ACPSEM ROMP workforce model

ACPSEM
Australasian College of Physical Scientists & Engineers in Medicine

Workforce modelling project task group
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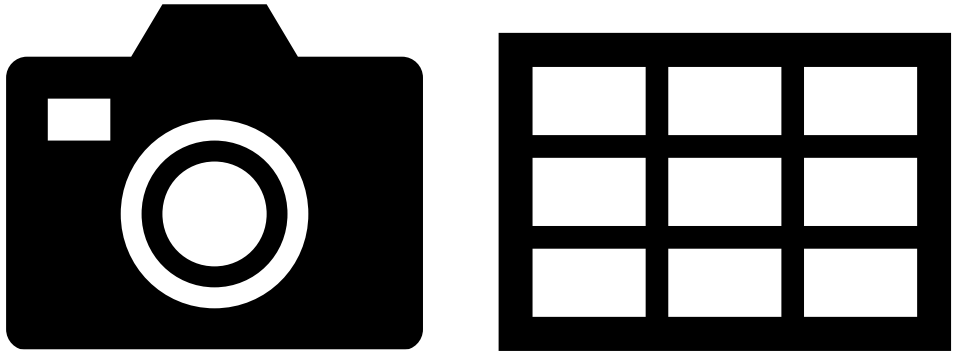
Introduction

In October 2020, the ACPSEM initiated a ROMP workforce modelling project, with two anticipated outcomes:

Workforce snapshot
For demographics, scope of practice, work arrangements and future plans.



Workforce model
For calculation of staff requirements at departmental and national levels.

The work was supported by the Australian Department of Health Supporting Medical Physics grant program.

Introduction

Why? We needed a model to support physicists and their managers to estimate staffing requirements in their departments. We needed a model that could be used to inform estimates about future workforce requirements. F2000 was no longer that model.

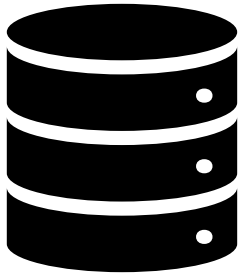
How? ACPSEM wanted to contextualise the IAEA activity based approach to staffing in radiotherapy, for medical physicists in Australia and New Zealand.

How?? A sector wide survey of members and facilities would give us the data needed.

Who? Consultants (Venndelta), an appointed chair (Howell Round), and a task group of members from an expression of interest process. +ACPSEM office staff.

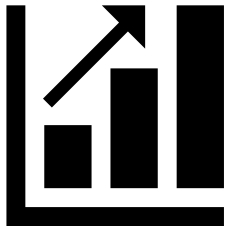
Member snapshot

Two sources of data on members: the ACPSEM databases and a member survey.



Database included age and gender demographics, for:

- 352 registered ROMPs: 314 AUS + 29 NZ + 9 international
- 79 ROMP TEAP trainees: 64 AUS + 15 NZ



We've been growing!

2006-2010: average of 17 TEAPs per year.

2016-2020: average of 29 TEAPs per year.

Member snapshot

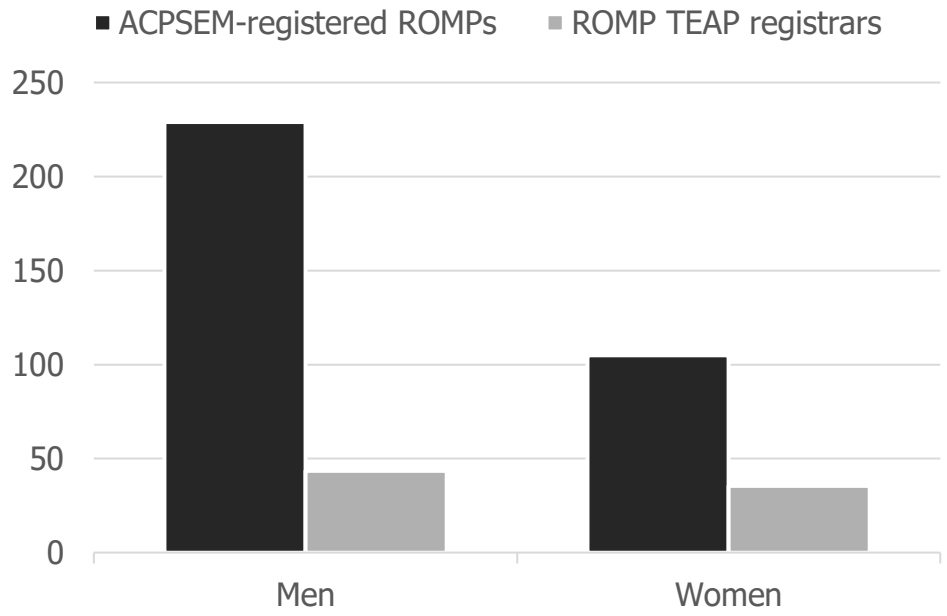
Survey section	Requested information
1. Demographic data	Name, gender, year of birth, location, citizenship, residency, and visa status.
2. Professional training and qualifications	Undergraduate degree and year of completion, registration or training status, year of entry into ROMP workforce, country of entry into ROMP workforce, years of overseas experience, intentions to remain working in Australia or New Zealand, first ROMP workforce position (e.g. in public or private sector, in academia).
3. Retirement status	Current retirement status and age of retirement, reasoning for earlier retirement than planned (if applicable), any ongoing associated activity (e.g. teaching, research).
4. Current working arrangements	Number of departments currently working in, number of leave weeks, typical hours spent per week in the following categories: patient based EBRT, specialist techniques and brachytherapy work, equipment QA work, academic and research work, TEAP supervision, professional activities, and other work; in which organisations that work occurs, and desired typical hours spent per week in those categories.
5. Future work arrangements	Anticipated changes in work arrangements and anticipated changes in working location in the next year and next five years, and age of expected retirement.

