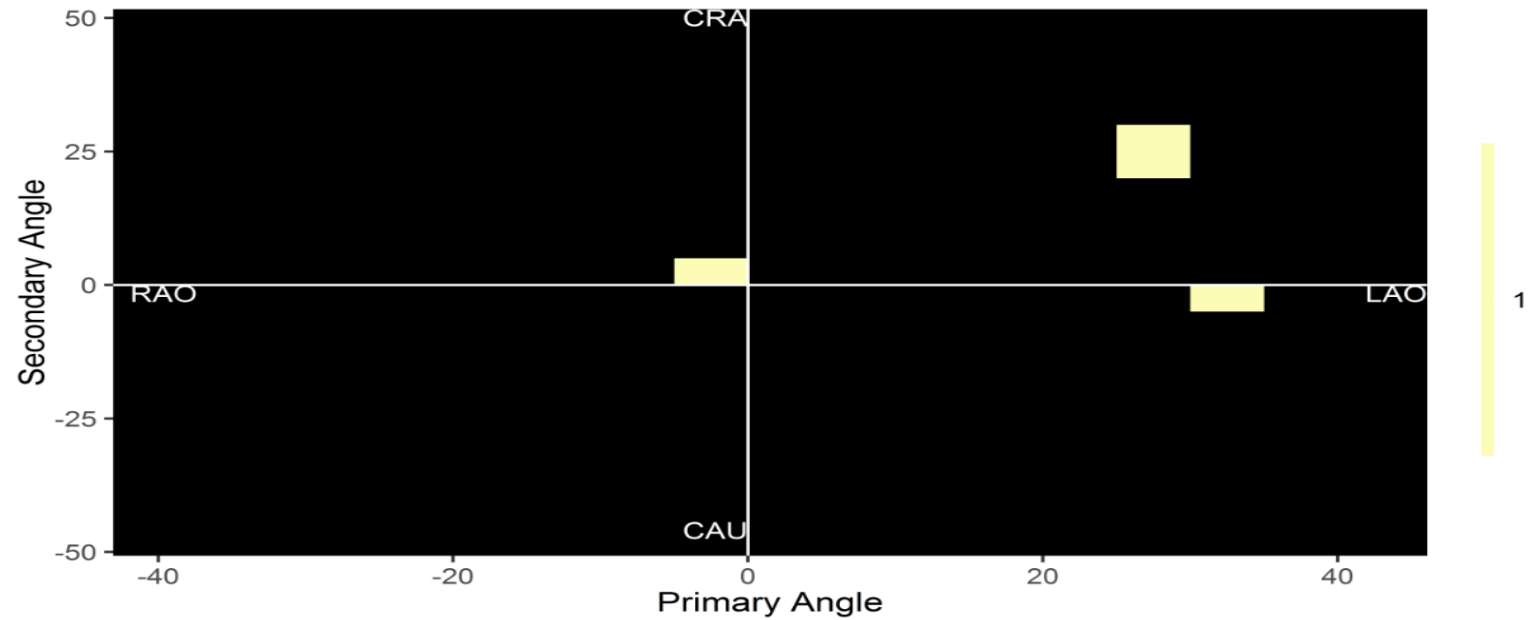
Part 3 – ‘Heat’ Maps

Heat Map of Average Operator Dose per Frame (Stationary Acquisition)



Part 3 – ‘Heat’ Maps

Heat Map of the Number of Events where the Operator Receives More Than 10% of the Reference Dose



Early trainee feedback

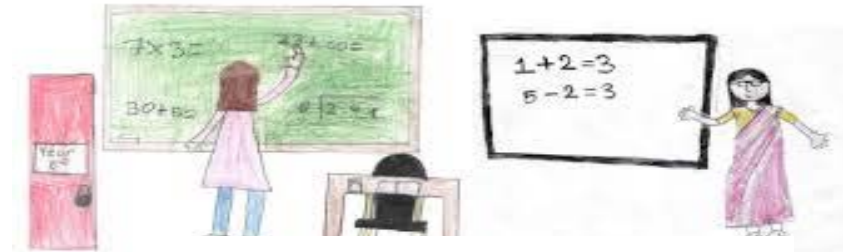
- Trainees very interested in heat maps
- Especially the angulations
 - Saw their practice visually
 - Engaged with consultant as to how to modify technique
 - We now see improvements [although numbers small]!
- Additionally, moving to quarterly data collection as numbers too small
- Considering rolling out to all staff



"A touch less rigour on the feedback next time, Stephen."

