
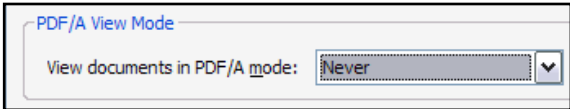
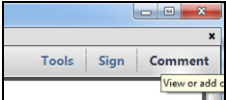
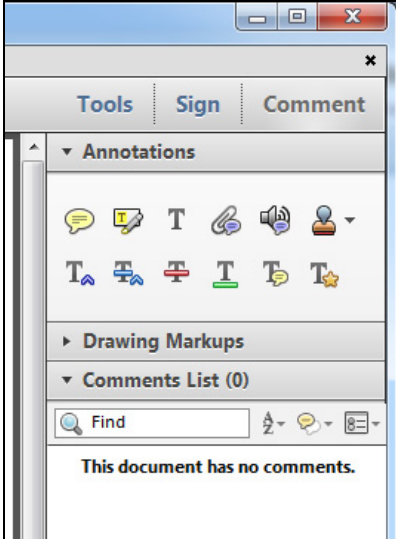


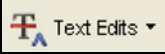


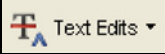

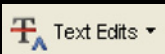





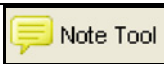

INSTRUCTIONS ON THE ANNOTATION OF PDF FILES

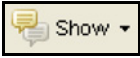
To view, print and annotate your article you will need Adobe Reader version 9 (or higher). This program is freely available for a whole series of platforms that include PC, Mac, and UNIX and can be downloaded from <http://get.adobe.com/reader/>. The exact system requirements are given at the Adobe site: <http://www.adobe.com/products/reader/tech-specs.html>.

Note: if you opt to annotate the file with software other than Adobe Reader then please also highlight the appropriate place in the PDF file.

| PDF ANNOTATIONS | |
|--|---|
| Adobe Reader version 9 | Adobe Reader version X and XI |
| <p>When you open the PDF file using Adobe Reader, the Commenting tool bar should be displayed automatically; if not, click on 'Tools', select 'Comment & Markup', then click on 'Show Comment & Markup tool bar' (or 'Show Commenting bar' on the Mac). If these options are not available in your Adobe Reader menus then it is possible that your Adobe Acrobat version is lower than 9 or the PDF has not been prepared properly.</p>  <p>(Mac)</p> <p>PDF ANNOTATIONS (Adobe Reader version 9)</p> <p>The default for the Commenting tool bar is set to 'off' in version 9. To change this setting select 'Edit Preferences', then 'Documents' (at left under 'Categories'), then select the option 'Never' for 'PDF/A View Mode'.</p>  <p>(Changing the default setting, Adobe version 9)</p> | <p>To make annotations in the PDF file, open the PDF file using Adobe Reader XI, click on 'Comment'.</p> <p>If this option is not available in your Adobe Reader menus then it is possible that your Adobe Acrobat version is lower than XI or the PDF has not been prepared properly.</p>  <p>This opens a task pane and, below that, a list of all Comments in the text. These comments initially show all the changes made by our copyeditor to your file.</p>  |

HOW TO...