The survey was sent to ROMPs and registrars.

182 of you responded!

Member snapshot

Age	ROMPs in 2009 (n=247)	ROMPs in 2021 (n-384)
<35	96 (39%)	156 (41%)
35-39	40 (12%)	56 (15%)
40-44	25 (10%)	41 (11%)
45-49	32 (13%)	55 (14%)
50-55	27 (11%)	22 (6%)
55-59	11 (4%)	20 (5%)
60-64	7 (3%	18 (5%)
>65	9 (4%)	16 (4%)

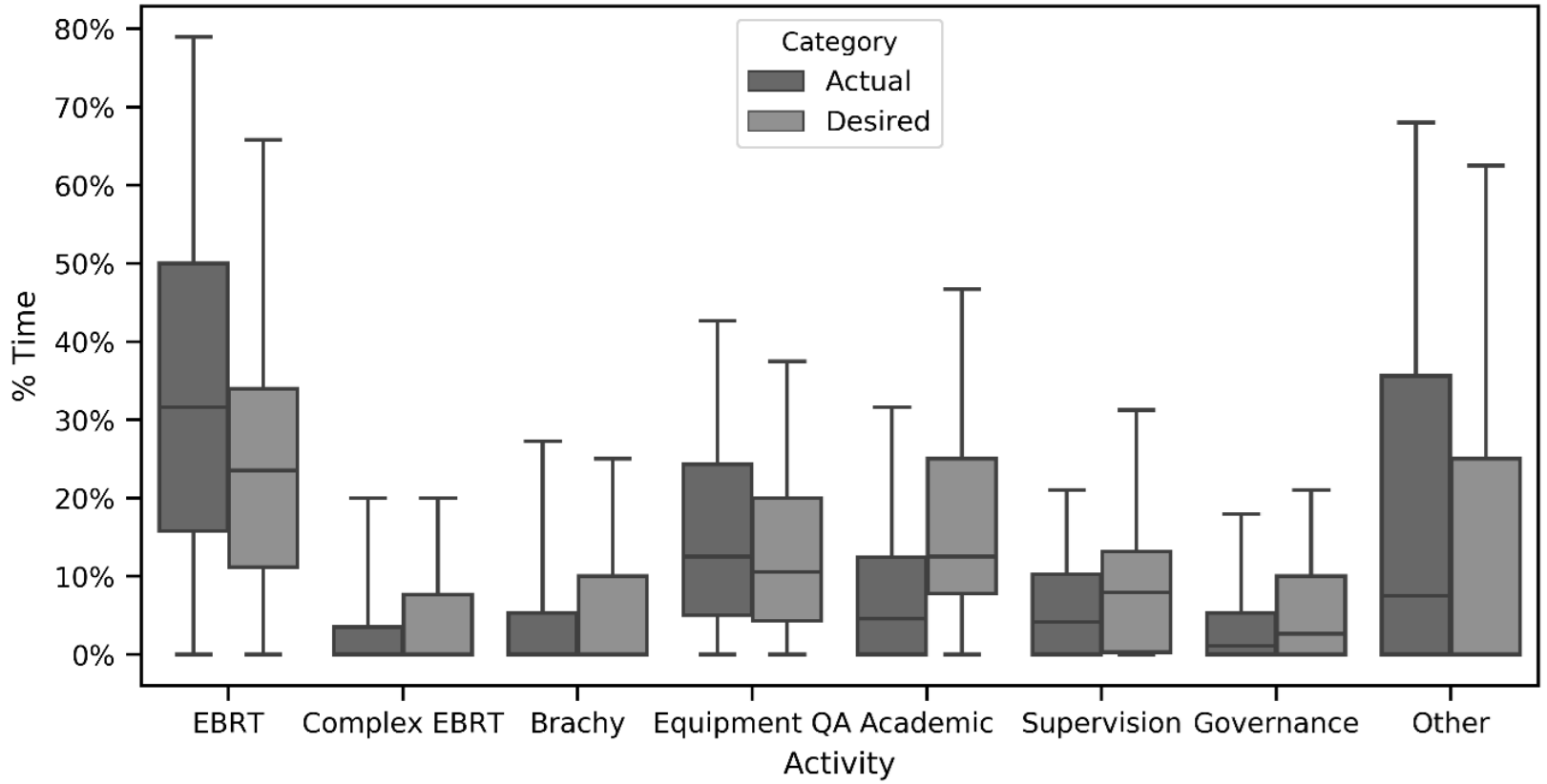


Hours worked	ROMPs in 2009 (n=218)	ROMPs in 2021 (n=181)
0-9	3 (1%)	8 (4%)
10-19	4 (2%)	2 (1%)
20-29	7 (3%)	9 (5%)
30-39	68 (31%)	131 (72%)
40-49	119 (55%)	25 (14%)
50-59	15 (7%)	3 (2%)
60-69	2 (1%)	0 (0%)
>70	0 (0%)	3 (2%)

Median age of 292 active, registered ROMPs was 42.5 years.

Women accounted for 31.4% of ROMPs and 44.9% of TEAP registrars (where gender had been specified on the member profile).

Member snapshot



Facility snapshot

Principal aim of the survey was to profile how time was spent by ROMPs on specific activities, defined in the IAEA model, within Australia and New Zealand.

Survey collected 2020 utilisation data, including equipment and patient volume.

Task group and volunteers piloted the survey.

Three levels of data validation:

1. Survey instrument contained model which calculated annual estimated ROMP equivalent FTE based on user entered data.
2. Project team (Venndelta) identified outliers and followed up with those sites.
3. Task group provided with aggregated statistics at intervals, for sanity checks.

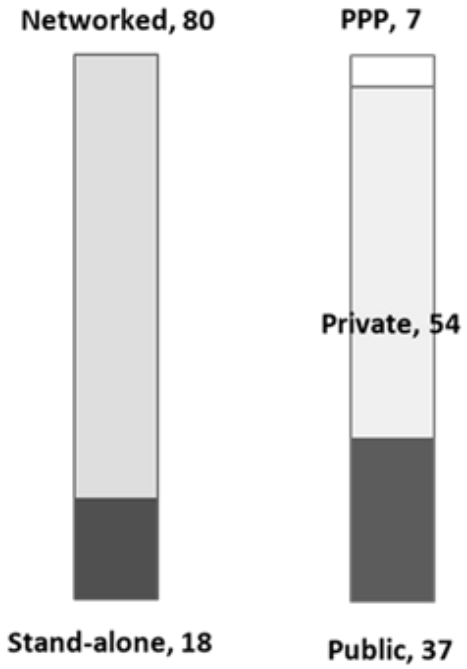
Facility snapshot

Section	Requested information
1. Profile of centre	Name and location of centre, public/private status, whether the facility was standalone or operating as part of a larger network of centres, any affiliation with external institutions, contact details for person completing the survey.
2. ROMP workforce	Details on the total number of ROMPs employed in 2020, including ACPSEM registered ROMPs, ROMPs registered elsewhere, ROMPs without registration, TEAP registrars, and other physics staff (e.g. technicians or associates); post-qualification experience profile, movement of staff in 2020 in above categories, reasons for staff movement, origin of staff recruited into department in 2020.
3. Standard hours	Standard hours (including hours per day, days per week, leave days, public holidays, professional development leave and other leave), the proportion of time spent on the activities not case- or equipment-based, and proportion of time spent by TEAP registrars and unregistered staff on unsupervised clinical activities.
4. Workforce planning	Plans for changes to workforce in next 12 months, issues making recruitment and retention difficult, potential initiatives to address supply and demand balance, practice changes in the next five years believed to impact the workforce, and potential impact of increasing ROMP workforce.
5. Staffing utilisation	Volume of patient cases and time spent by ROMPs on case-based activities, and volume and time spent by ROMPs on equipment-based activities.

The survey collected utilisation data for 2020.

98 centres responded.