Passive v. Electronic

- Generally, staff feedback of their doses has raised interest/awareness
- Software auto reports not good enough
- Need time to input to implement/interpret – more input from Medical Physics Expert
- Could we correlate passive/active? This was initial project objective



Margin-based MPE

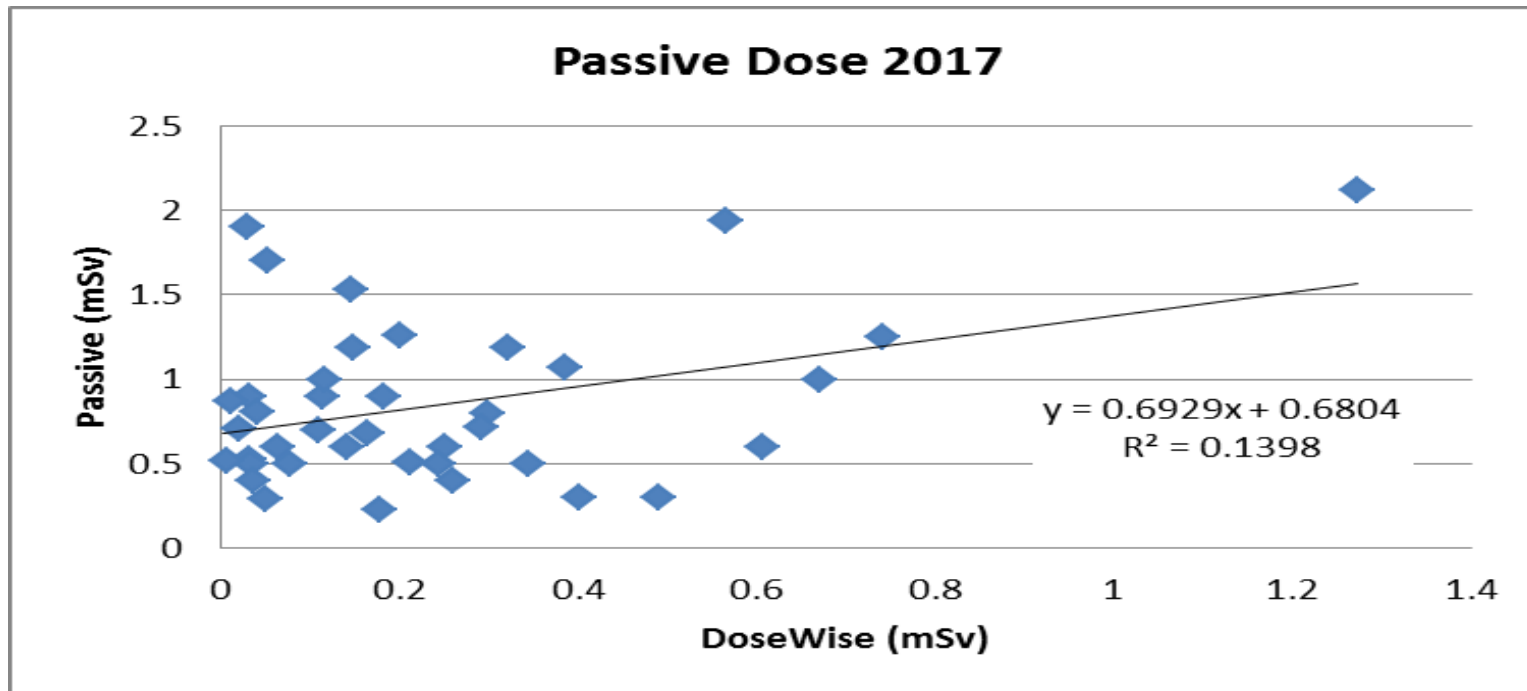
$$f_{\lambda, \sigma}^{MPE} = \sum_r \frac{\sum_{S_r} \epsilon_{r, \sigma} P(S_r)^{\sigma} p_{\lambda}(X_r | S_r)^{\sigma} e^{p_{\lambda, \sigma}}}{\sum_{S_r} P(S_r)^{\sigma} p_{\lambda}(X_r | S_r)^{\sigma} e^{p_{\lambda, \sigma}}}$$

