Technical Report

Future Trends in the Supply of and Demand for Medical Dosimetrists

April 2012

Prepared For:
American Association of Medical Dosimetrists

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Introduction

It is generally accepted that all professions need to plan for the future, and medical dosimetry is no exception to this tenet. A key aspect of such planning is to project future supply and demand from existing statistics, data and modeling. The 2017 initiatives are bringing a sense of rapid change to the medical dosimetry profession.

The American Association of Medical Dosimetrists Board of Directors commissioned a Workforce Survey to be conducted, and as such, a Workforce Committee was formulated. One charge to that committee was to determine a reasonably accurate projection of workforce supply and demand. If too many medical dosimetrists are trained, the resulting oversupply could lead to unemployment and lower wages. If too few training positions are available, the resulting undersupply could result in extended working hours and a lower quality of life. As a significant level of energy is required to create and maintain Joint Review Committee on Education in Radiation Technology (JRCERT) accredited training programs, it is perceived that the immediate danger is the likelihood of creating too few training positions rather than too many. Presently fewer than 50% of medical dosimetrists undergo a formal training program either within or after graduation from an academic program.

Medical Dosimetrists face three major issues:

- The percent rate of retirement of ROPs between the years 2010 and 2020 is approximately triple the rate that existed between 1990 and 2000 due to professional demographics. (See discussion below)

- Cancer incidence is projected to grow at approximately 2% per year. This leads to an increase in the number of cancer patients of approximately 22% between the years 2010 and 2020.

- In 2017, medical dosimetrists must graduate with a academic Bachelor’s degree and graduate from a JRCERT accredited training program in order to enter the certification process of the Medical Dosimetry Certification Board (MDCB). Beginning in 2017, only a graduate of a JRCERT training program wishing to enter medical dosimetry will be able to:

  o Sit for certification by the Medical Dosimetry Certification Board,

  o Be considered a Qualified Medical Dosimetrist (QMD) as defined by the American Association of Medical Dosimetrists

  o Enter the pathway for lifelong maintenance of certification as a Qualified Medical Dosimetrist

Since MDCB certification is required for entry into the profession, by the year 2017 the medical dosimetry profession must create enough training programs and/or combination academic/training programs and training positions to meet the demand. It is generally anticipated that the number of programs and training positions must at least double in order to meet demand, but as of this date there has been no rigorous demand and supply model to defend this assertion.
Methods

A Demand & Supply model assumes that factors affecting both supply and demand may be either positive or negative. See Table 1 and Table 2 for the scope of input information required for the model.

**Table 1 Supply and Demand Model Input Information**

<table>
<thead>
<tr>
<th>Year</th>
<th>New Cancer Patient Prevalence (millions)</th>
<th>MDCB Diplomats in Medical Dosimetry</th>
<th># AAMD Full Members only</th>
<th>Clinical FTE – 0.95 Clinical effort</th>
<th>Number of Medical Dosimetrists Retiring</th>
<th>Assumed Number of Patients per Clinical FTE Dosimetrist</th>
<th>Number of Dosimetry Students Entering JRCERT Pgm.</th>
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Table 2 Age Demographics of AAMD Members, May 2011

Age profile of AAMD members in May of 2011; Source – Spencer Boulter, American Association of Medical Dosimetrists. These numbers are not known precisely, but are estimated by the author based on the 2011 Membership survey and information provided by the AAMD. Total for 2011 is 2513 Full members.

<table>
<thead>
<tr>
<th>Age</th>
<th># Full Members</th>
<th>Age</th>
<th># Full Members</th>
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</table>

An increasing incidence of cancer would increase demand for medical dosimetry services while greater efficiencies in treatment plan optimization might decrease demand. Having more training programs would increase the supply of medical dosimetrists, while increasing retirement rates might decrease the supply. It is therefore important to identify and quantify as many factors as possible that influence both the demand and supply of medical dosimetrists.

