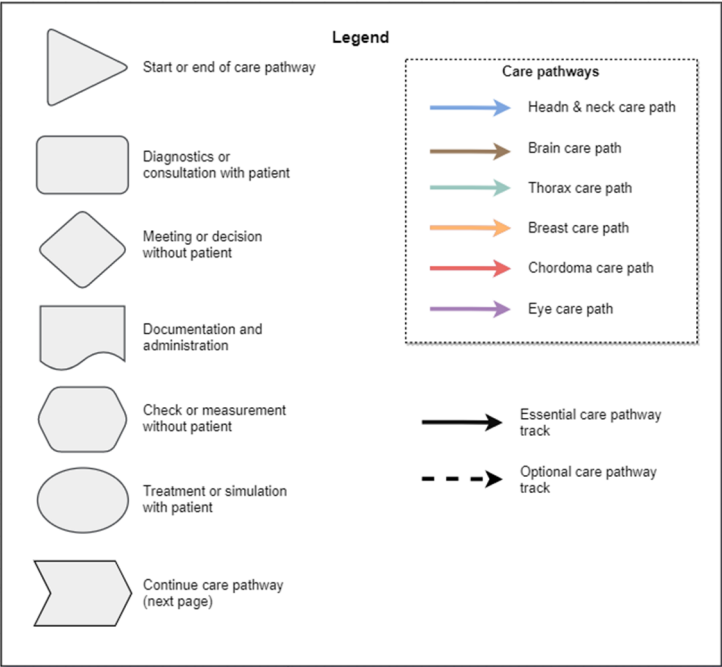
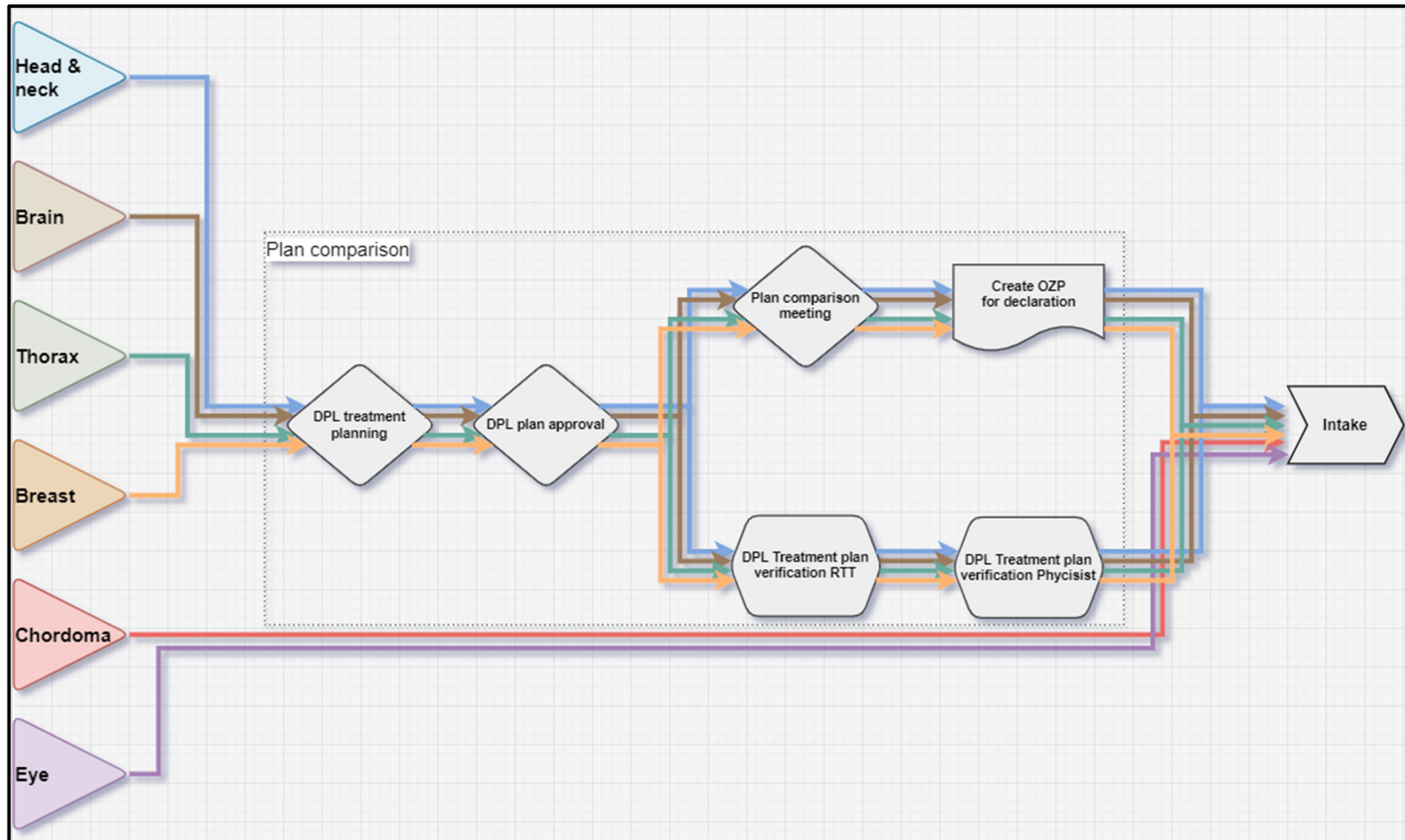