Rewrite the cost function in terms of pair-wise comparisons

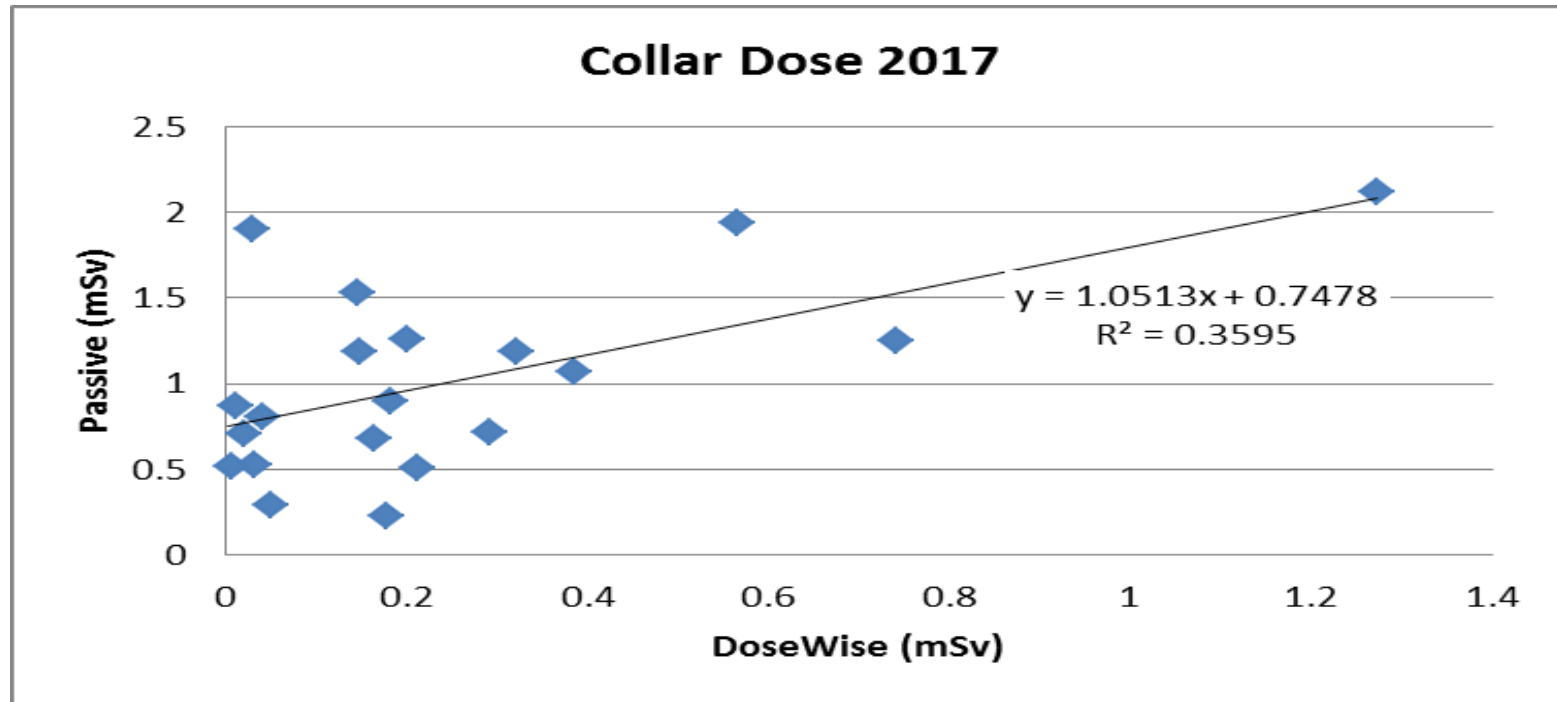
$$m_{k, \lambda}(X_r, \Lambda) = \log(P(S_k | p_{\lambda}(X_r, \Lambda))) - \log(P(S_r | p_{\lambda}(X_r, \Lambda)))$$