| Action | Adobe Reader version 9 | Adobe Reader version X and XI |
|---|---|---|
| Insert text | Click the 'Text Edits' button  on the Commenting tool bar. Click to set the cursor location in the text and simply start typing. The text will appear in a commenting box. You may also cut-and-paste text from another file into the commenting box. Close the box by clicking on 'x' in the top right-hand corner. | Click the 'Insert Text' icon  on the Comment tool bar. Click to set the cursor location in the text and simply start typing. The text will appear in a commenting box. You may also cut-and-paste text from another file into the commenting box. Close the box by clicking on '_'  in the top right-hand corner. |
| Replace text | Click the 'Text Edits' button  on the Commenting tool bar. To highlight the text to be replaced, click and drag the cursor over the text. Then simply type in the replacement text. The replacement text will appear in a commenting box. You may also cut-and-paste text from another file into this box. To replace formatted text (an equation for example) please Attach a file (see below). | Click the 'Replace (Ins)' icon  on the Comment tool bar. To highlight the text to be replaced, click and drag the cursor over the text. Then simply type in the replacement text. The replacement text will appear in a commenting box. You may also cut-and-paste text from another file into this box. To replace formatted text (an equation for example) please Attach a file (see below). |
| Remove text | Click the 'Text Edits' button  on the Commenting tool bar. Click and drag over the text to be deleted. Then press the delete button on your keyboard. The text to be deleted will then be struck through. | Click the 'Strikethrough (Del)' icon  on the Comment tool bar. Click and drag over the text to be deleted. Then press the delete button on your keyboard. The text to be deleted will then be struck through. |
| Highlight text/ make a comment | Click on the 'Highlight' button  on the Commenting tool bar. Click and drag over the text. To make a comment, double click on the highlighted text and simply start typing. | Click on the 'Highlight Text' icon  on the Comment tool bar. Click and drag over the text. To make a comment, double click on the highlighted text and simply start typing. |
| Attach a file | Click on the 'Attach a File' button  on the Commenting tool bar. Click on the figure, table or formatted text to be replaced. A window will automatically open allowing you to attach the file. To make a comment, go to 'General' in the 'Properties' window, and then 'Description'. A graphic will appear in the PDF file indicating the insertion of a file. | Click on the 'Attach File' icon  on the Comment tool bar. Click on the figure, table or formatted text to be replaced. A window will automatically open allowing you to attach the file. A graphic will appear indicating the insertion of a file. |
| Leave a note/ comment | Click on the 'Note Tool' button  on the Commenting tool bar. Click to set the location of the note on the document and simply start typing. <u>Do not use this feature to make text edits.</u> | Click on the 'Add Sticky Note' icon  on the Comment tool bar. Click to set the location of the note on the document and simply start typing. <u>Do not use this feature to make text edits.</u> |

| HOW TO... | | |
|---------------------------|--|---|
| Action | Adobe Reader version 9 | Adobe Reader version X and XI |
| Review | To review your changes, click on the 'Show' button  on the Commenting tool bar. Choose 'Show Comments List'. Navigate by clicking on a correction in the list. Alternatively, double click on any mark-up to open the commenting box. | Your changes will appear automatically in a list below the Comment tool bar. Navigate by clicking on a correction in the list. Alternatively, double click on any mark-up to open the commenting box. |
| Undo/delete change | To undo any changes made, use the right click button on your mouse (for PCs, Ctrl-Click for the Mac). Alternatively click on 'Edit' in the main Adobe menu and then 'Undo'. You can also delete edits using the right click (Ctrl-click on the Mac) and selecting 'Delete'. | To undo any changes made, use the right click button on your mouse (for PCs, Ctrl-Click for the Mac). Alternatively click on 'Edit' in the main Adobe menu and then 'Undo'. You can also delete edits using the right click (Ctrl-click on the Mac) and selecting 'Delete'. |

SEND YOUR ANNOTATED PDF FILE BACK TO ELSEVIER

Save the annotations to your file and return as instructed by Elsevier. Before returning, please ensure you have answered any questions raised on the Query Form and that you have inserted all corrections: later inclusion of any subsequent corrections cannot be guaranteed.

FURTHER POINTS

- Any (grey) halftones (photographs, micrographs, etc.) are best viewed on screen, for which they are optimized, and your local printer may not be able to output the greys correctly.
- If the PDF files contain colour images, and if you do have a local colour printer available, then it will be likely that you will not be able to correctly reproduce the colours on it, as local variations can occur.
- If you print the PDF file attached, and notice some 'non-standard' output, please check if the problem is also present on screen. If the correct printer driver for your printer is not installed on your PC, the printed output will be distorted.

EDITORIAL

A Commentary on Medical Student Perspective for Global Health Care in Radiation Oncology: Opportunities, Barriers to Sustainability, and Future Directions

Jeffrey Burkeen, MS, C. Norman Coleman, MD, Maithili Daphtary, PhD,
and Bhadrasain Vikram, MD

Received Aug 23, 2013

Defining the Gaps

Radiation therapy is one of the most cost-effective ways to treat patients on both a curative and a palliative basis in low- and middle-income countries (LMICs) (1). However, supply is far below need, and a severe shortfall exists for basic radiation services. For example, assuming that a radiation therapy machine can treat 450 new patients per year, it has been recently estimated that Africa needs more than 700 additional machines (2). An equally important barrier to radiation therapy is the lack of trained professionals and technical support. This represents an underserved people problem: those who need services, provide services, and support the services and providers.

