

Fluoroscopy Dose Management: Trials, Tribulations, & Successes

Experiences with Homegrown, Non-commercial Solutions

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Homebrewed Solutions

Fluoroscopy Dose Tracking

- Implementing a dose tracking system can be very expensive
 - Time DIY
 - Money Commercial Product
- Costs can depend on the size and complexity of the healthcare system
- Skillset can be beyond that of a typical physicist
- Ultimately can build the best solution for your individual needs





Homebrewed Solutions

Fluoroscopy Dose Tracking

I've spent the last 10+ years of my career working on fluoroscopy dose tracking systems and polices, but never with a commercial product.

These systems have ranged from very basic





Homebrewed Solutions

Fluoroscopy Dose Tracking

I've spent the last 10+ years of my career working on fluoroscopy dose tracking systems and polices, but never with a commercial product.

These systems have ranged from very basic

to much more advanced



Chapter 1: In the beginning...





Shands Hospital at University of Florida

Fluoroscopy Dose Tracking

NCRP REPORT No. 168

NCRP

Initially started at Shands Hospital at the University of Florida as a graduate student then resident from 2009 through the end of 2012

- Joint Commission Sentinel Event added ~ 2005
 - "Peak Skin Dose" summed over 6 12 months
 - PSD not reported by equipment
 - Onboard dose meters & RDSRs not widespread
- NCRP Report No. 168 published in 2010



RADIATION DOSE MANAGEMENT FOR FLUOROSCOPICALLY-GUIDED INTERVENTIONAL MEDICAL PROCEDURES



Shands Hospital at University of Florida

Fluoroscopy Dose Tracking

- Relatively small operation all at one physical location
 - Interventional Radiology only, initially 4 suites, expanded to 6
 - Several suites initially had no onboard dose monitors
- Simple Excel based system relied on technologists manually recording K_{a,r}, fluoro time, # of runs, and table height & physicists tracking over time
- Policy set patient levels based on cumulative air kerma:
 - Level 1: > 3 Gy
 - Level 2: > 6 Gy
 - Level 3: > 9 Gy
- Physicists would estimate PSD for every case/patient above Level 2
 - Manually calculated cumulative dose
 - Labor intensive, but had grad students and later residents to handle day to day





Spreadsheets!

Dose Meter Calculations

Meter Based Calculation									
-									
Room	16								
* Input '1' for AR1, '2' for AR2									
Meter input			Adjusted Doses						
Total Air Kerma	3,086	mGy	Frontal Dose (Gy)	1.700		Total Dose (Gy)			
frontal	3,086	100.0%	Lateral Dose (Gy)	0.000		1.70			
lateral	0	0.0%							
			Frontal Tube Distance Correction	AR1	AR2	Room 11	Room 12	Room 13	Room 16
Corrections			Exam Table Height	-9	0	6	90	89	98
(μen/ρ) soft tissue/air	1.06		Meter calibration table height	92	88	88	93	85	90
Back scatter factor	1.30		Isocenter to focal spot	60.75	60.75	64	60	55	55
table pad atten correction (13 & 16)	0.65		Reference pt to focal spot	45.75	45.75	49	45	40	40
table pad atten correction (12)	0.80		compressed pad thickness	3	3	3	3	3	3
table+pad atten correction (11)	0.89								
lateral atten correction (11&12)	0.97		dist correction	1.32	0.88	0.71	1.00	0.72	0.62
			Lateral Dist Correction (Rm 11)	(cm)					
			Distance to Ref Pt	66.00					
			Distance to skin surface	73.70					
			dist correction	0.80					



Spreadsheets!