Then the modified MPE loss can be expressed as

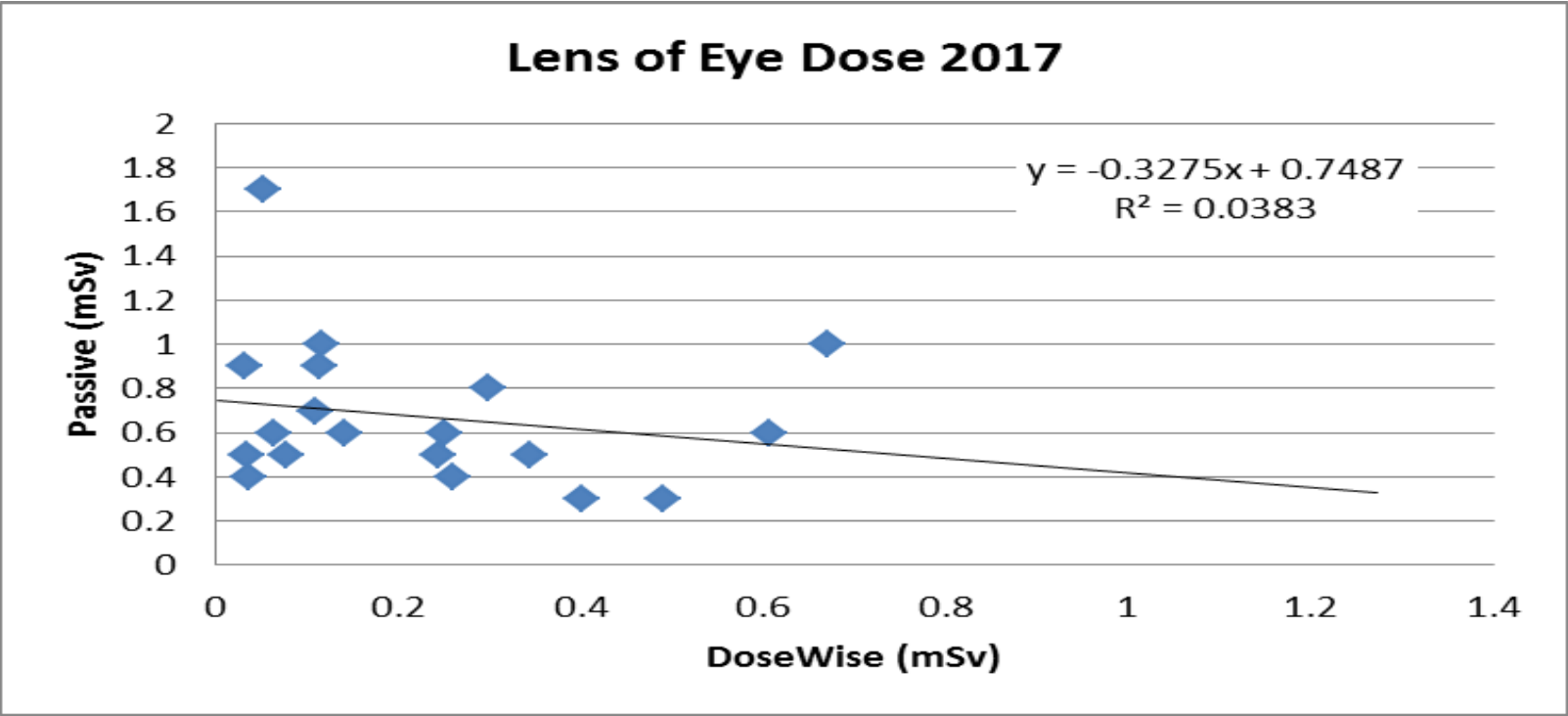
$$f_{\lambda, \sigma}^{MPE} = \sum_r \sum_{\Lambda} \frac{\epsilon_{r, \sigma}}{1 + \sum_{k \neq r} e^{p(m_{k, \lambda}(X_r, \Lambda) + \sigma \epsilon_{r, \sigma}^*)}}$$