This commentary provides the perspective from those who may look ahead to a decades-long career and considers how resource-rich countries might help solve the shortage of radiation oncology expertise. Community service is often a key part in the selection process for medical school and residency positions. According to the 2011 National Resident Matching Program Charting Outcomes in the Match document for radiation oncology, 67% (142/211) of applicants for radiation oncology had 4 or more volunteering experiences, with 85% (120/142) matching to a residency program (3). Community service is valued in the selection process for medical school and residency, but after residency there is a lack of defined career paths to achieve sustainable outcomes, specifically in LMICs.

Based on experience at the National Cancer Institute, this commentary focuses on opportunities for medical students, residents, and faculty to assist the underserved in LMICs, addresses sustainability issues, and offers a new possibility for creating a

career path to address service to the underserved, which would apply to populations in the United States that face health disparities as well. It focuses on radiation oncology, given its potential central role in the treatment of common diseases in LMICs, but the concepts are broadly applicable.

Current Opportunities

A few of the programs that offer opportunities to medical students and residents to become involved in global health initiatives in radiation oncology are highlighted. The Association of Residents in Radiation Oncology (ARRO) and the American Society of Radiation Oncology (ASTRO) have developed the ASTRO-ARRO Global Health Scholars Program, an initiative to encourage international outreach among radiation oncology residents (4). This program allows residents to develop a greater appreciation for the culture and attitudes related to cancer care, with the goal of creating a global perspective of oncology and treatment in LMICs.

Residents in their final year and faculty may participate in the Health Volunteers Overseas program associated with American Society of Clinical Oncology. This program recruits oncology physicians who can share their medical expertise and build sustainable relationships with physicians associated with cancer centers in LMICs (5). Participants teach and train staff and gain insight into the cancer center's management needs and challenges.

The International Atomic Energy Agency (IAEA) offers an internship program, which provides medical students and residents the chance to gain practical work experiences and exposes them to the work of the IAEA and the United Nations as a whole (6).

Conflicts of interest: none

Reprint requests to: C. Norman Coleman, MD, National Cancer Institute, Building 10 – Hatfield CRC, Room B2-3561, Bethesda, MD 20892-1682. Tel: (301) 496-5457; E-mail: ccoleman@mail.nih.gov

Int J Radiation Oncol Biol Phys, Vol. ■, No. ■, pp. 1–3, 2013
0360-3016/\$ - see front matter © 2013 Elsevier Inc. All rights reserved.
<http://dx.doi.org/10.1016/j.ijrobp.2013.10.013>

125 Finally, Radiating Hope offers medical students and residents the
126 opportunity to participate in such projects as Cancer Care, which
127 provides basic hygiene items to cancer patients and hospitals, and
128 the Senegal Project, in which members help update the Cancer
129 Center in Senegal (7).

131 Sustainability Barriers

132 Successful cancer management in LMICs requires extensive
133 capacity building to develop sustainability. This involves recruiting,
134 training, and maintaining staff and obtaining equipment that can
135 function in the resource-limited environment. Realistic goals are
136 needed that are built from the inside out, with local champions,
137 investment, and solutions as key to understanding the unique situ-
138 ation in each site (8). Furthermore, progress is built on appropriate
139 metrics and oversight that allow investments to be spent wisely and
140 the directions changed as necessary by the evolving circumstances.

141 What is striking is that the same issues limit efforts toward
142 helping LMICs by both resource-rich and resource-poor countries.
143 These include political will, addressing social issues of working in
144 underserved places, economic pressures of personnel to fully sup-
145 port their salaries and often subsidize other institutional expenses,
146 and per capita costs for health care that are high in all countries
147 relative to the total economy of the country. Resource-rich countries
148 can learn from resource-poor countries because the latter must
149 optimize every health care dollar with creative solutions (9).