Facility snapshot



Physics staff	FTE (% of total)
ROMPs, ACPSEM registered	283.1 (64.3%)
ROMPs, registered elsewhere	45.6 (10.4%)
ROMPs, not on any register	22.2 (5.0%)
TEAP trainees, pre-clinical	1.6 (0.4%)
TEAP trainees, clinical year 1	15.7 (3.6%)
TEAP trainees, clinical year 2	23.3 (5.3%)
TEAP trainees, clinical year 3+	33.7 (7.7%)
Other physics staff	14.9 (3.4%)

Facility snapshot

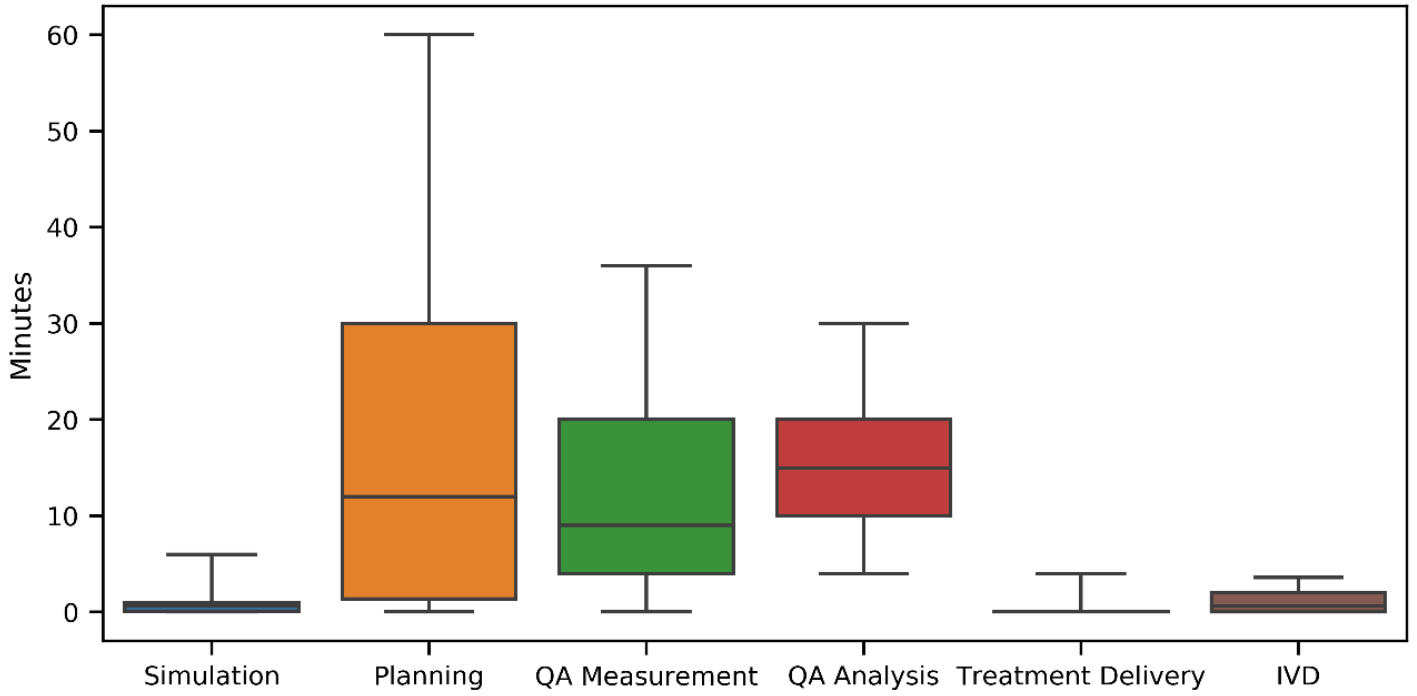
The survey requested data was granular, and broken down into ROMP time per task and frequency (i.e. % of patient volume where task was performed, e.g. in-vivo %).

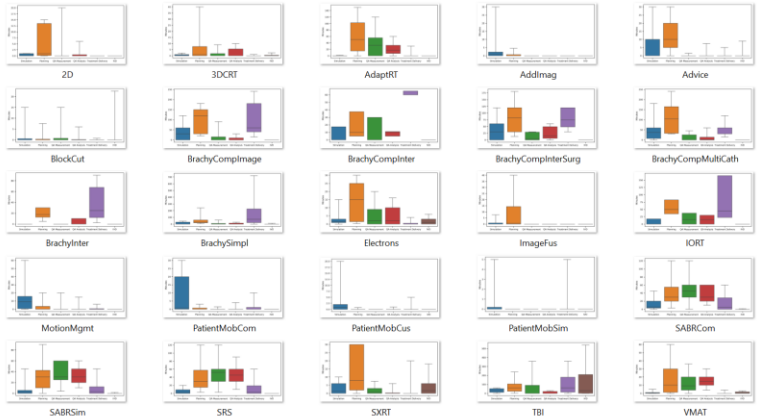
For example, time spent by ROMPs on patient-based activity (e.g. external beam and brachytherapy) was broken down into time spent on simulation, planning and checking, patient-specific QA measurement and analysis, treatment delivery, and in-vivo dosimetry.