Running List of Patient PSD's

Status	MR #	Name	Exams	Estimated Peak Dose (Gy)
up to date	123456	Ringo	8/21/2012, 8/23, 11/15, 12/13	11.3 Gy
up to date	123456	George	11/15	4 Gy
up to date	132456	John	11/17	5.5 Gy
up to date	123456	Paul	11/19	2 Gy
up to date	123456	Ringo	11/19	3.8 Gy
up to date	125256	George	11/21	3.5 Gy
up to date	125256	John	11/26/2012, 12/11	4.7 Gy
up to date	125256	Paul	11/6/2012, 11/27	2.8 Gy
up to date	125256	Ringo	11/25/2012, 11/27	7.2 Gy
up to date	125256	George	11/28/2012, 12/4, 12/5, 12/7, 12/8, 12/9, 12/10,	11.1 Gy
up to date	125256	John	12/2	2.4 Gy
up to date	125256	Paul	10/26/2012, 12/1	2.6 Gy
up to date	125256	Ringo	11/30/2012, 12/3, 12/4, 12/5	6.6 Gy
up to date	125256	George	12/4	11.6 Gy
up to date	125256	John	12/6	3.1 Gy
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🛿 Calendars	Interventional R	autology baily sched		- (2)	mui suay, Mi	
ORMIS / ORS	Schedule Date: 3/ 2011	Submit Date	UMsceral USpine UNeuro 🖲 All UNursing L	FB		Pri
Anniananata	<< Prev T	Next >>				Portal Lo
Assignments		***	VISCERAL NEURO AND SDINE C	ISES		
Schedule			VISCEIVAL, NEONO AND SPINE CA			
Pre-Evals	North Tower To	tal Cases: 21 Cancelled/I	No Show Cases: 1 Active Cases: 20			
Patient Search						
Procedure Search						
Case Documents						
	13:30 IR16 CS		TIPS REVISION/VARICEAL EMBOLIZATION		CR INR PLTS	TB ALB MEI
FinRep / Billing	CONS AO Done	55WM 1436a 1436a			3/17/11 3/17/11	
Board-Full	Cace#: 410375				3.2 61	
Board-Mini	Info Reports		Dx: Cirrhosis/Ugi Bleed	Refering: Lawson		Surgeon
	into Reports	(000. (1000)	Allergies:	10		10
• Calculators / Meds	Documents (4)	H&P:ma	Scheduled on: 3/17/2011 11:36:09 AM By: LW		Modified last on: 3/17/2011	11:43:33 AM By: WIL
+ Network		LEVEL 3	> bcornett::3/17 12:28 TIPS stenosis post revision 3/11 and 3/13 with r	ecurrent GI bleed. Receiving Sunits FFP for INR.		
	07:00 IB12 *ANE	(F:110 R:18 G:73.6)				
± Teaching Files	Done MAC	0 0044	CEREBRAL EMBOLIZATION		CR INR FLID	ID ALD MEL
• Forms	Case#: 408938	0800F poa 8244				
+ Specials Log	Info Reports		Dx: Cerebral Aneurysm	Refering:		Surgeon:
E opecials Log	Documents (3)	(22000000000000)	Allergies:		MITCHE ADDA	
+ Misc		1140	Scheduled on: 3/9/2011 2:12:26 PM By: LW Scheduleds Notes: INTERVENTIONAL		Modified last on: 3/9/2011	. 2:17:03 PM By: WIL
2 Herbe	15:00 IB13 CS	H&P: UNKNOWN	Scheduler's Notes, INTER VENTIONAL		CR INR PLTS	
	Cancelled	42W/F holding op	REMOVAL OF PORTA		293	
	Lase#: 396916	2	Dx: Lymphoma	Refering:		Surgeon
		0001 1001	Allergies:			000000000
	Documents (4)		Scheduled on: 12/28/2010 4:13:10 PM By: LW		Modified last on: 3/11/2011	i 4:07:43 PM By: WIL
		H&P: *NEEDED*	> pegro::3/16 16:30 L/M TO CONFIRM APPT @4:30PW/LJM!!! 247 12:32 and an and a second approximately and a second approximately			
	12:00 HLD01 CS	8 <u></u>	> pegro::3/17 13:20 pt to call back to rescriedule procedure when needs	2011.1Jm		
	AO Done	54\004 bolding on	EVAL PORT		en interes	
	Case#: 410391	S40000 Holding op				
	Info Reports		Dx: Infection Head/Neck Cancer	Refering:		Surgeon
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	08:00 IR16 *ANE	S* monoment	G/J TUBE PLACEMENT		CR INR PLTS	TB ALB ME
	CONS Roll Over GEN	2\WF 4549b 4549			3/14/11 3/16/11 3/14/11	
	C#- 410400				0.24 0.9 379	
	Case#: 410120		Dx: Gastroparesis/Emesis	Refering: Meeban		Surreon
		(C.C.C.C.C.C.C.C.C.C.C.C.C.C.C.C.C.C.C.	Alergies:	Hereing, meerlen		ourgeon
	Documents (5)	H&P: unknown	Scheduled on: 3/16/2011 10:47:43 AM By: LW		Modified last on: 3/16/2011	10:50:18 AM By: WIL
			> murphw::3/17 02:18 NPO / Full code / Non-Amb / Isol none / PIV / D	rips none .		
			> robertjkellyjr::3/17 10:29 PT TO RM16,NOT ABLE TO SEE COLON.TO	D GET BARIUM/KUB,RETURN FRI 3/18.MG.		and the second second
	10:00 IR16 CS		BLAND EMBOLIZATION		CR INR PLTS	IB ALB MEL
	Done	75WF holding 7446			0.7 1.0 215	0.2 4.2
	Case#: 405382					
	Info Reports		Dx: Carcinoid	Refering:		Surgeon
Shands Paging Shands	Documents (3)		Alergies: sulfa - Hives;	·0·		
AND THE REPORT OF THE REPORT O		H / P: upknown	scheduled on: 2/17/2011 12:24:25 PM BV: LW		modified last on: 3/16/2011	12:10:43 PM BV: WIL