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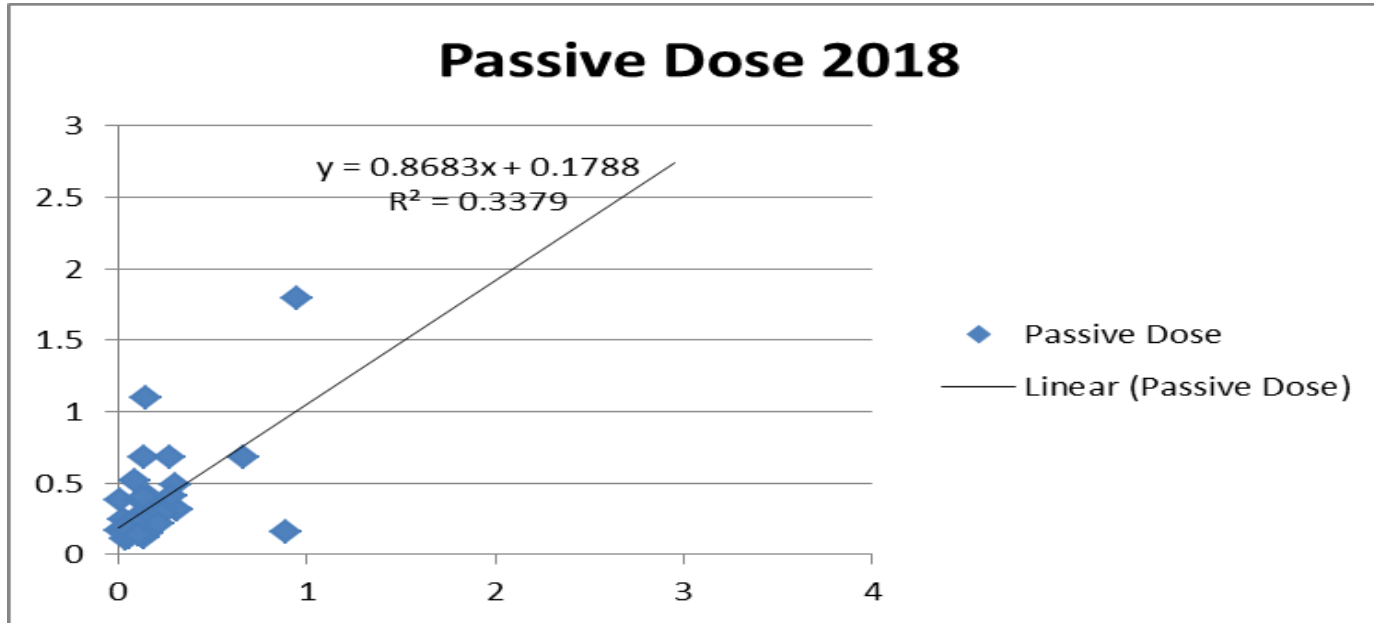
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... and then eye dose limit
reduction led to ...

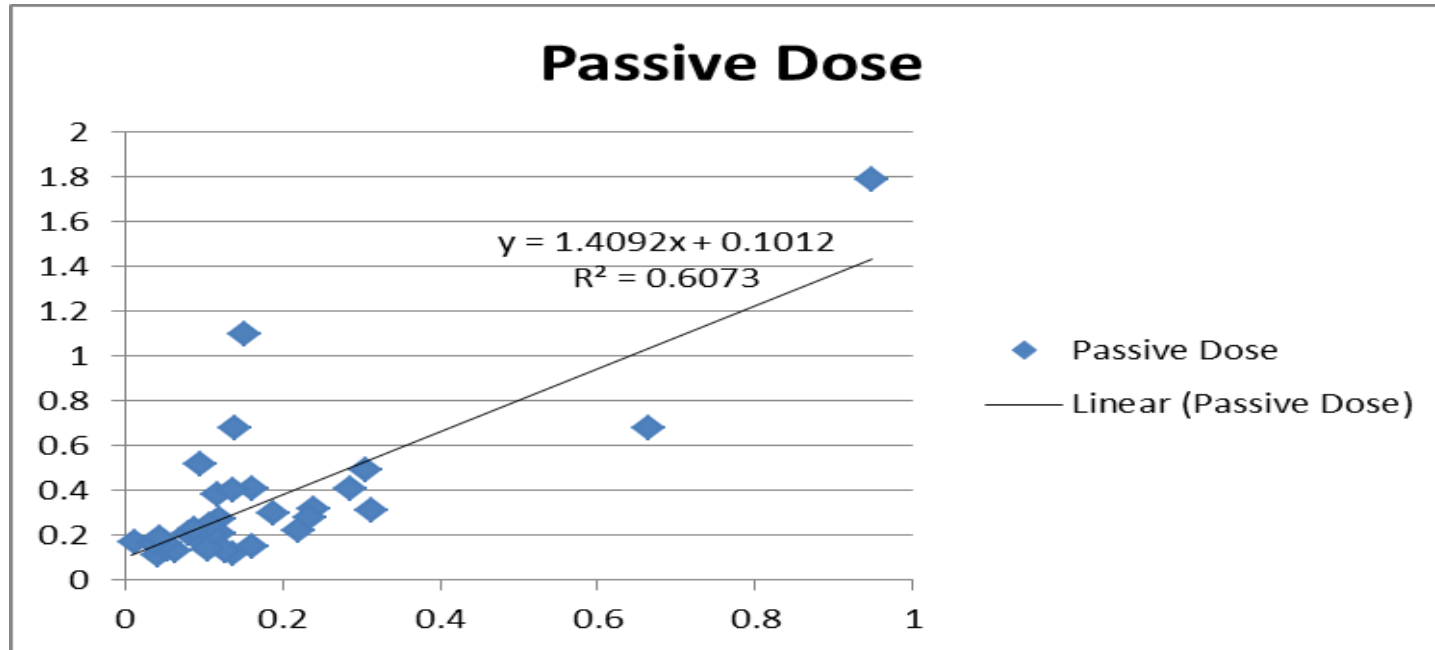
~~TOP SECRET~~
CLASSIFIED
~~TOP SECRET~~