153 Addressing Sustainability and Education

154 Issues

155 The education and training of medical students as future radiation
156 oncologists focused on global health should be an integral part of
157 the overall strategy for improving sustainable care in LMICs. We
158 suggest a targeted education and training plan to develop new
159 career paths for work in LMICs and also in underserved areas
160 within the United States. The effort would incorporate principles
161 of cancer care and public health and address the scope of chal-
162 lenges, which will vary with LMIC. For a medical student, short-
163 term initiatives may include seminars and workshops on global
164 health at the student's home institution, possibly in collaboration
165 with schools of public health.

166 After this training, for those interested in global health as a part
167 of their career, immersion within a LMIC is crucial. For a medical
168 student, short-term visits are important to immerse the student in
169 the local environment. Pairing the medical student with a local
170 radiation oncologist would provide exposure to how care is given
171 in the participating country. The participating resident would
172 spend time with all members of the staff, including physicians,
173 technicians, physicists, diagnostic imagers, and administrators, to
174 develop a better sense of the health care model. Education and
175 training would continue through telecommunications and web
176 conferencing back at the home institution to maintain collabora-
177 tion with the LMIC. Another idea is for senior residents in the US
178 to "adopt" a junior resident in an LMIC and build a long-term
179 relationship through tutoring, E-mail, videoconferencing, and
180 visits over the course of training. The ability to collaborate with
181 LMIC physicians and residents continuously may lead to long-
182 term professional collaborations, and that could help sustain the
183 cancer program in the LMIC.

187 Creating New Sustainable Programs and Career

188 Paths

189 As a new avenue to help address the sustainability of care to the
190 underserved, experts at the National Cancer Institute working with
191 academic, practice, and international colleagues have recently
192 created the International Cancer Expert Corps, Inc (ICEC), a not-
193 for-profit entity that will partner with government to develop
194 human resources for this critical gap. A detailed description and
195 ICEC website are forthcoming (C. N. Coleman et al, unpublished
196 data). Among the underlying premises is that the provision of Q1
197 long-term sustainable progress requires personal commitment,
198 which requires a fundamental change in what is rewarded in one's
199 career and a change in the value system of health care so that
200 human service is valued along with research, teaching, clinical
201 care, and practice revenue. The ICEC aims to sustain both on-site
202 projects and the connectivity over the long term, and it has metrics
203 for productivity and success. What would make the connectivity
204 sustainable would be the ability to have a committed percentage of
205 time and a career path with metrics for evaluation and promotion.
206 Given the cost-effective role of radiation therapy and its role in
207 curative and palliative therapy for the advanced stages of disease
208 seen in LMICs and the ability to develop quality assurance for
209 treatment delivery using telemedicine and chart-rounds-type
210 weekly conferences, radiation oncology will form a key platform
211 on which cancer care facilities in LMICs will be established.

212 Challenges and What Lies Ahead

213 The current situation of worldwide cancer burden in LMICs is un-
214 acceptable. Data from GLOBOCAN 2008 estimated 12.7 million
215 cases of cancer worldwide, with 7.6 million deaths (10). According
216 to this database, 70% of cancer deaths occur in the developing
217 world, and this number will continue to rise, inasmuch as the overall
218 cancer incidence is expected to rise to 15 million new cases in 2015,
219 with 10 million new cases occurring in LMICs. According to the
220 Directory of Radiotherapy Centers website (www.naweb.iaea.org/nahu/dirac), currently 2200 radiation therapy units are available in
221 LMICs, whereas 5000 are estimated to be needed. There are need,
222 opportunity, and potential huge advances to be made.

223 From the perspective of a medical student, the potential for ra-
224 diation oncology to address the shortage of cancer care to the un-
225 derserved is enormous. Building on well-intentioned programs,
226 continuity of participation from medical school to residency to
227 faculty and practice and even through retirement is needed to
228 generate sustainability of care in LMICs. The ICEC model is being
229 explored to address this critical need. All involved—residents, fel-
230 lows, faculty, and mentors—will gain greater appreciation for
231 different cultures and attitudes related to cancer care and will
232 develop an awareness of health disparities and an understanding of
233 the social, economic, cultural, and environmental factors affecting
234 cancer care in LMICs while working with colleagues with similar
235 global health interests.