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Shands Hospital at University of Florida

Fluoroscopy Dose Tracking – Summary

Pros

- Relatively lo fi, but functional and manageable
- Room specific corrections along with table height = ability to calculate PSD
- Notifications on daily schedule

Cons

- Labor intensive, manual processes
- Not easily scalable
- IR only

Chapter 2: The pond gets much larger...



Cleveland Clinic Scope

Much larger healthcare system

- ~ 90 IR/Cath Labs
- ~ 200 R/F, Mobile C-arms, etc.

Spread across ~ 35 locations in multiple states



Notalije Dee.com



Cleveland Clinic Scope

Much larger healthcare system

- ~ 90 IR/Cath Labs
- ~ 200 R/F, Mobile C-arms, etc.

Spread across ~ 35 locations in multiple states

LOTS OF DATA

Previously handled via paper logs

- Meets regulatory requirement
- Cumulative doses challenging
- Commercial tracking system not an option



Transition to Electronic Logs

Radiology

Started in Radiology and worked with IT group to build data form within RIS using tech notes

- Patient info already within RIS so no entry required
- Utilized free text and dropdowns
- Eventually transitioned to RDSR entry for capable equipment
- Data sent to database accessible from the web

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- TEST DIAG ONLY TECH NOTE FOR LW-	- 25		-	
Total Air Kerma primary (A) plane (ME): Total Air Kerma A-plane units (ME):	mGy 💌]		
Total Air Kerma lat (B) plane (bi-plane systems only):				
Fluoro Mode of Operation:	Continuous fluoro]		
Total Fluoroscopy Time Minutes (ME):	0			
Total Fluoroscopy Time Seconds (ME):	48	1		
Dose Area Product:				
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Dose Area Product units:	·			
Total Number of Acquisitions and Radiographs (ME):	2			
Clinical Engineering ID# (ME):	123456			
Primary Fluoroscope Operator Last Name (ME):	Fisher			
Primary Fluoroscope Operator First Name (ME):	Ryan			
Secondary Fluoroscope Operator Last Name:	「	1		
Secondary Fluoroscope Operator First Name:			•	
	Save Close Done	,		
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Radiology

