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- 1. Be familiar with the workflow of modern treatment planning process.
- 2. Understand the scope and challenges of managing modern treatment planning process.
- 3. Be able to implement some management techniques like Lean Six Sigma system introduced in the symposium.

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- 1. Planning goal
- 2. Influence of upstream and downstream operations
- Reduction of delay between planning steps
 Optimizing planning process itself

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- Clinical Environment like community hospital
 Routine clinical service mainly, min unusual treatment
 - Favor efficiency over quality
 - Work assignment change, like dosimetrist contour OAR

 - Min physics support, commissioning done by 3rd party
 Min IT support, like API scripting, admin right, policy for remote desktop/remote assistant

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Efficient

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- Benchmarked by turn around time
- Real working time and dead time
- High Quality
 - Benchmarked by dose constraint
 - Isodose distribution
- Error Proof
 - Benchmarked by mistakes, incident and near-miss
 - · Find known error easily
 - Known error check list · Incident report system and bi-weekly review
 - System wide reminder/alert on error prone scenario
 - Prone or Feet-first patient → shift direction
 Couch kick → collision

- Simulation
- Start from simulation scheduling
- Planning

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- All steps include physics check and patient specific QA
- Treatment
 - End after first day of treatment

Insurance pre-approval

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- "IMRT may be covered for a diagnosis that is not listed when at least one of the following conditions is present:
 - A non-IMRT technique would substantially increase

the probability of clinically meaningful normal tissue toxicity.

- The same or an immediately adjacent area has been previously irradiated and the dose distribution within the patient must be sculpted to avoid exceeding the cumulative tolerance dose of nearby normal tissue."
- Breast IMRT, esophagus IMRT, etc
- Often need to do both 3D and IMRT to show improvement in order to get pre-approval
- Due to uncertain of the approval status, both plans need to be ready for treatment

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- Simulation
 - ◆ Who schedule the simulation?
 - Front desk is convenient
 - Sim therapist is better choice, or therapist review sim schedule at least one day ahead.
 - Simulation request need to be clearly documented
 - ◆ Adequate personnel to cover like 4D, SRS/SBRT
 - Adequate equipment for simulation like spare vacuum bag
 - When unusual cases identified in simulation, notify physicist/dosimetrist early to be prepared.

Unusual cases in Simulation

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- Metal artifact: like prosthesis, breast expander, dental filling
- Dose limiting: pacemaker/ICD, fetus, gonald
- Electron: small field, large oblique angle, extended SSD, backscatter for keloid
- Breast: Flash, breast expander
- ◆ Nose/extremities: water, rice, bolus
- Simulation mistake: arm in beam, non-bladder control, object on patient, accessory/setup error

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Influence of downstream operations		
Treatment delivery consideration		
 Collision 		
 couch kick clearance 		
 electron cone clearance 		
 In-consistent setup 		
 Couch kick minimization 		
 Larger PTV margin for couch kick 		
 Treatment MU/Time 		
 Non-SRS mode has max 999 MU limit 		
 Tx time is not enough for arc patient 		
 Exact Couch side rail/bar 		
 Rail-in affect AP/PA KV imaging 		
 Rail-in give more room for rail-free arc 		
 Gantry angle sorting 		

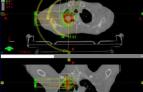
- Sort KV setup fields/CBCT, 90 deg difference
 Sort KV treatment fields
 179.9 or 180.1 instead of 180.0



Collision

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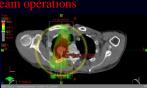
- Patient has difficulty to hold arm position during treatment
- both arm up, no gantry clearance with arm
- Cone beam panel collision can be resolved



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- Re-sim Option 1
- both arm down, no clearance issue
- Arc Avoid arm/shoulder
- Plan quality deteriorate greatly
 Re-sim Option 2
 - Right arm up, left arm down
 - Tattoo right side instead of middle
 - Right half arc
- Planning makeup
 Couch kick
 - Right Partial arc
 Adding margin



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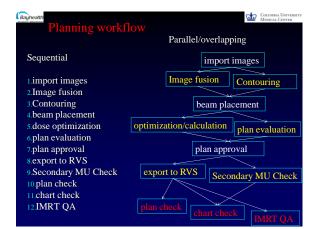


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- Real working time
- Dead time/delay
- Limited resource
- Lack of communication
- Lack of time

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Contour

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- Wait for image import for contour
 - 1st priority task for therapist
- Wait for Dx image for fusion
- Most OAR can be contoured without fusion
- ◆ No time (too much time needed)
 - Automatic contour (smart seg, model based, autoseg with SPICE)
 - Resident contour/Attending review
 - Dosimetrist OAR/Attending GTV
 - Dedicated/blocked time for MD contouring
- Remote contour Citrix
- Remote desktop to resume work easily Forgot
- - Communication/Reminder