Equipment based activity was broken down according to frequency (e.g. daily, weekly, monthly, annually, etc.), and maintenance and commissioning time.

This provided a lot of data that hasn't been fully explored yet, allowing for example, the identification of activities where practices are inconsistent across departments.

Facility snapshot





E.g., ROMP time spent on VMAT/ IMRT sub-activities.

Facility snapshot

Clinical activity	Volume (cases)	Mean time (min)	Mean by site (min)	Median by site (min)
2D	2,268	7.9	27.0	4.3
3DCRT	17,536	23.0	16.2	7.1
VMAT/IMRT/Tomotherapy	56,723	57.1	54.7	45.3
SXRT/superficial	2,467	22.8	27.0	20.5
Electrons	5,532	32.2	33.9	27.6
SABR simple (e.g. bony met)	2,580	103.7	122.2	102.3
SABR complex (e.g. lung with motion management)	2,442	157.2	161.8	156.0
SRS	2,500	153.0	167.2	129.0
Adaptive RT	217	145.5	181.6	110.0
TBI	227	486.9	594.1	523.0
Motion management	7,565	14.1	24.9	10.0
Simple patient positioning	5,416	2.1	2.2	0.0
Customised patient positioning	9,318	1.7	6.6	1.5
Complex patient positioning	2,764	7.2	16.0	7.8
Additional image acquisition (MRI/PET)	14,510	4.6	10.8	1.5
Additional activities related to treatment volume definition	16,136	7.9	16.4	3.0
Block cutting / accessories / bolus	8,137	5.2	15.4	5.5
Advice for implanted devices	3,188	23.4	25.1	20.0
Evaluation / advice during treatment	9,235	10.7	19.6	20.0
Brachytherapy, simple insertion with image guidance	360	203.3	399.2	140.0
Brachytherapy, complex insertion of intracavitary	442	320.2	278.6	300.0
Complex insertion of intracavitary, endocavitary, intraluminal, endovascular applicators	230	286.3	315.5	277.5
Complex insertion of interstitial implants not requiring surgery w/ image guidance	264	249.1	258.9	225.0

There was a lot of activity data!

Facility snapshot

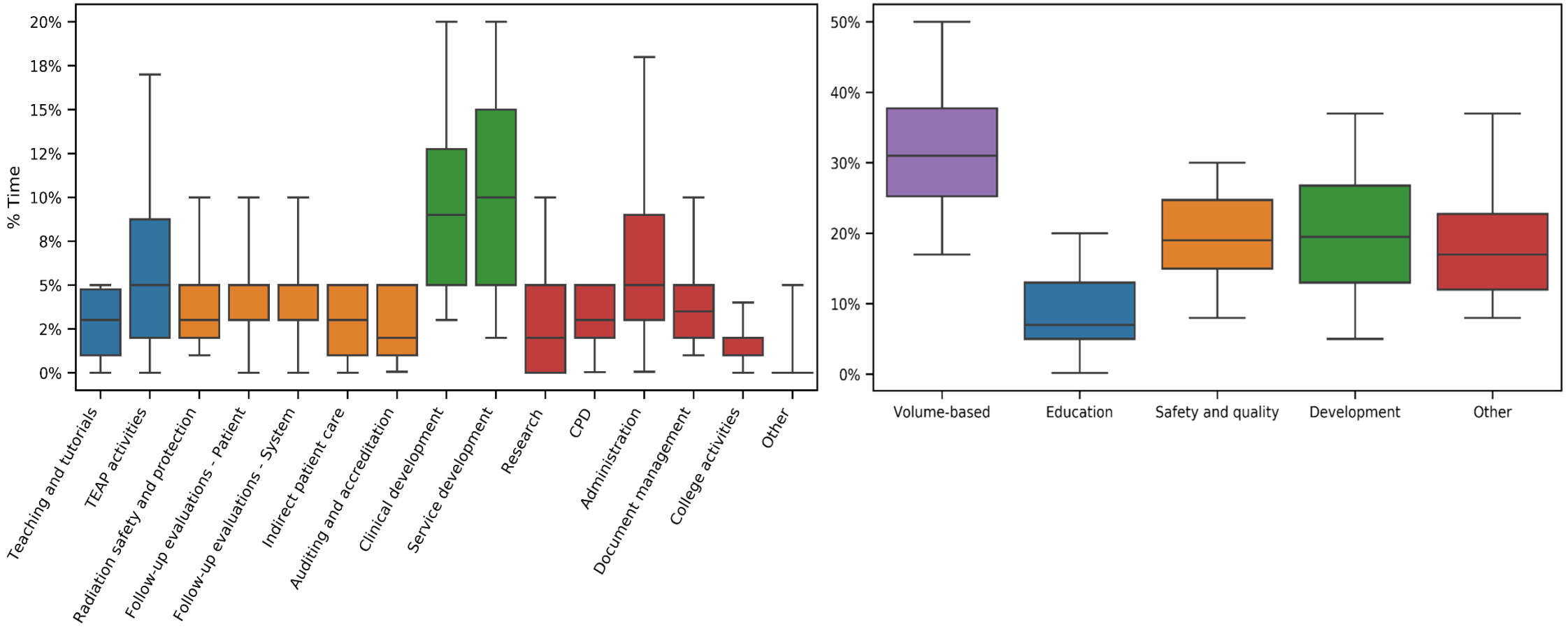
Equipment	Count (units)	Mean QA time (hr yr^{-1})	Commissioning time (hr)
Superficial x-ray therapy	36	84.8	95.0
Linear accelerator	211	192.4	510.5
CT simulator	91	52.5	41.5
HDR/PDR brachytherapy	24	102.4	83.5
LDR brachytherapy	17	18.3	-
Ultrasound	19	13.1	27.5
Cone beam CT	167	24.0	49.1
On-board imaging	139	14.2	57.5
Non-orthogonal kV	19	35.4	-
Surface guidance radiotherapy system	24	46.2	-
Electronic portal imaging device	175	18.9	23.0
MRI, PET-CT, 4D CT sim, SPECT-CT systems	76	35.2	41.5
Treatment planning system	145	54.4	474.5
Record and verify / oncology information system	66	46.6	46.5
Data management systems	55	81.7	107.0
Image processing and registration systems	50	15.7	55.0
Independent dose verification system	93	21.8	216.5
Absolute dosimetry equipment	271	15.8	46.0
Relative dosimetry equipment	383	10.8	14.5
Survey and monitoring equipment	158	4.4	5.5
In-vivo dosimetry equipment	95	15.0	53.0
Automatic/manual block cutter	25	2.5	4.0
Workshop for accessories, devices	34	19.0	38.5
SRT / SBRT / SRS / IORT equipment	63	35.6	58.5
Other equipment	46	50.8	217.5