• Training staff

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TEST DIAG ONLY TECH NOTE FOR LW-		
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Total Air Kerma A-plane units (ME):	mGy	- E
Total Air Kerma lat (B) plane (bi-plane systems only):		
Fluoro Mode of Operation:	Continuous fluoro	
Total Fluoroscopy Time Minutes (ME):	0	
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Dose Area Product units:		
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Clinical Engineering ID# (ME):	123456	-
Primary Fluoroscope Operator Last Name (ME):	Fisher	-
Primary Fluoroscope Operator First Name (ME):	Ryan	-
Secondary Fluoroscope Operator Last Name:		
Secondary Fluoroscope Operator First Name:		
		-
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Radiology

- Training staff
- Variations in unit reporting
 - Air kerma

 Interactive Document 		
TEST DIAG ONLY TECH NOTE FOR LW		_
Is this a Flouroscopic exam?(ME):	€Yes CNo	ŕ
Is contrast used in this exam?(ME):	CYes TNo	
	25	
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Total Air Kerma A-plane units (ME):	mGy	
Total Air Kerma lat (B) plane (bi-plane systems only):	Gy	
Fluoro Mode of Operation:	mRad	
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Total Fluoroscopy Time Seconds (ME):	48	Н
Dose Area Product:		
Dose Area Product units:		
Total Number of Acquisitions and Radiographs (ME):		
	~	
Clinical Engineering ID# (ME):	122450	
rinnary ridoroscope operator Last Name (MC).	Fisher	
Primary Fluoroscope Operator First Name (ME):	Ryan	
Secondary Fluoroscope Operator Last Name:		
Secondary Fluoroscope Operator First Name:		
		-
	Save Close Clone	0
		20

Radiology

- Training staff
- Variations in unit reporting
 - Air kerma
 - AKAP

Dose Area Product units:		
1	cGycm2	
	Gycm2	<u>^</u>
	mGycm2	
	mGym2	
	mRadcm2	
	Radcm2	
	Rcm2	Done
	uGym2	

Ten orders of magnitude difference between Gy*m² and uGy*cm²!

Radiology

- Training staff
- Variations in unit reporting
 - Air kerma
 - AKAP
 - Time

- 1:48 case could be displayed as:
- 1:48
- 1.8 min
- 108 sec
- 108.5 sec

Interactive Document		
TEST DIAG ONLY TECH NOTE FOR LW		
FLUOROSCOPIC SUMMARY INFORMATION: Total Air Kerma primary (A) plane (ME):	_ 25	
Total Air Kerma A-plane units (ME):	mGy	-
Total Air Kerma lat (B) plane (bi-plane systems only):		
Fluoro Mode of Operation:	Continuous fluoro	-
Total Fluoroscopy Time Minutes (ME):	1.8	
Total Fluoroscopy Time Seconds (ME):	0	
Dose Area Product:		
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Dose Area Product units:		-
Total Number of Acquisitions and Radiographs (ME):	2	
Clinical Engineering ID# (ME):	123456	-
Primary Fluoroscope Operator Last Name (ME):	Fisher	
Primary Fluoroscope Operator First Name (ME):	Ryan	
Secondary Fluoroscope Operator Last Name:		
Secondary Fluoroscope Operator First Name:		J
		-
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Radiology

- Training staff
- Variations in unit reporting
 - Air kerma
 - AKAP
 - Time
- Manual entry
 - Clinical Engineering #
 - Operator Names
 - Dose & Time