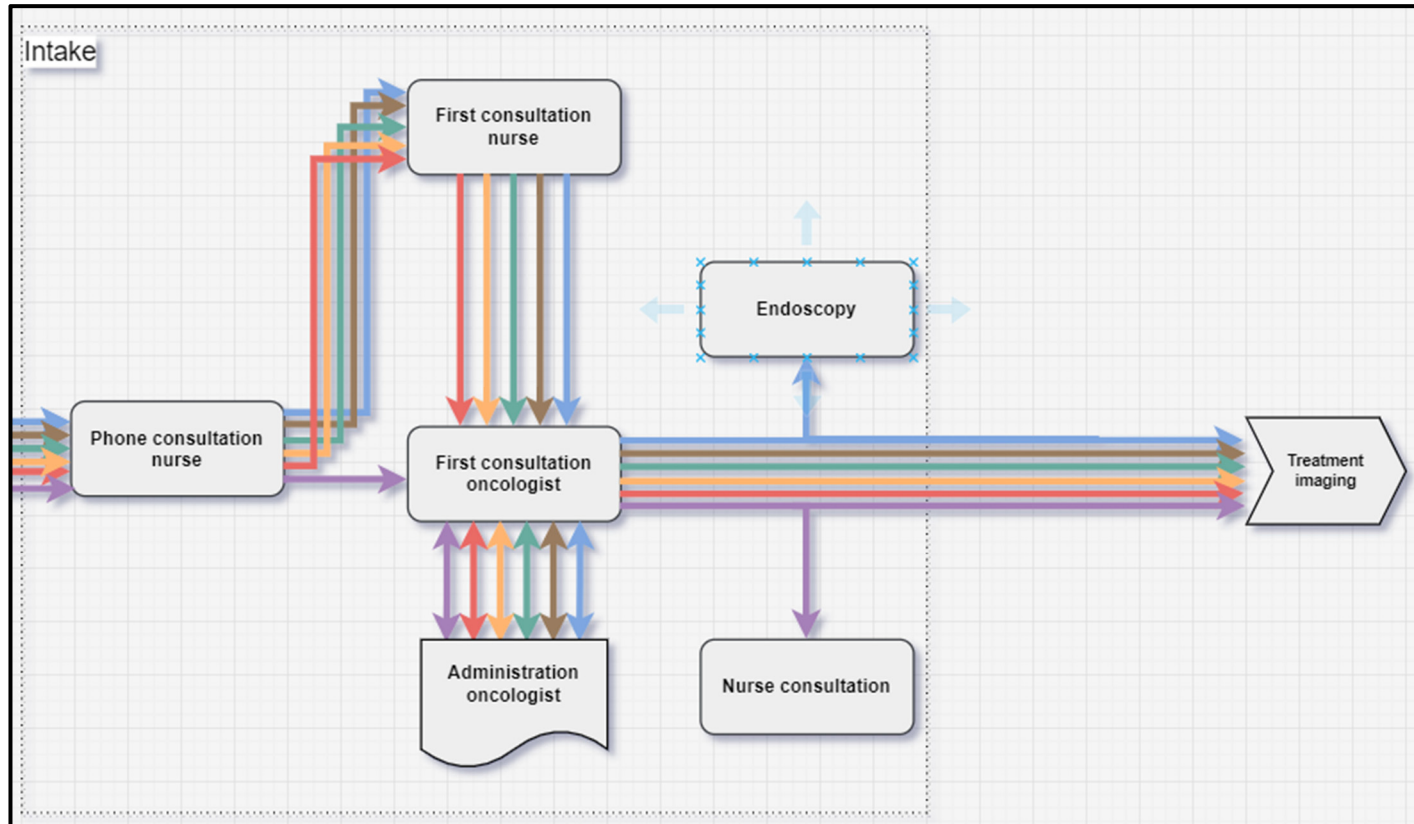
Supplementary Materials S1: Process map



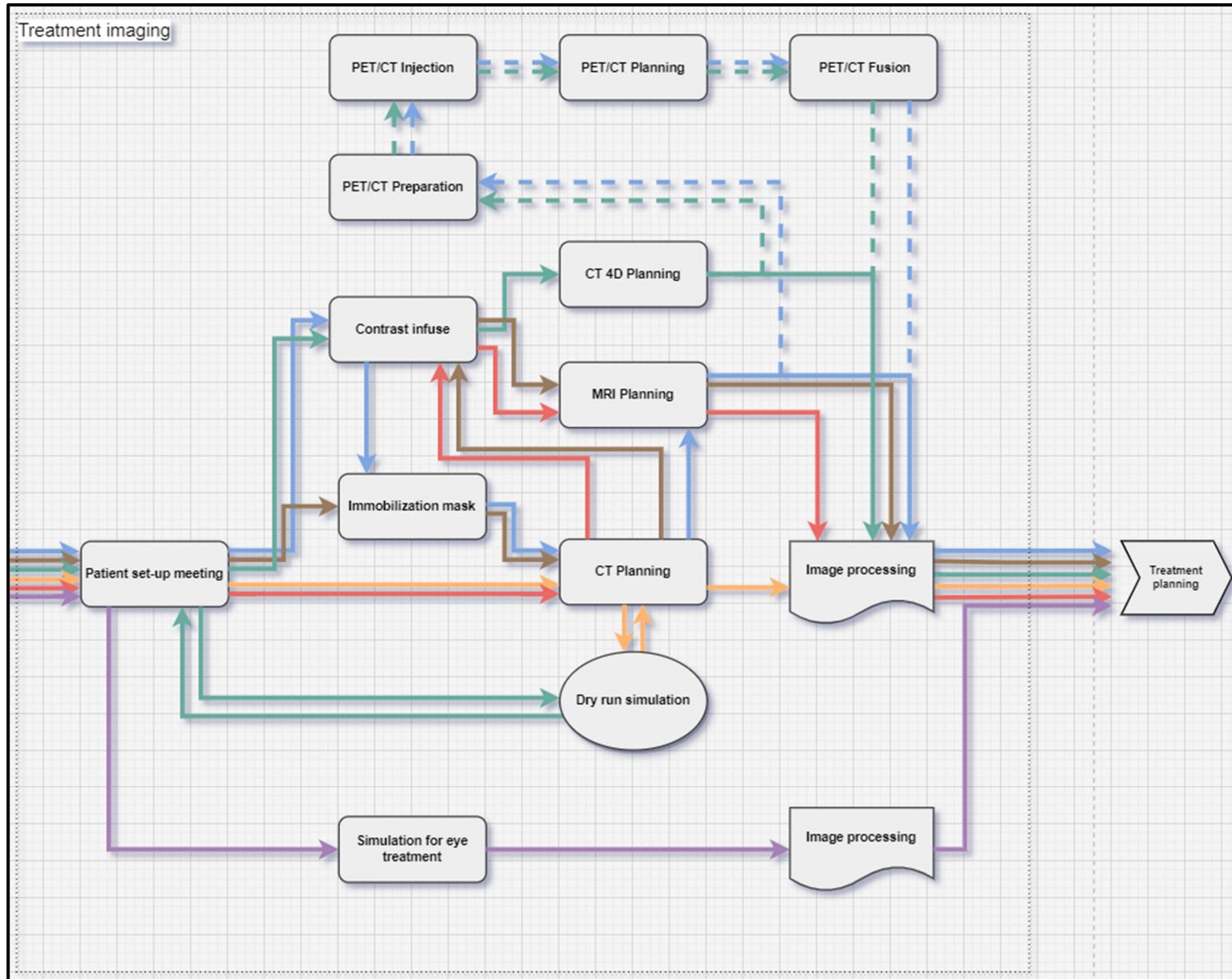
Plan comparison



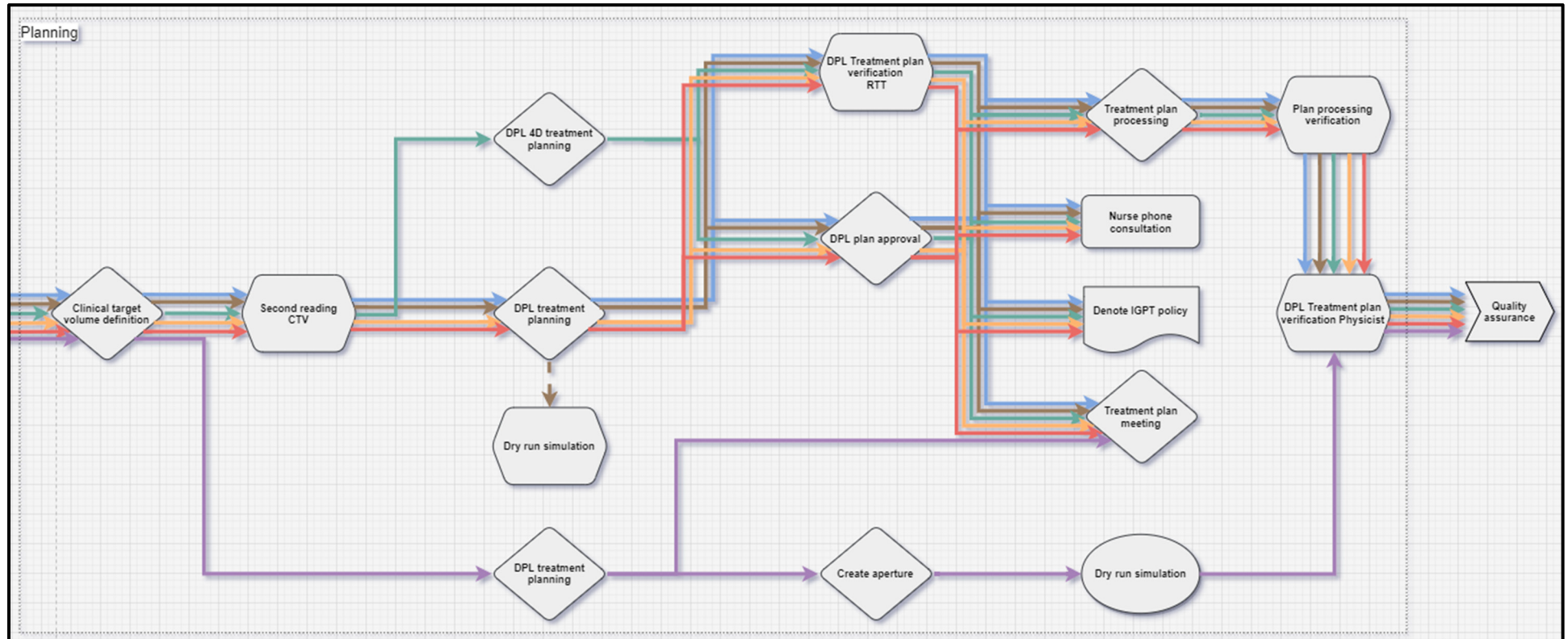
Patient intake



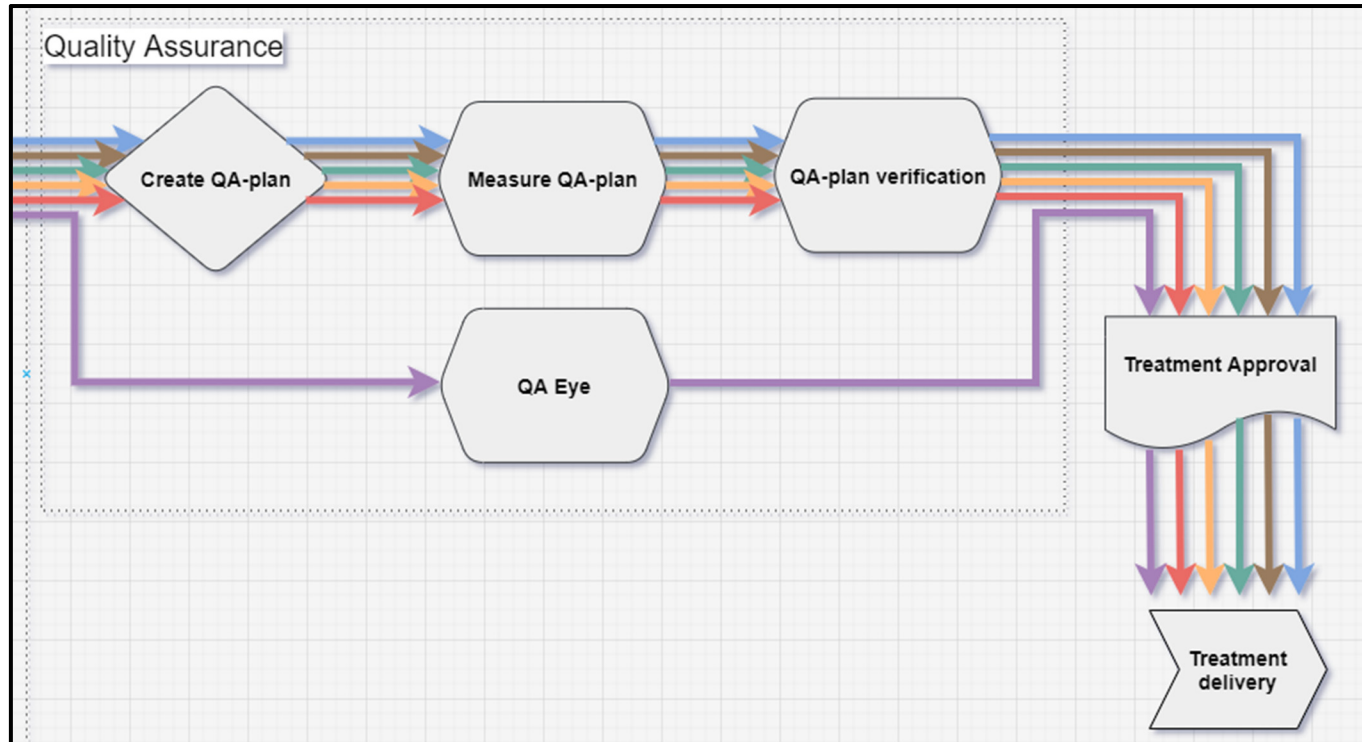
Treatment imaging



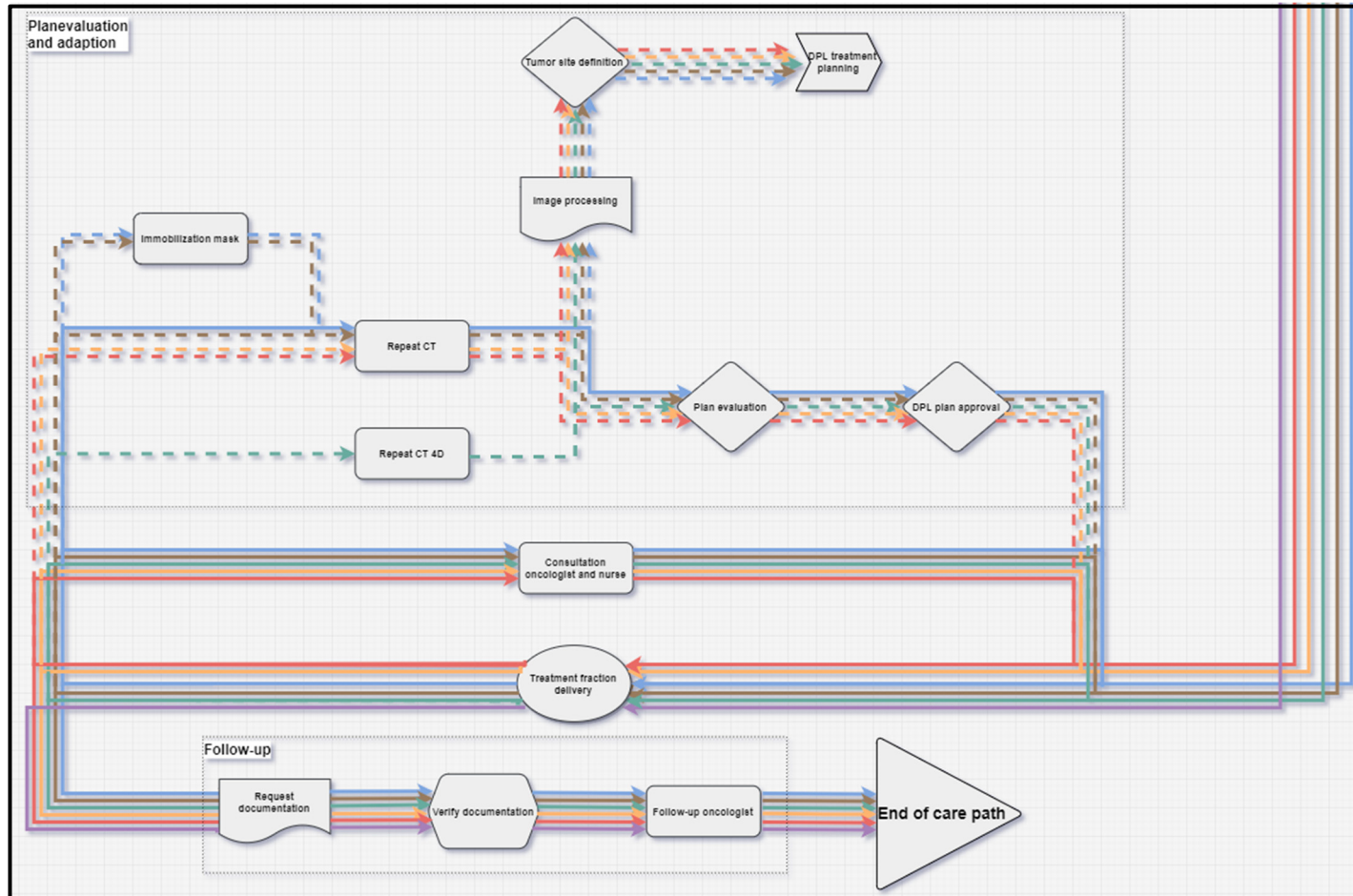
Treatment planning



Quality assurance



Treatment delivery, treatment plan adaptation and follow up



Supplementary Materials S2: Head & neck

Preparation phase, in minutes

Care path activities	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physicist	Medical physics engineer	Estimation method
<i>Treatment planning for comparison</i>				45			Time recording
<i>Approve treatment plan</i>	25						Interview
<i>Plan comparison meeting</i>	10*			5	5		Interview
<i>Treatment plan check</i>				10	30		Interview
Phone consultation		15					R&V system