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Plan approval

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- Plan quality deficient (Constraint not met)
 - Automatic plan quality analyze with DVH
 Communicate early, like half way of planning
- No time (too much time needed)
 - Automatic plan quality analyze with DVH

 - Remote review anywhere
 Citrix/Remote desktop/Remote Assistance
 - MD shares same screen with dosimetrist to evaluate and approve plan
- Forgot
 - Communication/Reminder

Reduction of delay between planning step

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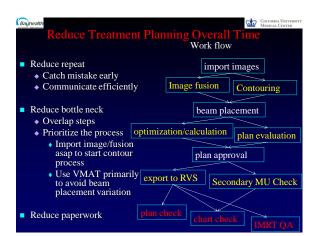
Communication

• QCL – limited to responsible person

- Global patient process status like dashboard
- in-time notification
 - EMR connect to email system, outlook
 - External script or manually to send email
 - External script or manually to send sms text
 - message
 - Notify repeatly
- Phone Call
- Face to face talk to the responsible person

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Reduction of delay b	etween j	planning step	ps
 QA IMRT QA fail Limit segment size Tune-up commissi Optimize dosin Make up missin size 	oning mode	ap	eld
IMRT QA Pass Rate Change	Dosimetric Data Machine: True Energy: 6X	Beam	OK Cancel
100.0	Material	Parameter	Value ~

	102.0		Energy: (6X		Cancel
	100.0	• • • • • • • • • • • • • • • • • • •	Material	Parameter	Value -
	100.0		BL1	Transmission Factor	0.000000
8	98.0	· · · · · · · · · · · · · · · · · · ·	MLC120TB	Transmission Factor	0.015000
5	96.0		MLC120TB	Dosimetric Leaf Gap [cm]	0.167000
Ť		* * *	Dosimetric Data		×
	94.0		_		
Pa	92.0	<u> </u>	Machine: True	Beam	ОК
	90.0		Energy: 6X		Cancel
	88.0	•	Material	Parameter	Value -
		/2014 4/25/2014 5/10/2014 5/25/2014 6/9/2014 6/24/201	MLC120TB	Transmission Factor	0.011500
	-4/ 10/		MLC120TB	Dosimetric Leaf Gap [cm]	0.035900
		Date	BL1	Transmission Factor	0.000000





Plan Check	PATIENT NAME:				DATE & TIME	1/14/2014
 Manual DVH Check 	Prescribed Dose	(\$GyX5) = 25Gy	RLL			
V Intanuar D VII Cheek	Actual Doses to Treatmen	vt Site	CTV_RLL PTV_RLL	95%	25.97 Oy 25.41 Oy	
 Time consuming 		Max Dose in		80%	26.83 Gy	
 Thie consuming 						
15 20		Tissue	Volume	Volume Max (Sy)	Max Point Dose (Gy)	Pess Parl Critery
 15-30min 	\$700 Date restrictions for argan	Spinal Cord exp	<035 cc	253 Qy (52 Qy / 5)	260y(650y/5t)	
	Actual doses per treatment plan 8100 Dose restrictors for argan		+1.2 cc	4 24 13 6 Gy (3 4 Gy / N)	4.85	
 Error prone 	Actual-doses per treatment plan			3.79		
*	\$100 Dase restrictors for argen	Existinguit"	15.00	18.8 Oy (4.7 Oy / 50	38.0y(7.5.0y/50	
 1-2 error/sheet 	Achai-doosa per treatment plan			1.40	2.50	· ·
V 1-2 CH01/Sheet	RTOG Dose restrictors for organ Actual doses per treatment plan	Heart / Pericardum	< 15 cc	21 Gy (7 Gy / 5c) 3.22	34 Gy (85 Gy / tx)	
	8500 Dose restrictors for eigen Actual doses per treatment plan	Great Vessels Des Aprils	+ 50 cc	43-09-(10.75-09-(10)) 1/26	49 Oy (12 25 Oy / 5)	
	Actual of the part of the second part	Aarto, Arsh		8.85	0.089	
	\$700 Date residutors for arcan		1470	15.6 Ov (3.8 Ov / N)	34.8 Ov (8.7 Ov / 50	_
	Actual doses per treatment plan	Trachea		0.065	0.133	P
		HT Large Bronchus Exp Litilarge Bronchus Exp		2.11	275	
	1700 Dose restrictions for argan	(in	1.50.00	332 GV (83 GV / N)	3604(804/50	
	Actual doses per treatment plan			5.21	4.73	
	\$700 Date restrictors for areas	Dia.	<166	35.0v (7.0v/50	43.0v (84.0v/50)	
	Actual doses per treatment plan	R8 7	<166	12.32	16.21	
		2 (a) (b) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c		14.32	17.83	1
		14.7			12.200	· ·
	\$700 Date restrictors for start	Liver.	< 769.00	2120v1420v150	NA Patalet	
	Actual dones per treatment plan			0.045		
	RT00 Dase restrictors for argan	Stonech	× 10.00	178-0y (44-0y/50)	27.2 Oy (5.2 Oy I%)	
	Actual-dones per treatment plan			0.099	4.15	P
		Parallel Tissue	Critical	Critical Volume		
	\$700 Dase restrictors for ingen	Ling	Volume 1500 cc	Does Max (Gy) 11.5 Or (2.5 Or / 50		-
	Actual doses per treatment plan	Fight		NA.	total volume total volume	1239.ce
		Both Lungs		0.113	totel volume	2075 cc
	2006 Dose restrictions for organ Actual doses per treatment plan	Lung	1000 cc	124 Gy (31 Gy / N)		
		Let		856		
		Both Lungs		4.61		