📮 Interactive Document			X
TEST DIAG ONLY TECH NOTE FOR LW FLUOROSCOPIC SUMMARY INFORMATION: Total Air Kerma primary (A) plane (ME):	- 25		-
Total Air Kerma A-plane units (ME):	mGy	1	
Total Air Kerma lat (B) plane (bi-plane systems only):			
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Total Fluoroscopy Time Minutes (ME):	1.8		
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Dose Area Product:			
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Clinical Engineering ID# (ME):	123456		
Primary Fluoroscope Operator Last Name (ME):	Fisher		
Primary Fluoroscope Operator First Name (ME):	Ryan		
Secondary Fluoroscope Operator Last Name:			
Secondary Fluoroscope Operator First Name:			•
	Save Close Done		10
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Eluoro Log : Web Form

-

TUOIO LOU : WED FORM		Q -		
Date & Location			eractive Document	
Procedure Date	8/12/2020		DIAG ONLY TECH NOTE FOR LW	
Fluoro Equipment CE#	if don't know, select facility and equipment below		REPORT AND A REPORT	25
Facility	select facility -		Air Kerma primary (A) plane (ME):	
Equipment	select fluoro unit 👻		Air Kerma A-plane units (ME):	mGy
			ir Kerma lat (B) plane (bi-plane systems only):	
Patient & Procedure			Mode of Operation:	Costinueus fluoro
	1 Tune MPN L	2 Click Auto fill by MON 🕹	Elucroscopy Time Minutes (ME):	
	i. Type wirdin 🗢	2. Click Auto-lill by WRIT	riuoroscopy i lille minutes (ME).	1.8
MRN		Q Auto-fill Patient Info by MRN	Fluoroscopy Time Seconds (ME):	0
Enterprise MPI (E#)	starts with E Q Search EPIC		rea Product:	
Patient Name	Last name	First name		
DOB	MM/DD/YYYY Q Find By DOB+Last			
Procedure	auto-completion will help		rea Product units:	•
			Number of Acquisitions and Badiographs (ME):	
Dperator(s)				2
)perator-1				
ast	First	Employee ID	J Engineering ID# (ME)-	
1 Last name	First name	Employee ID		123456
perator-2			y Fluoroscope Operator Last Name (ME):	Fisher
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Last name	First name	Employee ID	laru Elucroscopo Operator Last Marroy	
			aly Fluoroscope operator Last Name.	
luoro Dose		-	lary Fluoroscope Operator First Name:	
Air Kerma (A-Plane)	mGy 🔺]		
Air Kerma (B-Plane)	- ONLY FOR BI-PLANE -]		
АКАР	mGy*cm² ◄]		Save Close Done
🗆 This U	Init DOES NOT REPORT ANY DOSE (neither Air Kerma no	AKAP)		

Cleveland Clinic

Medical Physics

Welcome Ryan Fisher [Logout]