First consultation + Endoscopy	45	60					Interview
Overall administration	40						Interview
Set-up meeting	5		**				Interview
Immobilization mask			**				R&V system
Contrast infuse		10					R&V system
CT planning			90*				R&V system
MRI planning			120*				R&V system
PET planning			200*				R&V system
Image processing				515			Time recording
CTV definition	240						Interview

Second check definition	60*						Interview
Treatment planning				10			Time recording
Treatment plan check				10			Interview
Approve treatment plan	30						Interview
Treatment plan meeting	20*			10	10		Interview
Phone consultation		15					Time recording
Treatment plan processing				10			Interview
Plan processing check				5			Interview
Treatment plan check					30		Interview
Create QA plan						30	Interview
Measure QA plan						80*	Time recording
Check QA plan					2.5		Interview
Treatment approval					2.5		Interview
TOTAL (excl. PET)	475	100	210	620	80	110	

* Summed time estimate based on two participating employees.

** Time estimate is included in the “CT planning” task.

N.B: The “PET planning” care path activity, depicted in darker green, is optional.

Treatment and follow-up phase (in minutes)

Care path activities	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Treatment delivery RTT	Dietician	Estimation method
Treatment delivery*					30 min · 35 · 3 RTT's = 3150		R&V system
Consultation during treatment**	15 · 6 = 90	20 · 6 = 120				45 · 6 = 270	Interview and R&V system
CT repetition***			15 · 4 · 2 = 120				R&V system
Plan evaluation***				90 · 4 = 360			Interview
Plan approval***	15 · 4 = 60						Interview
Follow-up at XXXX	20 · 4 = 80 (After 6 weeks, 3 months, 6 months, 12 months)	20 · 2 = 40 (After 1 st week and after 3 weeks)	120 (MRI after 3 months)				Interview
TOTAL	230	160	240	360	3150	270	

* Each treatment fraction is executed by 3 RTTs each day.

** Summed estimate, based on weekly consultations from the 2nd week of treatment delivery (6 in total).

*** Summed estimate, based on 4 evaluation CT scans during the treatment phase.

Total human resource consumption (in minutes)

	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physicist	Medical physics engineer	Treatment delivery RTT	Dietician
Preparation phase	475	100	210	620	80	110	-	-
Treatment and follow-up phase	230	160	240	360	-	-	3150	270
TOTAL	705	260	450	980	80	110	3150	270

Available fractionation schemes

Fractionation schemes			
Oropharynx	Nasopharynx	Larynx	Hypopharynx
35 x 2Gy = 70Gy	35 x 2Gy = 70Gy	35 x 2Gy = 70Gy	35 x 2Gy = 70Gy

Supplementary Materials S3: Brain

Preparation phase (in minutes)