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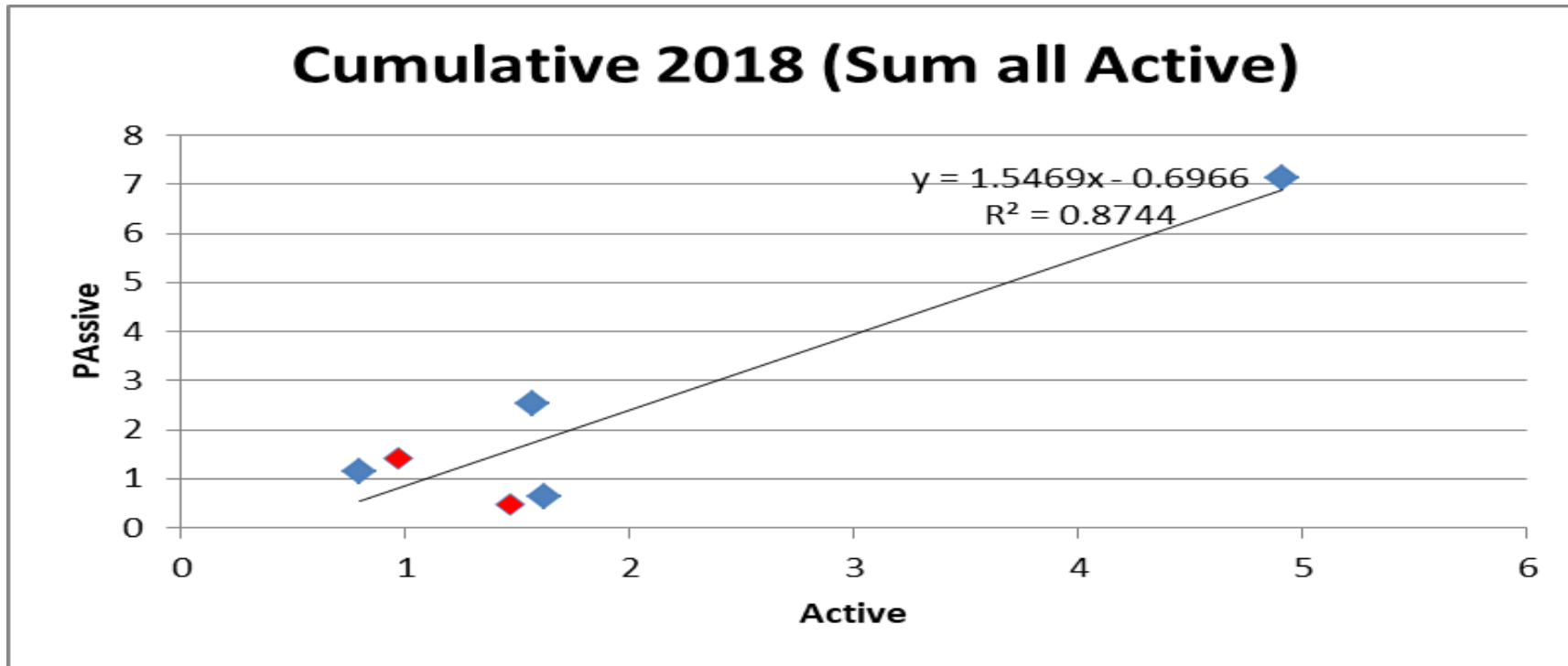


All Classified dosimeters – not that good!