Web-accessed Database

🚹 Home 🛛 🔢 E	NTERPRISE 🛛 😚 Rad Safety 🛛 🛃 Dx Imaging	site 🚽 Feedback									
> Dx Imaging > Fluoro Log: QC											
Fluoro Exam Log - QC By Facility											
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Report type:	Site QC: All Entries with Errors	CE# - All Units At Facility -									
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MC	NDA	Main - Imaging			202533	Siemens Artis Q (BP) A-Plane	NAEEM	SANA	FRUNER	FRANK	114	12.0	11.8	1502.7	REPORTED
MC	MCA	Main - Imaging			202541	Siemens Artis Q	GEISINGER	MICHAEL	WILLIAMS	DONNIE	210	16.1	0.0	3799.9	REPORTED
MC	NDA	Main - Imaging			142172	Siemens Artis Q (BP) A-Plane	тотн	GABOR	FRUNER	FRANK	750	410.2	140.9	5:2715.8	REPORTED
MC	NDA	Main - Imaging			202533	Siemens Artis Q (BP) A-Plane	HARDMAN	JULIAN	FRUNER	FRANK	785	700.8	162.5	8.3602.3	REPORTED
MC	MCA	Main - Imaging			107564612		D'AMICO	JOSEPHINE			68	118.4	0.0	35670.0	REPORTED
MC	NIA	Main - Imaging			142172	Siemens Artis Q (BP) A-Plane	ТОТН	GABOR	FRUNER	FRANK	336	492.5	138.0	51419.2	REPORTED
MC	NDA	Main - Imaging			202531	Siemens Artis Q (BP) A-Plane	GILL	AMANJIT	HAMILTON	AMANDA	1290	45.2	506.4	24004.6	REPORTED
MC	NDA	Main - Imaging			202533	Siemens Artis Q (BP) A-Plane	ELGABALY	MOHAMED H	FRUNER	FRANK	1350	557.5	122.3	68821.4	REPORTED
MC	MCN	Main - Imaging			202535	Siemens Artis Q	PAVLINSKY	KIMBERLY R	MARTIN	CHARLES	402	689.9	0.0	17.3800.0	REPORTED
MC	NDA	Main - Imaging			212531		KELLER	VICKIE			0	16.9	5.6	2754.2	REPORTED
MC	NIA	Main - Imaging			142172	Siemens Artis Q (BP) A-Plane	ELGABALY	MOHAMED	JULIAN	HARDMAN	7350	4511.0	1851.0	14.3245.8	REPORTED
MC	NDA	Main - Imaging			202533	Siemens Artis Q (BP) A-Plane	ТОТН	GABOR	FRUNER	FRANK	618	360.4	167.9	60080.7	REPORTED
MC	NDA	Main - Imaging			202531	Siemens Artis Q (BP) A-Plane	HAYNES	JACQULINE	HAMILTON	AMANDA	67	20.1	170.3	14434.8	REPORTED
MC	MCA	Main - Imaging			202541	Siemens Artis Q	RYMUT	DAVID	SHEHU	STEPH	2184	1036.0	0.0	171890.0	REPORTED
MC	MCA	Main - Imaging			130068	Siemens Artis Zee	HERBAWI	AMANNI	🔲 GURAJALA	RAM	216	26.7	0.0	.3608.4	REPORTED
MC	MCA	Main - Imaging			202541	Siemens Artis Q	MONTGOMERY	JENNIFER		JULIE	558	345.6	0.0	36273.0	REPORTED
MC	MCA	Main - Imaging			202537	Siemens Artis Q	PAVLINSKY	KIMBERLY R	TRITLE	BEN	450	14.3	0.0	1721.1	REPORTED
MC	MCA	Main - Imaging			202537	Siemens Artis Q	PAVLINSKY	KIMBERLY R	TRITLE	BEN	30	2.2	0.0	267.0	REPORTED

Efficient end user data clean up

Thome ENTERPRISE Stad Safety										Equipme	nt		
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osp	Dept	Facility	Exam Date	Accession	CE # 🔺	Equipment	Oper1 Last	Here are	a bunch c	of entries with	similar, but inc	orrect CE	#s.
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/	FVX	Fairview			20283		AHMED	ABRAHAM		6	0.3 0	.0 0.0	REPORTED
/	FVX	Fairview			20283		BRETHAUER	PAMELA		127	32.6 0	.0 0.0	REPORTED
/	FVX	Fairview			20283		JOHNSON	REBECCA		186	29.7 0	.0 0.0	REPORTED
/	FVA	Fairview			20283		AHMED	ABRAHAM		42	5.8 0	.0 0.0	REPORTED
/	FVX	Fairview			20283					54	12.2 0	.0 0.0	REPORTED
/	FVX	Fairview			20283		BRETHAUER	PAMELA	HOGAN KA	AREN 48	22.9 0	.0 0.0	REPORTED
/	FVX	Fairview			202831		KWOK	PAULINE		42	94.6 0	.0 0.0	REPORTED
/	FVX	Fairview			202831		LAMPL	BROOKE		66	2.6 0	.0 0.0	REPORTED
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		Fairview			202831		CHEN	GARY		150	32.9 0	.0 0.0	REPORTED
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Efficient end user data clean up Equipment

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Efficient end user data clean up Operators

Fluore		Log - Q																
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The ability to batch corrections made a HUGE improvement in the efficiency of data clean up.