Care path activities	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physics group	Medical physics engineer	Estimation method
<i>Treatment planning for comparison</i>				45			Time recording
<i>Approve treatment plan</i>	25						Interview
<i>Plan comparison meeting</i>	10*			5	5		Interview
<i>Treatment plan check</i>				10	30		Interview
Overall administration	40						Interview
Phone consultation		15					R&V system
First consultation	45	45					Interview
Set-up meeting	5		**				Interview
Immobilization mask			**				R&V system
Contrast infuse		10					R&V system
CT planning			80*				R&V system
MRI planning			120*				R&V system
Image processing				395			Time recording
CTV definition	150						Interview
Second check definition	60*						Interview
Dry-run gantry				15			Interview

Treatment planning				30			Time recording
Treatment plan check				10			Interview
Approve treatment plan	30						Interview
Treatment plan meeting	20*			10	10		Interview
Phone consultation		15					Time recording
Treatment plan processing				10			Interview
Plan processing check				5			Interview
Treatment plan check					30		Interview
Create QA plan						30	Interview
Measure QA plan						60*	Time recording
Check QA plan					2.5		Interview
Treatment approval					2.5		Interview
TOTAL	385	85	200	535	80	90	

* Summed time estimate based on two participating employees.

** Time estimate is included in the “CT planning” task.

Treatment and follow-up phase (in minutes)

Care path activities	Physician	Treatment delivery RTT	Estimation method
Treatment delivery*		(28 fraction scheme) $20 \text{ min} \cdot 28 \cdot 3 \text{ RTT's} = 1680$	R&V system

		(33 fraction scheme) 20 min · 33 · 3 RTT's = 1980	
Consult during treatment**	(28 fraction scheme) 5 · 15 = 75 (33 fraction scheme) 6 · 15 = 90		Interview
Follow-up (phone consultation)	3 · 15 = 45 (After 1 month, 6 months and 1 year)		Interview
TOTAL (28 fraction scheme)	120	1680	
TOTAL (33 fraction scheme)	135	1980	

* Each treatment fraction is executed by 3 RTTs each day

** Summed estimate, based on weekly consultations

Total human resource consumption (in minutes)

	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physicist	Medical physics engineer	Treatment delivery RTT
Preparation phase	385	85	200	535	80	90	
Treatment and follow-up phase (28 fraction scheme)	120	-	-	-	-	-	1680

Treatment and follow-up phase (33 fraction scheme)	135	-	-	-	-	-	1980
TOTAL (28 fraction scheme)	505	85	200	535	80	90	1680
TOTAL (33 fraction scheme)	520	85	200	535	80	90	1980

Available fractionation schemes

Fractionation schemes				
Meningeoma	Low grade glioma	Anaplastic glioma	Hyopfyse	Craniofayngioma
Benigne: 30 x 1.8Gy = 54Gy Atypical: 30 x 2.0Gy = 60Gy	28 x 1.8Gy = 50.4Gy	33 x 1.8Gy = 59.4Gy	28 x 1.8Gy = 50.4Gy	30 x 1.8Gy = 54Gy

Supplementary Materials S4: Breast

Preparation phase (in minutes)

Care path activities	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physics group	Medical physics engineer	Estimation method
<i>Treatment planning for comparison</i>				35			Time recording
<i>Approve treatment plan</i>	25						Interview
<i>Plan comparison meeting</i>	10*			5	5		Interview
<i>Treatment plan check</i>				10	30		Interview
Phone consultation		15					Time recording
First consultation	45	45					Interview

Overall administration	40						Interview
Set-up meeting	5		**				Interview
CT planning			80*				R&V system
Dry-run gantry			30*				R&V system
Image processing				50			Time recording
CTV definition	150						Interview
Second check definition	40*						Interview
Treatment planning				10			Time recording
Treatment plan check				10			Interview
Approve treatment plan	30						Interview
Treatment plan meeting	20*			10	10		Interview
Phone consultation		15					Time recording
Treatment plan processing				10			Interview
Plan processing check				5			Interview
Treatment plan check					30		Interview
Create QA plan						30	Interview
Measure QA plan						60*	Time recording
Check QA plan					2.5		Interview
Treatment approval					2.5		Interview
TOTAL	395	75	110	145	80	90	

* Summed time estimate based on two participating employees.

** Time estimate is included in the “CT planning” task.

Treatment and follow-up phase (in minutes)

Care path activities	Physician	Nurse	Treatment delivery RTT	Estimation method
Treatment delivery*			(15 fraction scheme) $30 \text{ min} \cdot 15 \cdot 3 \text{ RTT's} = 1350$ (22 fraction scheme) $30 \text{ min} \cdot 22 \cdot 3 \text{ RTT's} = 1980$	R&V system
Consult during treatment**	(15 fraction scheme) $2 \cdot 15 = 30$ (22 fraction scheme) $3 \cdot 15 = 45$	(15 fraction scheme) $3 \cdot 15 = 45$ (22 fraction scheme) $4 \cdot 15 = 60$		Interview
Follow-up at XXXX	$4 \cdot 20 = 80$ (After 2 weeks 3 months, 6 months and 1 year)			Interview
TOTAL (15 fraction scheme)	110	45	1350	
TOTAL (22 fraction scheme)	125	60	1980	

* Each treatment fraction is executed by 3 RTTs each day

** Summed estimate, based on weekly consultations from the 2nd week of treatment delivery.

Total human resource consumption (in minutes)