The Demand information used as input to the model is:

- Cancer incidence and prevalence 1990 – 2020 (American Cancer Society)
- Median new cancer patients treated per Clinical FTE Medical Dosimetrist (Abt Study of Medical Physicist Work Values for Radiation Oncology Physics Services)

The Supply information used as input to the model is:

- Non-JRCERT medical dosimetrists trained and MDCB Certified 1988 – 2011 and projected through 2017 (calculated based on information provided by Felicia Lembesis, Medical Dosimetry Certification Board, and Spencer Boulter, American Association of Medical Dosimetrists)
• JRCERT accredited program medical dosimetrists trained and MDCB Certified 2004 – 2011 and projected through 2020 (calculated based on information provided by Felicia Lembesis, Medical Dosimetry Certification Board, and Spencer Boulter, American Association of Medical Dosimetrists)

• Number of Working Medical Dosimetrists 1990 – 2011 (calculated based on information provided by Spencer Boulter, American Association of Medical Dosimetrists)

• The demand forecasts are based on the forecasts of incident and prevalent cancer cases, as well as the estimated age and gender-specific oncologist visit-rates for cancer patients developed by the National Cancer Institute (NCI) in July 2006. While constructing the model, several assumptions were made that affect Demand and Supply, both Positive and Negative. These are listed below:

Positive Demand Assumptions:

• One half of all new cancer patients are treated with radiation therapy.

• The median number of new cancer patients managed by an FTE medical dosimetrist was measured as approximately 500 in 1997, 330 in 2002 and 271 in 2007. This factor has a most significant impact on the model. In the absence of additional data, it was assumed that there was a linear decline in the number of patients managed by medical dosimetrists between 1995 and 2007. The median number was assumed to be 500 before 1997 and to continue to decline linearly to approximately 200 in the year 2020. See Table 1, column 8.

• A working medical dosimetrist is assumed to spend 95% of time on clinical service and therefore to provide 0.95 clinical FTE. The remainder of time is allocated to teaching, research, administration and other non-clinical services such as serving on institutional committees, radiation safety, JCAHO facility support, and other duties. Therefore the ratio of working medical dosimetrists to Clinical FTEs is 1.05.

Negative Demand Assumptions:

• Full Members of the American Association of Medical Dosimetrists are involved in radiation oncology medical dosimetry service.

• Since most medical dosimetrists retire between 65 and 69, for a given year, an average of the number of AAMD members between 65 and 69 is used. It was assumed that this percentage remained constant between 2000 and 2007. Assuming the AAMD membership has remained relatively stable, it is possible to project the number of medical dosimetrists retiring as a fraction of the entire membership. When performed, this calculation results in an average retirement rate of 0.015 for the years between 2000 and 2007. (Since this era is before the baby boomers begin to retire, a constant rate is not unreasonable.) For years 2008 – 2020, this same method was used, assuming a rolling 5 year average age based on the age profile of the current AAMD membership. For example, for 2012, the number of medical dosimetrists
between 63 and 67 (as of 2010) was taken, and averaged over 5 years, to determine the number of retiring medical dosimetrists in 2012. This number was multiplied by 0.95 to determine the number of retiring therapy clinical FTEs. Finally, retirement numbers were smoothed and used as input to the calculation model. (Calculated based on information provided by Spencer Boulter, American Association of Medical Dosimetrists)

Positive and Negative Supply Assumptions:

- Assume that figures supplied by the Medical Dosimetry Certification Board and the American Association of Medical Dosimetrists accurately reflect the number of JRCERT and non-JRCERT trained and certified medical dosimetrists entering the workforce between 2000 and 2011.

- Assume a linear ramping of JRCERT accredited program graduates between 2011 and 2020. Evaluate the consequences of training between 75 and 225 training program graduates per year in JRCERT accredited programs in 2020.

The Demand & Supply workforce model was designed and programmed using the STELLA modeling application (ISEE Systems, Inc., Lebanon NH). The model features a means to vary the rate of retirement from that initially predicted by the model and to vary the number of expected JRCERT graduates in the year 2020. Additional output information includes the number of work hours per week of the median QMD, and the cost of maintaining training programs with respect to the number of medical dosimetrists trained. The Demand & Supply model for medical dosimetrists consists of five components: 1) cancer demand, 2) QMD demand, 3) QMD supply 4) training funds and 5) operating funds. The model conveys information and passes data between components to produce the information desired.

Training and Operating Funds Model:

These models contain the following assumptions:

- The inflation rate will rise at 5.0% per year for training wages 2004 - 2020.

- The annual cost to support a dosimetry trainee for a year (salary plus benefits) was estimated at $7,500 in 1996. This is equivalent to approximately $16,500 in 2008.

- The salary plus benefit compensation for the median medical dosimetrist in 1995 was $70,000. This along with a 4% annual increase yields salary and benefit figures experienced today by AAPM membership.

- Annual training funds needed in millions are the dollar amounts to support salaries and benefits of all residents in all United States JRCERT programs.