Longitudinal High Dose Patient Tracking

- System can sum K_{a,r} over 6 month period based on patient MR #
 - Included all fluoroscopy across entire system
 - Built a high dose report view of data
 - Plans to include Rad Onc notification
 - Email notifications for patients over thresholds
 - Not able to split out by body region yet

Longitudinal High Dose Patient Tracking

🔤 🖬 ් ර	↑ ↓ =			Fluoro: High-D	ose Alert - Message (HTMl)	
FILE MESS	AGE ACROBAT						
ि⊊ Ignore X Sunk - Delete	Reply Reply Forward More -	Image: Service Key Req Image: Service Key Req Image: Service Key Req Image: Service Key Reply & Done Image: Service Key Reply & Done Image: Service Key Reply & Dolete Image: Service Key Reply & Done Image: Service Key Reply & Dolete Image: Service Key Reply & Done Image: Service Key Reply & Dolete Image: Service Key Reply & Done Image: Service Key Reply & Dolete Image: Service Key Reply &	Actions *	Mark Categorize Follo Unread • Up	w Translate ↓ Select •	Zoom Re Phi	eport ishing
Delete	Respond	Quick Steps	ra Move	Tags	Editing	Zoom Cybe	ersecurity
Fri 6/1 Med Fluor	12/2020 7:05 AM IPhysics_NOREPLY@ccf.org ro: High-Dose Alert						
То							

You forwarded this message on 6/12/2020 7:37 AM.

Patiend Total Dose Above 10Gy Detected: 1 Date Range: 12/12/2019 - 6/12/2020 With last exam within past 3 days.

MPI	Patient Name	AirKerma Total	Exam Count	Last Exam	Status	Ph.Of Record
		13270.5	5	6/11/2020 11:34:00 AM	Pending Review	

High-Dose Exam Detected: 1

Date	Hosp	Accession	Procedure	MPI	Patient Name	DOB	Fluoro Seconds	AirKerma	KAP	Data Src	Status	Ph.Of Record
6/11/2020 3:51:00 PM	AG		NIL CAROTID CEREBRAL BILATERAL		Ringo		3630	8417.0	0.0	TechNote	Pending Review	Yoko

Longitudinal High Dose Patient Tracking

- System can sum K_{a,r} over 6 month period based on patient MR #
 - Included all fluoroscopy across entire system
 - Plans to include Rad Onc notification
 - Email notifications for patients over thresholds
 - Built a high dose report view of data
 - Not able to split out by body region yet
- Initially had issues as an individual could be issued multiple MR #s depending on how/where they entered our healthcare system
 - MR #s would eventually be merged but process had a time lag which could delay notifications
 - Eventually was able to work out
- Later built out patient case review infrastructure

■ Back To List Fluoro High-Dose Case Review: [652]

Patient		♥ Last Exam	
Name McCartney, Pau	I	Location	Abbey Rd.
DOB 6/18/42		Procedure	
MPI		Acc# / WebForm	
BMI:		Ph.of Record:	

 Q Case Assignment		High Dose Case	
Review Staff	Yoko	Threshold	6m Dose>10Gy
Follow-Up Staff	Not Assigned	AK (mGy)	13270.5
Case Status	Pending Review	Exam Count	5

Case Tracking Dates										
Detected Reviewed FolUp-Required? FolUp-Alert 4wk f	olUp-Date 26wk FolUp-Date									
6/12/2020 Pending										

