## How Many Physicists Does it Take?

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## Three Staffing Algorithms

1. Time Study (Abt, Klein, Beaulieu, etc.)
   FTE = (Time/Procedure x # Procedures/yr)/(Work Time/yr)
2. FTE Weights (Centre Planning)
   FTE weight assigned to each workload parameter – equipment, procedure, etc
   FTE weight = FTE required for standard # procedures per year
3. Simplified Guideline (Provincial Planning)
   - Ratio normalized to 'n' treated cases /yr
   - Set 'n' by "best fit" for centres of all sizes using method 1 or 2
     e.g., 1 FTE physicist per 300 RT cases/yr (old Ontario guideline)

Ontario Algorithm
Tuesday, 10:30

| ITEM | Workload | FTE Weighting Factor | | | | | |
|---|---|---|---|---|---|---|---|
| | | Physicist | Physics Assistant | Planner | Engineering Electronics | Engineering Mechanical | Computer Support |
| **CLINICAL PROCEDURES and SERVICES** | | | | | | | |
| All radiation beam/source therapy - includes external beam therapy and brachytherapy | 2500 | 1.25 | 0.50 | 5.00 | | 0.50 | 0.25 |
| Complexity bonus increment for inverse IMRT including tomotherapy, clinical trial protocols, gated beams, 4D plans, multi-modality image fusion (cases/yr) . | 700 | 1.05 | | 2.10 | | | 0.21 |
| External beam - special procedure bonus increment (total body X or electron, radiosurgery) (cases/yr) | 50 | 0.25 | 0.13 | 0.05 | | 0.05 | |
| Brachytherapy - LDR or HDR (fractions/yr) | 300 | 0.60 | 0.15 | 0.12 | | | |
| Brachytherapy - interstitial seed implants (cases/yr) | 50 | 0.25 | 0.10 | 0.10 | | | |
| **RADIOTHERAPY EQUIPMENT SUPPORT** | | | | | | | |
| Accelerators (all linacs, including tomotherapy and robotic linacs) | 6 | 1.20 | 1.80 | | 1.80 | 0.60 | |
| Major ancillary RT equipment: TPS (1 per vendor per 10 workstations), PET-CT, MR-Sim, 4D CTsim, HDR | 4 | 0.40 | 0.20 | | 0.80 | 0.20 | 0.40 |
| Minor ancillary RT equipment: X-ray Sim, CT-Sim, LDR unit, Cobalt unit, Gamma Knife, orthovoltage unit, ultrasound unit, gating/motion monitoring device | 4 | 0.20 | 0.10 | | 0.40 | 0.20 | |
| **TRAINING and EDUCATION of specialists** | | | | | | | |
| Radiation Oncology Residents* | 5 | 0.15 | | 0.25 | | | |
| Radiation Therapy Students* | 5 | 0.10 | | 0.25 | | | |
| Clinical Physics Residents * | 2 | 0.20 | | 0.10 | | | |
| Medical Physics Graduate Students * | 3 | 0.40 | | | | | |
| **SubTotals** | | 6.15 | 2.98 | 7.97 | 3.00 | 1.55 | 0.86 |
| **Administration & Other Duties** | | | | | | | |
| Administrative workload per staff category (Human Resources) | | 0.62 | 0.06 | 0.16 | 0.06 | 0.03 | 0.02 |
| Administration (by Chief, Radiation Safety Officer) | | 0.94 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Clinical development, conference attendance, courses, site visits | | 1.77 | 0.03 | 0.08 | 0.03 | 0.02 | 0.01 |
| Time away for paid holidays and vacation (FTE per employee) | | 0.89 | 0.30 | 0.81 | 0.30 | 0.16 | 0.09 |
| **Total required staff of each type** | | **9.75** | **3.31** | **8.86** | **3.33** | **1.73** | **0.96** |

## Why Ontario?

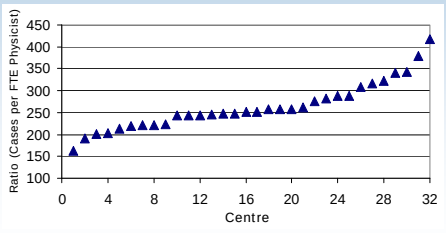
- 1/3 population of Canada
- 10 years experience with the method
- Provincial system promotes standard statistics
- Funded residency program (C$1,000,000/yr, 20 FTE)

**Cross Canada Survey**

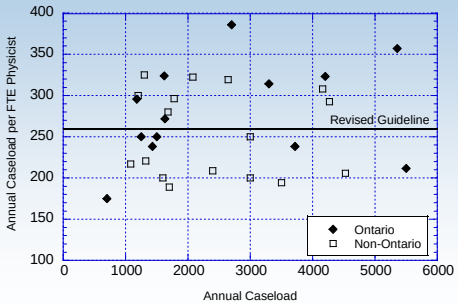
- **32/37** centres responded
- **76,927** annual treated (new) cases
  - 22.3% complex (IMRT, etc.)
  - 14.5% brachytherapy
- **198** megavolt accelerators
- **301.4** medical physicists
- **639** "students" including 45 physics residents