- Annual faculty salary and benefit funds to support training are the dollar amounts to support faculty salary and benefits for all programs in the United States assuming each resident requires a total 0.5 FTE.
We designed a test of the model using a subset of the data. The presented dataset contains as input the number of medical dosimetrists successfully passing the MDCB between 2000 and 2011. We compare these numbers in this model with projections from the model but missing four years of this data: 2007 - 2011. The purpose of this test is to see if the model would predict over the five year period after 2007 an appropriate Demand and Supply profile for the profession.

**Results**

Respecting the test described above, the assumptions were run for 150 medical dosimetry trainees entering JRCERT training in 2020. The model demonstrates these numbers of MDCB certified medical dosimetrists are currently slightly less than demand and may be creating the beginning of an undersupply. Although in 2009 supply approximately equals demand, between 2010 and 2014, the undersupply may reach 50 – 60 medical dosimetrists less than the number of positions open per year. The model predicts the undersupply is expected to increase once the 2017 mandate takes effect. The current job market bears out this observation as some new medical dosimetry positions are finding it difficult to locate appropriate candidates.

Figures 1, 2, 3, 4 and 5 show the results of the model run for an anticipated 100, 125, 150, 175, and 200 trainees admitted to United States JRCERT programs in the year 2020. The results show the effect on the gap between demand and supply, the median ROP work week, and program costs. Each figure has four quadrants, and each quadrant is discussed as follows:

**Demand and Supply Model** – The red line shows the anticipated number of newly diagnosed cancer patients each year between 2000 and 2020. The green line shows the anticipated number of medical dosimetrists that exit the profession each year due to retirement from the field. The pink line shows the number of medical dosimetrists demanded based on demographics and the median number of new patients for which a medical dosimetrist is responsible. Since the retirement rate is held constant for this analysis, the Demand & Supply Model graph does not change between Figures 1 and 4.

**Medical Dosimetrists Passing MDCB Examination in Medical Dosimetry** – The model assumes a linear increase in the number medical dosimetry trainees entering JRCERT training programs between 2011 and 2020. Additionally, the model assumes a drop in the number of medical dosimetrists who are able to enter the profession after 2017 without going through a JRCERT training program. It is assumed that although this pathway remains open in 2015 and 2016 that the number will already be diminishing by 2015 due to the elimination of the non-JRCERT pathway, the declining job market for entry-level medical dosimetrists without JRCERT training program experience, and the increasing availability of JRCERT training positions. Note that the total number passing the MDCB examination lags the number entering JRCERT training by two - three years.
Upper left quadrant: 1. (Red) New Cancer Patients Each Year. 2. (Pink) New Clinical FTE QMDs demanded. 3. (Green) Exiting QMDs.

Lower left quadrant: 1. (Blue) JRCERT <trainees> Passing MDCB. 2. (Red) Non-JRCERT <trainees> Passing MDCB. 3. (Pink) Total <trainees> Passing MDCB.

Upper right quadrant: 1. (Blue) Average Work Hours per Week. 2. (Red) Gap between Demanded Working QMDs in Clinical Practice and Supply.

Lower right quadrant: 1. (Pink) Annual Training Funds Needed in Millions. 2. (Red) Annual Faculty Salary and Benefit Funds to Support Training.
Figure 2 125 JRCERT Accredited Training Positions in 2020

Upper left quadrant: 1. (Red) New Cancer Patients Each Year. 2. (Pink) New Clinical FTE QMDs demanded. 3. (Green) Exiting QMDs.

Lower left quadrant: 1. (Blue) JRCERT <trainees> Passing MDCB. 2. (Red) Non-JRCERT <trainees> Passing MDCB. 3. (Pink) Total <trainees> Passing MDCB.

Upper right quadrant: 1. (Blue) Average Work Hours per Week. 2. (Red) Gap between Demanded Working QMDs in Clinical Practice and Supply.

Lower right quadrant: 1. (Pink) Annual Training Funds Needed in Millions. 2. (Red) Annual Faculty Salary and Benefit Funds to Support Training.
Upper left quadrant: 1. (Red) New Cancer Patients Each Year. 2. (Pink) New Clinical FTE QMDs demanded. 3. (Green) Exiting QMDs.

Lower left quadrant: 1. (Blue) JRCERT <trainees> Passing MDCB. 2. (Red) Non-JRCERT <trainees> Passing MDCB. 3. (Pink) Total <trainees> Passing MDCB.