236 The recognition in 2011 by the United Nations of the growing
237 burden of noncommunicable diseases in LMICs makes this the
238 right time to make fundamental changes (www.un.org/en/ga/ncdmeeting2011/pdf/NCD_draft_political_declaration.pdf). The
239 solution to this problem requires research, creativity, and sus-
240 tainable effort. Capturing the enthusiasm and altruism of students
241 and trainees and supporting them during their professional careers


249 require novel solutions and dedicated students, mentors, and
 250 partners. Big problems require innovative solutions, and radiation
 251 oncology is in a unique position to address the growing burden of
 252 cancer in LMICs.
 253
 254

255 References

- 256
 257
 258 1. Barton MB, Frommer M, Shafiq J. Role of radiotherapy in cancer
 259 control in low-income and middle-income countries. *Lancet Oncol*
 260 2006;7:584-595.
 261 2. Abdel-Wahab M, Bourque JM, Pynda Y, et al. Status of radiotherapy
 262 resources in Africa: an International Atomic Energy Agency analysis.
 263 *Lancet Oncol* 2013;14:e168-e175.
 264 3. National Resident Matching Program. Charting Outcomes in the Match,
 265 2011. Washington, DC: National Resident Matching Program; 2011.
4. Association of Residents in Radiation Oncology. Global Health
 Initiative. Available at: <https://www.astro.org/ARRO/Global-Health-Initiative/Index.aspx>.
 5. American Society of Clinical Oncologists. ASCO International Pro-
 grams. Available at: <http://www.asco.org/international-programs>.
 6. International Atomic Energy Agency. Internship Program. Available
 at: <http://www.iaea.org/About/Jobs/internships.html>.
 7. Radiating Hope. Getting Involved. <http://www.radiatinghope.org/get-involved/>.
 8. Love RR, Ginsburg OM, Coleman CN. Public health oncology: a
 framework for progress in low- and middle-income countries. *Ann*
Oncol 2012;23:3040-3045.
 9. Crisp N. Turning the World Upside Down: The Search for Global
 Health in the 21st Century. 1st ed. CRC Press; 2010.
 10. Ferlay J, Shin HR, Bray F, et al. GLOBOCAN 2008—Cancer Inci-
 dence and Mortality Worldwide: IARC CancerBase No 10. Lyon:
 International Agency for Research on Cancer; 2010.

UNCORRECTED PROOF

AUTHOR QUERY FORM

| | | |
|--|---|--|
|  ELSEVIER | Journal: ROB Article Number: 21870 | |
|--|---|--|

Dear Author,

Please check your proof carefully and mark all corrections at the appropriate place in the proof (e.g., by using on-screen annotation in the PDF file) or compile them in a separate list. Note: if you opt to annotate the file with software other than Adobe Reader then please also highlight the appropriate place in the PDF file. To ensure fast publication of your paper please return your corrections within 48 hours.

For correction or revision of any artwork, please consult <http://www.elsevier.com/artworkinstructions>.

Any queries or remarks that have arisen during the processing of your manuscript are listed below and highlighted by flags in the proof.

| Location in article | Query / Remark: Click on the Q link to find the query's location in text Please insert your reply or correction at the corresponding line in the proof |
|---|--|
| Q1 Q2 Q3 Q4 Q5 | <p>If there are any drug dosages in your article, please verify them and indicate that you have done so by initialing this query</p> <p>Please give date (year) of these unpublished data_x</p> <p>Ref 4, 5, 6, 7: Please give dates you accessed this material_x</p> <p>Reference 9: Please give location of publisher_x</p> <p>Please provide affiliation for all authors_x</p> <p>Please confirm that given names and surnames have been identified correctly.</p> <div data-bbox="304 1378 895 1555" style="border: 1px solid black; padding: 5px;"> <p style="color: red;">Please check this box or indicate your approval if you have no corrections to make to the PDF file</p> <input data-bbox="791 1442 874 1521" type="checkbox"/> </div> |

Thank you for your assistance.