Commissioning estimates varied a lot, due to variations in interpretation.

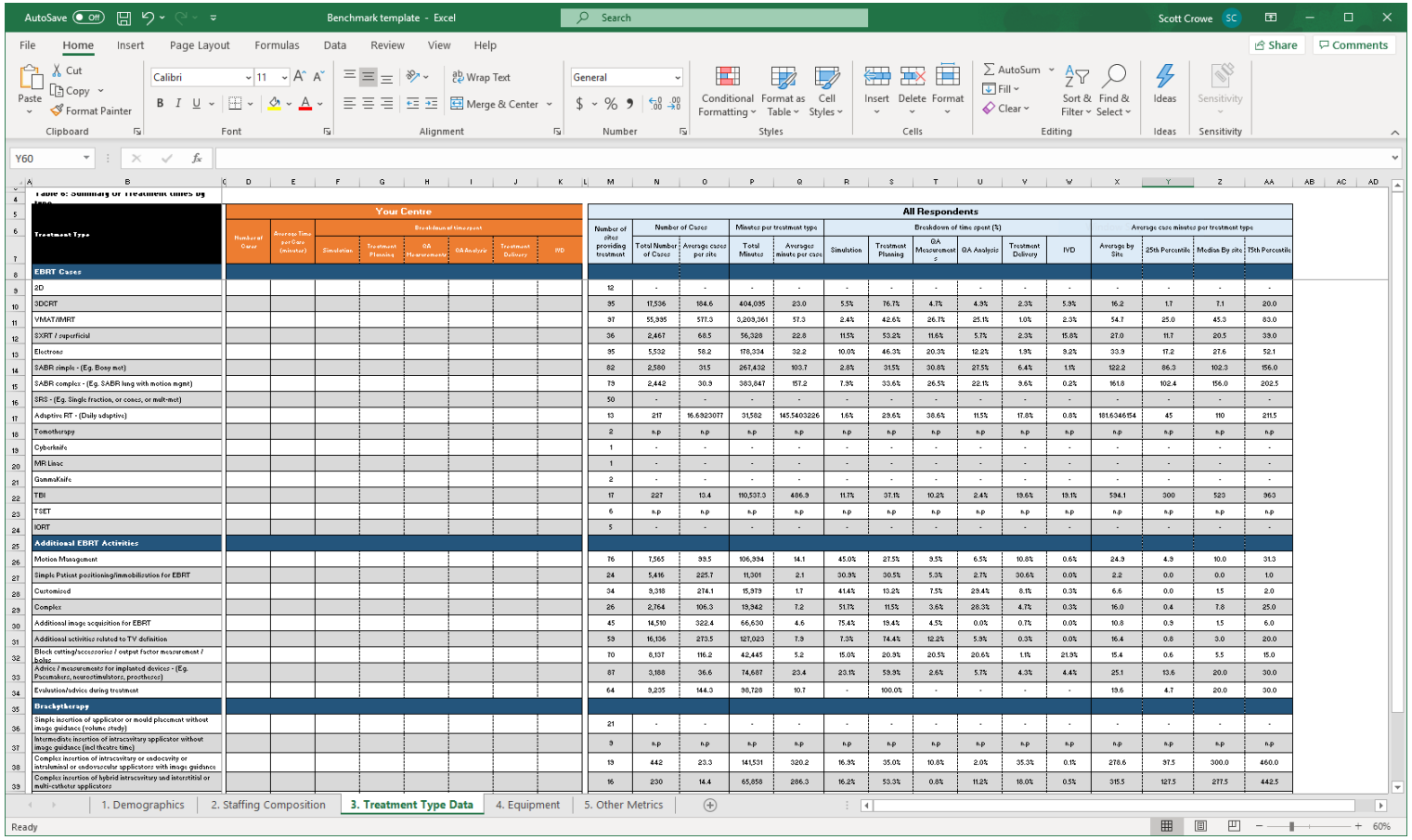
E.g. time spent on a new system in 2020 **vs.** time spent in 2020 on upgrades to an existing system **vs.** per annum mean assuming 10 year life cycle.