Upper right quadrant: 1. (Blue) Average Work Hours per Week. 2. (Red) Gap between Demanded Working QMDs in Clinical Practice and Supply.

Lower right quadrant: 1. (Pink) Annual Training Funds Needed in Millions. 2. (Red) Annual Faculty Salary and Benefit Funds to Support Training.
Figure 4 175 JRCERT Accredited Training Positions in 2020

Upper left quadrant: 1. (Red) New CancerPatients Each Year. 2. (Pink) New Clinical FTE QMDs demanded. 3. (Green) Exiting QMDs.

Lower left quadrant: 1. (Blue) JRCERT <trainees> Passing MDCB. 2. (Red) Non-JRCERT <trainees> Passing MDCB. 3. (Pink) Total <trainees> Passing MDCB.

Upper right quadrant: 1. (Blue) Average Work Hours per Week. 2. (Red) Gap between Demanded Working QMDs in Clinical Practice and Supply.

Lower right quadrant: 1. (Pink) Annual Training Funds Needed in Millions. 2. (Red) Annual Faculty Salary and Benefit Funds to Support Training.
Figure 5 200 JRCERT Accredited Training Positions in 2020

Upper left quadrant: 1. (Red) New Cancer Patients Each Year. 2. (Pink) New Clinical FTE QMDs demanded. 3. (Green) Exiting QMDs.

Lower left quadrant: 1. (Blue) JRCERT <trainees> Passing MDCB. 2. (Red) Non-JRCERT <trainees> Passing MDCB. 3. (Pink) Total <trainees> Passing MDCB.

Upper right quadrant: 1. (Blue) Average Work Hours per Week. 2. (Red) Gap between Demanded Working QMDs in Clinical Practice and Supply.

Lower right quadrant: 1. (Pink) Annual Training Funds Needed in Millions. 2. (Red) Annual Faculty Salary and Benefit Funds to Support Training.
Figure 6 150 JRCERT Accredited Training Positions in 2020

Retirement Rate Adjusted Downward by 25%

(Fewer Dosimetrists Retire; Compare with Figure 3)

Upper left quadrant: 1. (Red) New Cancer Patients Each Year. 2. (Pink) New Clinical FTE QMDs demanded. 3. (Green) Exiting QMDs.

Lower left quadrant: 1. (Blue) JRCERT <trainees> Passing MDCB. 2. (Red) Non-JRCERT <trainees> Passing MDCB. 3. (Pink) Total <trainees> Passing MDCB.

Upper right quadrant: 1. (Blue) Average Work Hours per Week. 2. (Red) Gap between Demanded Working QMDs in Clinical Practice and Supply.

Lower right quadrant: 1. (Pink) Annual Training Funds Needed in Millions. 2. (Red) Annual Faculty Salary and Benefit Funds to Support Training.
Figure 7 150 JRCERT Accredited Training Positions in 2020

Retirement Rate Adjusted Upward by 25%

(More Dosimetrists Retire; Compare with Figure 3)

Upper left quadrant:  1. (Red) New Cancer Patients Each Year.  2. (Pink) New Clinical FTE QMDs demanded.  3. (Green) Exiting QMDs.

Lower left quadrant: 1. (Blue) JRCERT <trainees> Passing MDCB.  2. (Red) Non-JRCERT <trainees> Passing MDCB.  3. (Pink) Total <trainees> Passing MDCB.

Upper right quadrant: 1. (Blue) Average Work Hours per Week.  2. (Red) Gap between Demanded Working QMDs in Clinical Practice and Supply.

Lower right quadrant: 1. (Pink) Annual Training Funds Needed in Millions.  2. (Red) Annual Faculty Salary and Benefit Funds to Support Training.
Gap between Demand & Supply and Average Medical Dosimetrist Work Hours per Week – This quadrant illustrates the gap between demand and supply and the work hours per week of medical dosimetrists between the years 2000 and 2020. The work hours per week are determined based on the manpower available to treat the estimated number of cancer patients treated with radiation oncology. It is important to note that the model assumes a medical dosimetrist will be able to provide services for 500 patients in 1997 and this number declines linearly to approximately 200 in the year 2020. It is certainly possible that medical dosimetry work respecting time-consuming optimization procedures will become more efficient. If that is indeed the case, the presented results might well overestimate medical dosimetrist demand by 2020. The results suggest that creating only 100 JRCERT training positions should be damaging to the profession. Demand is seen to exceed supply and work hours increase beyond reasonable limits. Creating 150 positions is the minimum that would seem to allow for stability in the profession, given work stress and overtime demands involved at this level. Providing the community with 175 training positions would marginally meet anticipated demand and 200 training positions would actually approach equivalence between supply and demand. It should be noted that the pool of qualified QMDs is relatively robust (approximately 2500 – 2700 in the United States at present) and that there is some elasticity in the community to take up the slack if fewer than 150 JRCERT training positions are created. However, if too few positions are created by 2020, there is the possibility in the succeeding years that more medical dosimetrists will retire or leave the profession, with a potential negative impact on patient care.