## Results – Algorithm Predictions

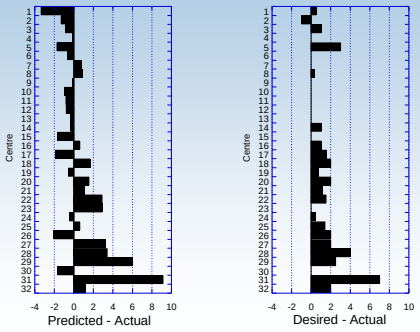
| | Physicist | Physics Assistant | Planner | Engineering Electronics | Engineering Mechanical | IT Support |
|---|---|---|---|---|---|---|
| Average (Canada) | 263.3 | 692.7 | 317.7 | 626.1 | 1269.5 | 2508.0 |
| Standard Deviation | 55.0 | 110.4 | 52.9 | 142.1 | 219.9 | 776.0 |



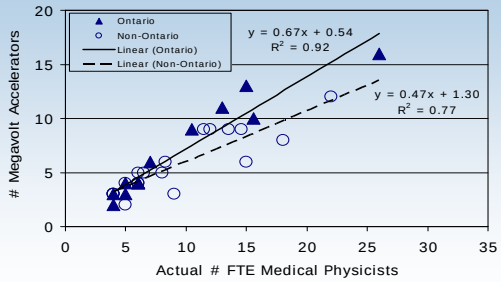

## Actual Annual Caseload / FTE Physicist



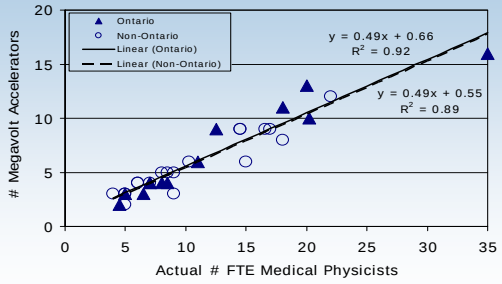
## Results – Algorithm Predictions



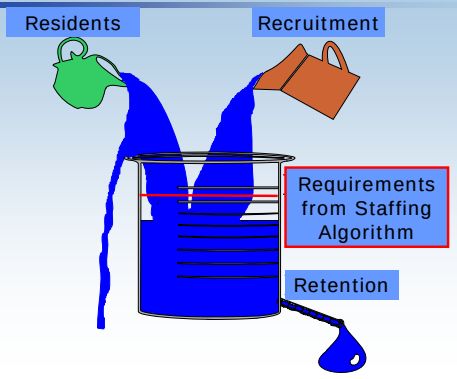

## # Linacs vs # Physicists




## # Linacs vs # Physicists+Assts




## The "4Rs" Model




## The "4Rs" Model

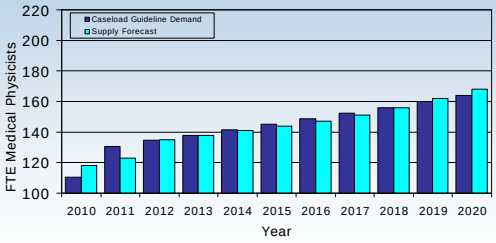
N_end = N_start + N_recruit_external + N_recruit_residency - N_lost

Assumptions:

- 2.5%/year increase in cancer incidence
- 10 treatment hours per day
- 7 physicists/year attrition rate for 2010-2015, then reduced to 5 physicists/yr
- 5 physicists/year out-of-province recruitment, reduced to 0 by 2020
- 7 physicists/year recruitment from Ontario residency program
- No change in clinical practice or utilisation

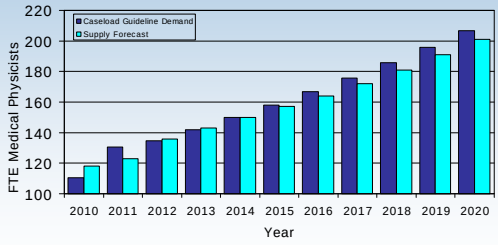
## Results - 4Rs Prediction Ontario

No growth in utilisation



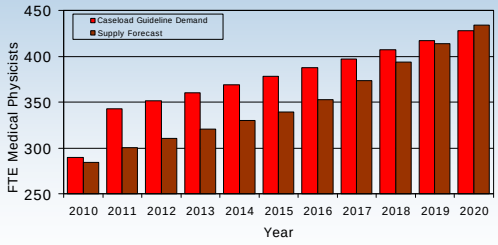
## Results - 4Rs Prediction Ontario

5.5%/yr caseload growth for increase in utilisation




## Results - 4Rs Prediction Canada

Caseload 50% incidence
Residency growth 30-48 FTEs, 80% retention

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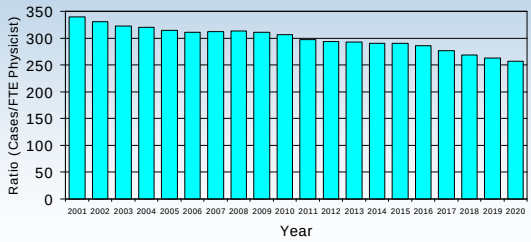


## Proposed Ontario Guidelines

**RT cases/yr/staff**

| **Model Year** | **1999** | **2010** |
|---|---|---|
| 1 Physicist per | 300 | 260 |
| 1 Assistant/Associate per | 600 | 700 |
| 1 Planner per | 500 | 300 |
| 1 Electronics Engineer per | 500 | 600 |
| 1 Mechanical Engineer per | 1000 | 1200 |
| 1 IT Support per | | 2000 |