	$s \circ$	verall Ti	Ime		
Plan Check	2	- Children	Real Local		-15
 DVH check tool 	and the second		All a state of the second	******	6 .1
 Homemade software 	Stucture	Index		Target Value	Actua
	GTV	D95.00 (% of dese)	is more than	25.00	10
· Commercial Dlan quality cofficient	PTV	D95.00 (% of dose)	is more than	95.00	5
 Commercial Plan quality software 	SPINAL	D0:00cc (cGy) D0:35cc (cGy)	is less than	2300.00	71
	SPINAL	D120cclcGel	is less than	1450.00	6
 Script extension of Pinnacle/Eclipse 	SPINAL C.	DD:00cc (cGy)	is less than	3000.03	8
	SPINAL_C	D0.35cc (cGy)	is less than	2300.00	76
 Plan Objectives in Eclipse 	SPINAL_C.	D1.20cc (cGy)	is less than	1450.00	7.
	ESOPHING.	D0:00cc (cGy)	is less than	3503.03	64
◆ 5-10Sec	ESOPHAG.	D5:00cc (cGy)	is less than	1950.00	-
	HEART	DB:00cc (cGy)	is less than	3800.00	4
 Can be used by dosimetrist after 	HEART DESC AD.	D15.00cc [cOy] D0.00cc [cGy]	is less than	3200.00	1
	DESC_AO.	D10.0000 [cGy]	is less than	4303.03	-
each optimization cycle	AORTICA.	DB Bloc kGel	is less than	4900.00	4
1	AORTICA.	D10.00cc [cGy]	is less than	4300.00	5
 Can be used by Physician to 	BRONCH.	D0:00cc (cGy)	is less than	3493.03	
	BRONCH.	D4.00cc [cGy]	is less than	1653.03	
review before plan approval	BRONCH.	D0:00cc (cCy)	is less than	3480.00	- 68
	BRONCH.	D4.00cc (cGy)	is less than	1650.00	
Plan meet minimum standard	SKIN	D0:00cc (cGy) D1:00cc (cGy)	is less than	3600.00	236
	SAN SAN	D10.0000 [cGy]	is less than	3323.03	10
before Physicist chart check	Rits	DB Block (cGv)	is less than	4300.00	423
	Rits	D1 Olec kGal	is less than	2501.03	380
	Uver	D0.00 (% of doce)	is less than	100.00	
	Liver	D700.00cc.[cGy]	is less than	2100.00	
	Stomach	D0.00cc (cGy)	is less than	2720.00	
	Stomach	D10.00cc [cGy]	is less than	1760.00	
	LUNG_R	D1000.00cc (cGy)	is less than	1240.00	
	LUNG R	D 1500 00cc (cGy)	is less than	1163.03	

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is less than 124 is less than 1190 is less than 1240

- Option 1
 - Plan Check
 - MD approve the plan
 - Chart Check
 - dosimetrist generate plan printout and load to EMR
- Physicist approve the plan printout
 Option2
 - - Plan Check
 - MD approve the plan
 MD lock the plan
 - Chart Check
 - dosimetrist generate plan printout and load to EMR and dosimetrist approve printout
 Physicist check plan printout approval date/time matching with TPS
 - Physicist approve the plan printout

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- Prostate patient,
 - Plan 0, prostate+SV+LN
 - CD1, prostate+SV
 CD2, prostate
- Option1
 - Plan and approve 3 plans at the beginning,
 - QCL to export fields and plan printout/document 3 times at different dates
 - IMRT QA, Physics chart check, approve fields and plan printout 3 times,
- Option2

 - Plan and approve 3 plans at the beginning,
 Export Fields, plan printout/document once for all 3 plans
 - IMRT QA and Physics chart check once for all 3 plans
 - Physicist approve fields and printout once for all 3 plans
 - QCL dosimetrist to approve plan printout at different dates, and bill on corresponding date

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- Automatic Contour
 - Smart segmentation does not work well
 - Might need to create our own expert case library
- Automatic Planning
 - Rapid Plan evaluation and license
- Physicist Planning
 - Routine planning done primarily by dosimetrist
 - Non-standard plan done mainly by physicist