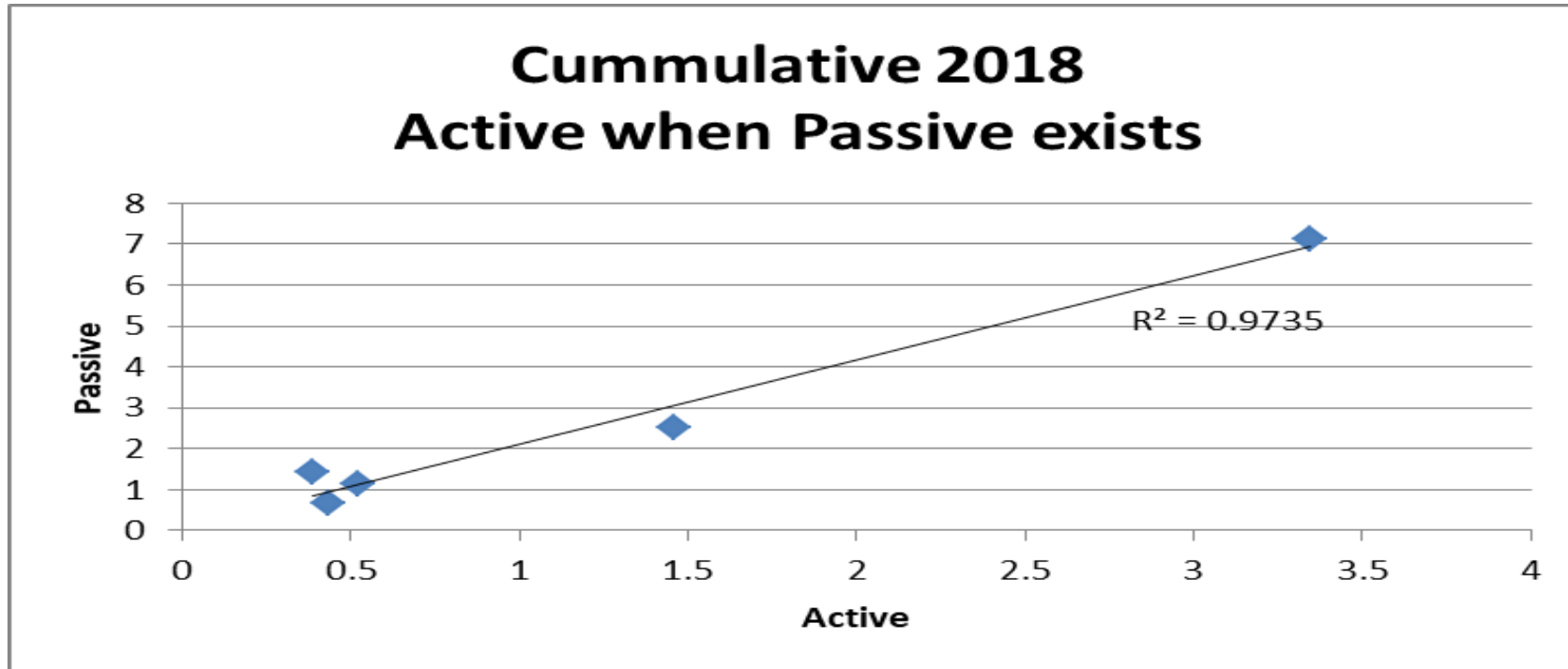
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Exclude device staff – just include LHS table work – much better!



Cumulative dose : Red = device staff



Plus dodgy individual excluded from data!

Initial conclusions

- Looks robust enough to dispense with passive monitoring for PCI work
- Need to further analyse RHS table data
- Moving to thyroid shields with dosimeter pouch



What next?



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Further Work

- Extend reports to all cardiologists
- Write up paper for dosimeter correlation
- Eliminate passive dosimeters [apart from finger monitoring] (assuming further data analysis OK!)
- Develop radiation dashboards for lead radiographer & Cardiology Radiation Management Group
- ?hopefully extend to interventional radiology
- ?possibilities for collaboration/joint projects

Thank you!

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