The model is sensitive respecting several factors, but demonstrates elasticity respecting others. One sensitive factor is the median number of patients a medical dosimetrist supports on an annual basis, as supplied from the Abt data. Medical dosimetrists could become more efficient performing special procedure plans and optimizations and therefore be able to handle more patients per year by 2020. Conversely, medical dosimetrists might be faced with new technologies that allow them to handle fewer patients per year. Since these factors are difficult to predict, it is assumed in this model the median medical dosimetrist will manage 200 patients per year by 2020. However, a 10-20% change in this number has a significant effect on the model.

The retirement of QMDs is another important factor, however one that demonstrates elasticity. Compare Figures 6 and 7 with Figure 3. A 25% change in the retirement rate decreases or increases the median workweek by about 1-2 hours per week, with a 3% decrease or increase in the gap between demanded and supplied medical dosimetrists. Respecting manpower, there seems to be a lot of elasticity in the system, as the pool of clinical FTEs available to do medical dosimetry work is expected to expand or contract based on need and incentives. Retired QMDs may be persuaded to work part-time if the rewards are sufficient.

There is also a potential major impact of the current economic crisis on the delay of QMD retirement. This is expected to manifest beginning in 2012, and may continue for between five and ten years. This factor may lessen the anticipated undersupply over the next 7 years and could positively impact the profession. We may however see hiring and/or salary freezes before the nation’s economy recovers.
One factor that is difficult to predict is the number of medical dosimetry trainees currently participating in non-JRCERT programs that have expedited the progress of their training in order to enter the certification pathway before the 2017 deadline. If these numbers approach 200 MDCB certified medical dosimetrists per year between 2012 and 2017, there could be a sharp oversupply of medical dosimetrists by up to 100 per year through the year 2017. This oversupply could negatively affect the profession’s ability to place medical dosimetrists as well as maintain the current entry level salaries.

Medical Dosimetry Student Support Costs and Faculty Costs to Support Training – It is assumed that the FTE faculty/staff medical dosimetrist support for a training program is 0.5 FTE per trainee. The salary plus benefits for a trainee are also estimated in the model beginning at $7500.00 per year in 1996. Therefore the cost of providing support for one dosimetry student during training is approximately 1/8 the cost in dollars as compared to one FTE of faculty support to mentor and train the student.

The current economic climate might negatively impact the willingness to allocate funds for medical dosimetry training. It might also affect hospital funding decisions with regard to major radiation oncology equipment purchases. These decisions would have an effect on the quality of training available as well as the number of training slots offered. These factors are difficult to predict and beyond the scope of this model.

**Conclusion**

It is easy to be unreasonably pessimistic respecting the ability to create a sufficient number of training positions to meet the projected demand in 2020. However, the true demand is likely to be near ½ the middle of the estimated range (around 150 per year). As more training programs are accredited and as combined academic/clinical training programs emerge, the number of training positions may reasonably be expected to grow to meet the demand required by 2020. The large pool of working medical dosimetrists combined with the elasticity of the workforce helps to buffer the immediate effects of a few years of shortage or surplus. If 150 positions seem to be too few in 2020 or a few years beyond, the AAMD may wish to perform another supply and demand study to ascertain the dynamics of the workforce.

The models suggest that the retiring wave of medical physicists coupled with demographic population growth will expand the market for employment of medical dosimetrists between 2012 and 2020. As the new education and training requirements fall into place, this likely will decrease the supply of new graduates looking for entry level employment. It seems likely that the medical dosimetry community will struggle to create enough training positions to meet demand for several years after 2017. With a large employment pool, the dosimetry community should be able to meet the additional work challenges during this period. If existing medical dosimetry training programs are willing to expand, it is likely this challenge will be met within several years. After 2020, supply and demand should balance as the first wave of graduates from the expanded programs enter the workforce.