	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physicist	Medical physics engineer	Treatment delivery RTT
Preparation phase	395	75	110	145	80	90	
Treatment and follow-up phase (15 fraction scheme)	110	45	-	-	-	-	1350
Treatment and follow-up phase (22 fraction scheme)	125	60	-	-	-	-	1980
TOTAL (15 fraction scheme)	505	120	110	145	80	90	1350
TOTAL (22 fraction scheme)	520	135	110	145	80	90	1980

Available fractionation schemes

Fractionation schemes		
15 x 2.67Gy = 40.05Gy	20 x 2.67Gy = 53.40Gy	22 x 2.67Gy = 58.74Gy

Supplementary Materials S5: Thorax (lymphoma and lung)

Preparation phase (in minutes)

Care path activities	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physics group	Medical physics engineer	Estimation method
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<i>Treatment planning for comparison</i>				105			Time recording
<i>Approve treatment plan</i>	25						Interview
<i>Plan comparison meeting</i>	10*			5	5		Interview
<i>Treatment plan check</i>				10	30		Interview
Overall administration	40						Interview
Phone consultation		15					Time recording
First consultation	45	45					Interview
Set-up meeting	5		**				Interview
Contrast infuse		10					R&V system
CT 4D planning			80*				R&V system
PET planning			200*				R&V system
Dry-run gantry			30*				R&V system
Image processing				120			Time recording
CTV definition	180						Interview
Second check definition	60*						Interview
Treatment planning				15			Time recording
Treatment plan check				10			Interview
Approve treatment plan	30						Interview
Treatment plan meeting	20*			10	10		Interview
Phone consultation		15					Time recording
Treatment plan processing				10			Interview

Plan processing check				5			Interview
Treatment plan check					30		Interview
Create QA plan						30	Interview
Measure QA plan						70*	Time recording
Check QA plan					2.5		Interview
Treatment approval					2.5		Interview
TOTAL	415	85	110	290	80	100	

* Summed time estimate based on two participating employees.

** Time estimate is included in the “CT planning” task.

N.B: The “PET planning” care path activity, depicted in darker green, is optional.

Treatment and follow-up phase (in minutes)

Care path activities	Physician	Nurse	Treatment delivery RTT	Estimation method
Treatment delivery*			(15 fraction scheme) $25 \text{ min} \cdot 15 \cdot 3 \text{ RTT's} = 1125$ (30 fraction scheme) $25 \text{ min} \cdot 30 \cdot 3 \text{ RTT's} = 2250$	R&V system
Consult during treatment**	(15 fraction scheme) $3 \cdot 15 = 45$ (30 fraction scheme) $6 \cdot 15 = 90$	(30 fraction scheme) $6 \cdot 15 = 90$		Interview

Follow-up at XXXX	20 (End of treatment)			Interview
TOTAL (15 fraction scheme)	65	-	1125	
TOTAL (30 fraction scheme)	110	90***	2250	

* Each treatment fraction is executed by 3 RTTs each day

** Summed estimate, based on weekly consultations

*** Nurse consultations during the treatment phase is not conducted for lymphoma patients (15 and 18 fractionation schemes).

Total human resource consumption (in minutes)

	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physicist	Medical physics engineer	Treatment delivery RTT
Preparation phase	415	85	110	290	80	100	
Treatment and follow-up phase (15 fraction scheme)	65	-			-	-	1125
Treatment and follow-up phase (30 fraction scheme)	110	90			-	-	2250
TOTAL (15 fraction scheme)	480	85	110	290	80	100	1125
TOTAL (30 fraction scheme)	525	175	110	290	80	100	2250

Available fractionation schemes

Fractionation schemes			
Hodgkin Lymphoma		Non-Hodgkin Lymphoma	
Early stage <60 year	Advanced stage <60 year	Stage 1/2	Stage 3/4
15 x 2Gy = 30Gy	18 x 2Gy = 36Gy	18 x 2Gy = 36Gy	15 x 2Gy = 30Gy 18 x 2Gy = 36Gy
Non-small cell lung cancer	Small cell lung cancer	Thymoma	Sarcoma
30 x 2Gy = 60Gy 25 x 2Gy = 50Gy 30 x 2Gy = 60Gy	30 x 1.5Gy = 45Gy 25 x 2 = 50Gy	25 x 2 = 50Gy 30 x 2 = 60Gy	25 x 2 = 50Gy

Supplementary Materials S6: Chordoma

Preparation phase (in minutes)

Care path activities	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physics group	Medical physics engineer	Estimation method
Phone consultation		15					Time recording
First consultation	45	45					Interview
Overall administration	40						Interview
Set-up meeting	5		**				Interview
Contrast infuse		10					R&V system
CT planning			80*				R&V system
MRI planning			120*				R&V system
Image processing				155 (515)***			Time recording
CTV definition	180 (360)***						Interview
Second check definition	60*						Interview
Treatment planning				10 (480)***			Time recording
Treatment plan check				10			Interview
Approve treatment plan	30						Interview
Treatment plan meeting	20*			10	10		Interview

Phone consultation		15					Time recording
Treatment plan processing				10			Interview
Plan processing check				5			Interview
Treatment plan check					30 (60)***		Interview
Create QA plan						30	Interview
Measure QA plan						80*	Time recording
Check QA plan					2.5		Interview
Treatment approval					2.5		Interview
TOTAL (spinal column)	380	85	200	200	45	110	
TOTAL (skull base)	560	85	200	1030	75	110	

* Summed time estimate based on two participating employees.