Refined by task group by Delphi process.

Facility snapshot



Facility snapshot



Survey results were returned to facilities that responded as a benchmarking tool.

This enabled a comparison of local practices against Australian and New Zealand practices.

ARW model

The workforce calculator was adapted from the IAEA activity-based model, except it was solely focussed on the ROMP workforce, and it used time per activity from Australian and New Zealand survey results to calculate workforce requirements.

For activities that were not directly patient- or equipment- driven, example data was included as a guide for the user.

The user can effectively choose between using the lower, median or upper quartile of time estimates from the survey. In this way, variations in departmental practice can be considered. For example, for a department with mature or automated QA processes, the time spent by ROMPs on patient-specific QA may be lower than the median.

Conversely, for a department implementing a new technique, or that frequently performs in-vivo measurements, the time spent by ROMPs may be higher than the median.

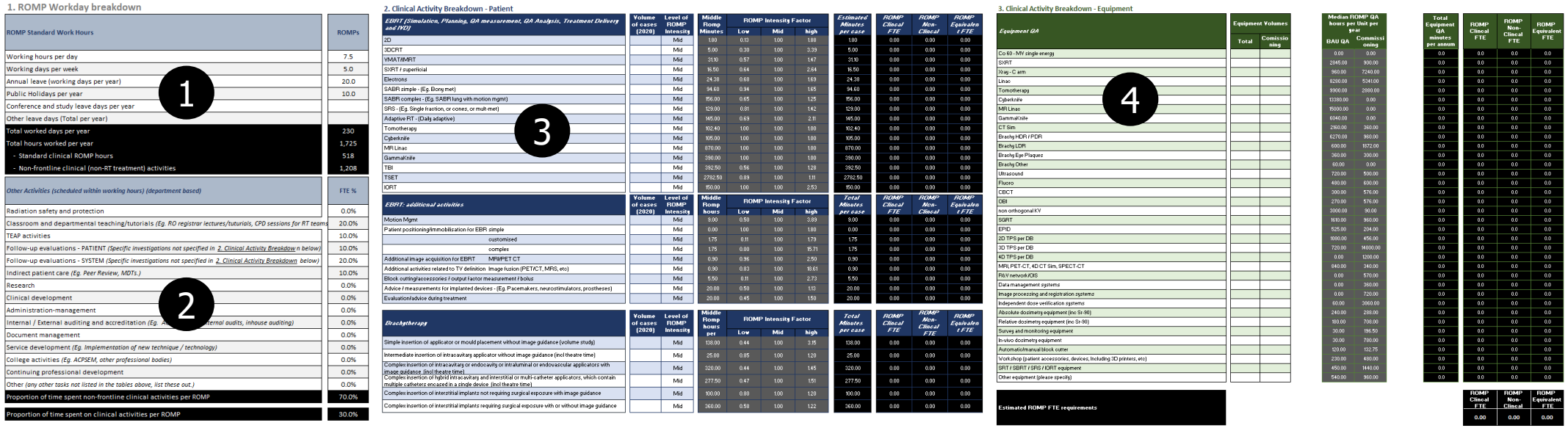
ARW model

2. Clinical Activity Breakdown - Patient

EBRT (Simulation, Planning, QA measurement, QA Analysis, Treatment Delivery and IVD)	Volume of cases	Level of ROMP Intensity	Middle Romp Minutes per Case	ROMP Intensity Factor			*Estimated Minutes per case*
				Low	Mid	high	
VMAT/IMRT/Tomotherapy	1380	Low	45.3	0.55	1.00	1.83	25.0
VMAT/IMRT/Tomotherapy	1380	Mid	45.3	0.55	1.00	1.83	45.3
VMAT/IMRT/Tomotherapy	1380	High	45.3	0.55	1.00	1.83	83.0

Example of low, middle and high ROMP time per task, with 25, 45 and 83 minutes per VMAT/IMRT/Tomotherapy case, respectively. This number reflects total ROMP equivalent time, potentially split across multiple physicists, depending on department practices.