Dose Reviewed - F/U Not Needed

Intry Duplicate Data Dose Reviewed - F/U Required

			Dept:	~	Has Dose Info Post Proc	. Doc In EPIC	Save		
🗮 Exam(s) Details								
Date	Facility	Area/Dept/Rm	Equipment	Accession	Procedure	Air Kerma (mGy)	KAP	Operator(s)	DataSrc
()	Main - Imaging	IR / MCA Gb-023	Siemens Artis Q (IR Lab 3)		IR CHEMOTHERAPY EMBOLIZATION	2790.0	572830.0	Ringo	TechNote RSLT
	Main - HVI	Cath Labs / J2-828	Siemens Artis Zee (BP) (Cath Lab 4 A- Plane)		Coronary ^A Intervention	2168.7	129334.9	Ringo	RDSR
4)	Main - HVI	Cath Labs / J2-822	Siemens Artis Q (Cath Lab 1)		Coronary^Diagnostic Coronary Catheterization	496.9	19550.5	Ringo	RDSR
)	Main - HVI	Cath Labs / J2-822	Siemens Artis Q (Cath Lab 1)		Coronary ^A Intervention	6066.9	395649.6	Ringo	RDSR
	Main - Imaging	IR / MCA Gb-024	Siemens Artis Q (IR Lab 4)		IR CHEMOTHERAPY EMBOLIZATION	1748.0	304630.0	Ringo	TechMote RSC

Patient Case Review Framework

- Notifications & documentation of follow-up contact or visits
- Can assign cases to staff for review
- Determine whether follow-up required
- Can track follow up
 - Post procedure documentation in EMR
 - Auto generated alerts for follow up
 - Call/visit at 4 & 26 weeks
 - Referrals to other services
- Tying fluoro dose information back into patient care

Areas for Future Growth

- No real analytics, despite huge amount of data
- Have location, operator, procedure & equipment information in addition to fluoro data
 - Create and compare Facility Datasets per, NCRP Report No. 168
 - Equipment & procedure specific thresholds for review
 - Compare sites/equipment/operators for outliers
 - Median and percentile K_{a,r} and time comparisons
 - Derived metrics
 - Divide $K_{a,r}$ by fluoro time to get average rate per user can gauge use of acquisitions

Air Kerma Rate per Case: Operator – Q3





Areas for Future Growth

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 - Derived metrics
 - Divide $K_{a,r}$ by fluoro time to get average rate per user can gauge use of acquisitions
 - Divide AKAP by $K_{a,r}$ to get average field size to show differences in collimation use
- Also had database system for occupational dose, could compare operator's total K_{a,r} over period to dosimetry



Cleveland Clinic

Fluoroscopy Dose Tracking – Summary

Pros

- Highly customized to handle clinical situation
- Multiple streams of data into enterprisewide database
 - Scalable
- Integration with training databases to improve regulatory compliance
- High dose case review framework

Cons

- Took a lot of work & Vadim
- No analytics







The Next Episode



The MetroHealth System

Fluoroscopy Dose Tracking

Current situation looks a lot like my first:

- Much smaller operation:
 - 3 IR suites & 3 Cath labs, 1 OR hybrid room, all in one building
- No commercial dose tracking system
- No Vadim ⊗
- Back to Manual / Excel based process





Fluoroscopy Dose Tracking – Ongoing Issues

- Last mile problem
 - Even with robust system, data is mostly in front of physicists, not physicians
- Lower end fluoroscopy still an issue
 - Joint Commission & some states require
 - Generally no RDSR
 - Often need multiple data entry pathways
 - Overall dose and risk is low
 - Is tracking even useful?

Low	End Fluoro	Data
n	Med AK	75th %
3261	17.8 mGy	87.7 mGy





Homebrewed Solutions – Conclusions

Fluoroscopy Dose Tracking

- Size of the system and resources available will dictate the approach
- There are freeware systems available (OpenREM)
 - Requires some programming chops
- If you have the right resources, a homegrown system can offer substantial advantages as far as customization and clinical integration



Free and Open Source Radiation Exposure Monitoring for the physicist







Radiation exposure incidence map