** Time estimate is included in the “CT planning” task.

***Estimated minutes in parenthesis is particularly for Skull base chordoma’s.

Treatment and follow-up phase (in minutes)

Care path activities	Physician	Treatment delivery RTT	Estimation method
Treatment delivery*		(35 fraction scheme) $25 \text{ min} \cdot 35 \cdot 3 \text{ RTT's} = 2625$ (37 fraction scheme) $25 \text{ min} \cdot 37 \cdot 3 \text{ RTT's} = 2775$	R&V system

Consult during treatment**	(35 fraction scheme) 15 · 7 = 105		Interview
	(37 fraction scheme) 15 · 7 = 105		
Follow-up at XXXX	20 (After 1 month)		Interview
TOTAL (35 fraction scheme)	125	2625	
TOTAL (37 fraction scheme)	125	2775	

* Each treatment fraction is executed by 3 RTTs each day

** Summed estimate, based on weekly consultations

Total human resource consumption (in minutes)

	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physicist	Medical physics engineer	Treatment delivery RTT
Preparation phase	380	85	200	200	45	110	
Preparation phase (skull base)	560	85	200	1030	75	110	
Treatment and follow-up phase (35 fraction scheme)	125	-	-	-	-	-	2625
Treatment and follow-up phase (37 fraction scheme)	125	-	-	-	-	-	2775

TOTAL for spinal column chordoma's (35 fraction scheme)	505	85	200	200	45	110	2625
TOTAL for spinal column chordoma's (37 fraction scheme)	505	85	200	200	45	110	2775
TOTAL for skull base chordoma's (35 fraction scheme)	685	85	200	1030	75	110	2625
TOTAL for skull base chordoma's (37 fraction scheme)	685	85	200	1030	75	110	2775

Available fractionation schemes

Fractionation schemes	
Chordoma (spinal column)	Skull base chordoma
Post-surgery and primary: 35 x 2Gy = 70Gy	Post-surgery and primary: 35 x 2Gy = 70Gy
Post-surgery and primary: 37 x 2Gy = 74Gy	Post-surgery and primary: 37 x 2Gy = 74Gy

Supplementary Materials S7: Eye melanoma

Preparation phase (in minutes)

Care path activities	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physics group	Medical physics engineer	Estimation method
Multicenter eye patient meeting	20*						Interview
Phone consultation		15					Time recording
First consultation	45	15					Interview
Overall administration	30						Interview
Set-up meeting	5		10*				Interview
Immobilization mask			60*				Interview
Eye simulation			90*				Interview
Image processing eye			***				Interview
CTV definition	240*						Interview
Treatment planning				150*			Interview
Approve treatment plan	**						Interview
Treatment plan meeting	20*						Interview
Create aperture						30*	Interview
Dry run				70*			Interview
Treatment plan check					30		Interview
QA eye						90*	Interview

Treatment approval					5		Interview
TOTAL	360	30	160	220	35	110	

* Summed time estimate based on two participating employees.

** Time estimate is included in the “CTV definition” task.

*** Time estimate is included in the “Eye simulation” task.

Treatment and follow-up phase (in minutes)

	Physician	Treatment delivery RTT	Estimation method
Treatment delivery*	40 min · 4 = 160	40 min · 4 · 2 RTT's = 320	Interview
Consult during treatment**	25		Interview
Follow-up (phone consultation)	15 · 3 = 45 (End of treatment, after 1 month and after 1 year)		Interview
TOTAL	240	320	

*Each treatment fraction is executed by 2 RTTs and a physician each day

** Once during the treatment phase

Total human resource consumption (in minutes)

	Physician	Nurse	Treatment imaging RTT	Treatment planning RTT	Physicist	Medical physics engineer	Treatment delivery RTT
Preparation phase	360	30	160	220	35	110	-
Treatment and follow-up phase	240	-	-	-	-	-	320

TOTAL	600	30	160	220	35	110	320
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Available fractionation scheme

Fractionation scheme
4 x 15Gy = 60Gy

Supplementary Materials S8: Treatment plan adaptation (excluding eye melanoma)

Adaptation phase (in minutes)

Care path activities	Physician	Treatment imaging RTT	Treatment planning RTT	Physics group	Medical physics engineer	Estimation method
Immobilization mask		10*				R&V system
CT planning		80*				R&V system
Image processing			***			Interview
CTV definition	30 to 90**					Interview
Treatment planning			60			Interview
Treatment plan check			***			Interview
Approve treatment plan	30					Interview
Treatment plan meeting	20*		***	10		Interview
Treatment plan processing			***			Interview
Plan processing check			***			Interview
Treatment plan check				20		Interview
Create QA plan					30	Interview
Measure QA plan					60*	Time recording
Check QA plan				2.5		Interview
Treatment approval				2.5		Interview
TOTAL (breast)	80	90	60	35	90	

Average per patient (p = 10%)	8	9	6	3.5	9	
TOTAL (head & neck)	140	90	60	35	90	
Average per patient (p = 80%)	112	72	48	28	72	

* Summed time estimate based on two participating employees.

** CTV definition varies between 30 minutes for breast plan adaptations and 90 minutes for head & neck plan adaptations.

*** Time estimates are included in the "Treatment planning" task.