ARW model



The user enters standard working hours (1), estimates of percentage of time spent on activities other than patient- and equipment-based activities (2), patient load data (3) and equipment load data (4).

ARW model

Once completed, the user will get an estimate of the ROMP FTE requirements.

The ROMP FTE requirement indicates the number of registered physicists estimated to be required to handle the workload defined by the user, based on survey results.

The potential contribution of unregistered experienced physicists, TEAP registrars and other staff to this FTE is left to the discretion of the user, as these contributions vary.

Estimated ROMP FTE requirements	ROMP Patient and Equipment QA FTE	*ROMP activities that are not patient or equipment QA specific*				ROMP Equivalent FTE
		Education	*Quality and Safety*	*Clinical and service development*	*Other professional activities*	
	3.23	0.60	0.99	1.22	3.70	9.74

Evaluation

Variable	Large department	Small department
ROMP activity (% of time)	• 31.3% on patient or equipment QA activity. • 9.1% on education. • 19.6% on quality and safety. • 20.3% on clinical and service development. • 19.7% on other activities (including research, CPD, document management, etc.)	• 37.6% on patient or equipment QA activity. • 2.8% on education, with no TEAP training provided. • 19.6% on quality and safety. • 20.3% on clinical and service development. • 19.7% on other activities (including research, CPD, document management, etc.)
Patient courses	• 1,800 external beam patients (89% VMAT/IMRT, 5.5% 3DCRT, 5.5% electrons). • 300 stereotactic patients (33.3% SABR simple, 33.3% SABR complex, 33.3% SRS). • 200 brachytherapy patients (25% simple insertion, 25% complex intra- or endo-cavity, intraluminal or endovascular, and 50% complex interstitial implants)	• 750 external beam patients (80% VMAT/IMRT, 6.7% 3DCRT, 13.3% electrons). • 50 stereotactic patients (100% SABR simple).
Supporting activity (% of cases)	• 20% of cases require motion management • 24% of cases require image fusion • 5% of cases require block cutting and/or accessories • 10% of cases require advice or measurements for implanted devices • 5% require evaluation or advice during treatment	• 12.5% of cases require motion management • 12.5% of cases require image fusion • 12.5% of cases require block cutting and/or accessories • 3.8% of cases require advice or measurements for implanted devices • 2.5% require evaluation or advice during treatment
Major equipment	• 4 linear accelerators with OBI/CBCT/SGRT • 1 stereotactic linear accelerator with non-orthogonal imaging • 1 linear accelerator being commissioned • 1 CT and 1 MR simulator • 1 HDR and 1 LDR brachytherapy system • 3 treatment planning systems	• 2 linear accelerators with OBI/CBCT/SGRT • 1 CT simulator • 1 treatment planning system

Calculations performed for 3 departments, 1 large, 2 small (networked and non-networked).

Evaluation

ROMP equivalent FTE.

Department	ARW	F2000	IAEA	COMP
Large	11.0	23.1	19.4	9.4
Small, standalone	3.4	8.3	5.4	2.8
Small, networked	2.1	8.3	5.4	2.8

Department	ARW	F2000	IAEA	COMP
Large	1.8	3.9	3.2	1.6
Small, standalone	1.7	4.2	2.7	1.4
Small, networked	1.1	4.2	2.7	1.4

ROMP equivalent FTE per linac.

Conclusion

The training program worked!

Number of ROMPs ↑

Vacant positions ↓

Hours worked per ROMP ↓

Year	ROMPs (headcount, not FTE)	Linear accelerators	ROMPs per linear accelerator
2008	268	150	1.79
2011	329	155	2.12
2014	407	197	2.07
2020	519	228	2.28

The developed survey better reflects current practice, and is an improvement on F2000.

Practices will continue to change, and this activity-based approach demonstrated by the IAEA can be adapted to reflect those changes.

Conclusion

Workforce calculator is available on the ACPSEM website, along with supporting documentation.

The report of the workforce task group has been submitted to PESM for review and publication. Supplementary material will include survey instruments, plots of collected data, the workforce model, and example test cases.

This was a group effort, including Venndelta, Howell Round, the task group, the ACPSEM office, and of course the survey respondents. Thanks!