Radiological services in rural mission hospitals in Ghana

J. Sekiguchi¹ & S.R. Collens²

The provision of basic radiological services in rural, first-referral hospitals is an essential component of any country’s attempt to achieve health for all. We report the results of a review of examination frequency trends, operator training background, and machine operational and safety status in the X-ray facilities in rural mission hospitals in Ghana in 1991–92.

The radiological workload at the reporting hospitals was low and declined by more than 50% over the study period. Although most of the X-ray operators had little or no formal training, they produced adequate imaging results. Most of the X-ray machines seen were over 20 years old, yet remained functional, but less than 25% had standard radiation safety (beam limitation) devices. These results suggest that many rural, first-referral hospitals in developing countries could benefit from a careful review of their services and adoption of the WHO Basic Radiological System (WHO–BRS).

Introduction

WHO recommends that radiological services should be available to everyone in need (1, 2). This means that first-referral level hospitals, and all health care facilities at levels above this, should be able to carry out at least chest and skeletal X-rays of their patients. In developing countries there are many challenges in areas where the radiological workload is relatively low, highly trained technicians are few, and aging equipment is costly to repair or replace (3).

In 1986, Tole estimated the frequency of radiological examinations in Kenya, which included workload data for mission and government first-referral level hospitals (4). This study, however, was limited to an estimate of radiological workload, and this only for those examinations performed in 1986. In 1990, Bentil Andam et al. reported data on X-ray equipment type and radiation protection measures for 16 urban hospitals in Ghana (5).

The present article presents the results of an on-site survey of X-ray services at 15 rural mission hospitals in Ghana in 1991–92. Three sets of results are reported and analysed: a 5-year retrospective survey of the frequency of both total and chest X-ray examinations over the period 1986–90; the number and type of X-ray operator(s) observed at their post; and the number, type, and operational status of X-ray equipment found during the survey.

Methods

In March 1991, all 26 of Ghana’s Catholic mission hospitals known to have X-ray facilities were contacted by mail and offered an on-site review of their X-ray services free of charge. This voluntary review was administered by a qualified X-ray technician who had professional working experience both in Japan and Ghana. All the hospitals were assured that the information they provided would be treated in confidence. No sampling methods were employed to select hospitals.

All site visits took place between May 1991 and January 1992. Each visit consisted of four elements. (1) A questionnaire (covering overall hospital workload and historical features of the X-ray unit) was administered verbally to the medical officer in charge (or delegate). (2) The annual X-ray workload data for 1986–90 inclusive was collected directly from the X-ray and/or medical records department(s). (3) All X-ray staff at their posts at the time were interviewed using a second questionnaire. (4) The operational status of all X-ray equipment was assessed using a standardized checklist.

Results

Radiological workload: 1986–90

Of the 26 rural hospitals that were offered an on-site review of their X-ray services, 15 (58%) responded positively. Of these hospitals, four were unable to provide the requested 1986–90 workload data because they had no X-ray equipment operators. This state of affairs had prevailed for 7–34 years in these four institutions. Of the remaining 11 hospitals, not

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all were able to provide workload data for all 5 years requested.

The mean total number of radiological examinations per reporting hospital over the period 1986–90 was 1328 (Table 1), equivalent to 4.3 examinations per hospital per day.⁴ There was a 28% decline in the mean number of examinations per hospital from 1601 in 1986 to 1148 in 1990, corresponding to a reduction from 5.1 examinations per day in 1986 to 3.7 examinations per day in 1990.

The number of hospitals able to report both the total number of chest X-ray examinations and the number of chest X-ray examinations was markedly lower than the response rate for the total number of X-ray examinations only, particularly for 1986 and 1987. The results indicate that the relative frequency of chest X-ray examinations to the total number of radiological examinations was 52–60% over the 1986–90 period, with a 5-year mean of 54% (Table 2).

Type of X-ray operator and level of training

A total of 16 X-ray equipment operators were found at their posts in the 15 institutions visited. Only 3 (19%) of these 16 operators had completed a 3-year technician training diploma programme. The remaining 13 (81%) were either X-ray assistants (4) with a 6-month certificate in basic imaging and darkroom technique or X-ray attendants (9) who were trained on the job. One X-ray technician had received formal training in the United Kingdom; the remaining X-ray technicians and the X-ray assistants had received their training locally at one of Ghana's two teaching hospitals.

No objective measurement technique (i.e., densitometry) was employed to assess the quality of the X-ray imaging results. However, on-site observation of all X-ray operators at the time of survey indicated that the overall quality of imaging results was adequate in most cases.

The mean working experience of the operators was as follows: X-ray attendants (10.5 years); X-ray assistants (6.0 years); and X-ray technicians (3.7 years).

Operational status of the X-ray equipment

Of the 26 X-ray machines in the study hospitals, 15 (58%) were observed to be in use, as shown in Table 3. Of the remaining 11 X-ray machines, 6 (23%) at four hospitals were reported not to be in use because of the lack of operator personnel. A further three X-ray machines (11%) were declared not to be in use because of mechanical faults, while another two (8%) were stated to be non-functional owing to both lack of operator(s) and mechanical faults.

A basic radiation protection device (beam-limitation device for chest X-ray examinations) was found on 6 (23%) of the 26 X-ray machines.

Discussion

Tole estimated that the mean number of X-ray examinations performed by Kenya's mission hospitals in 1986 was 1335 (S.E. = 215) (4). The results of our survey for 15 mission hospitals in Ghana indicate a similar mean workload: 1328 examinations per hospital over the 5-year period 1986–90. The 28% drop in the mean total number of X-ray examinations per mission hospital from 1986 to 1990 could have arisen, in part, because of a substantial reduction in the mean number of outpatient visits per reporting hospital over this period. In 1986, the average number of outpatient visits per reporting hospital was 99 156; by 1990, this workload indicator had fallen to 48 807 (51% reduction). The mean number of inpatient admissions per reporting hospital also declined over the same period from 6124 to 5655 — an 8% drop. The causes of this decline in outpatient visits require further investigation.

In our survey, only 19% of the X-ray operators seen at their post were X-ray technicians. Difficulties in recruiting and retaining fully trained technical (and professional) staff remain a major concern in many rural mission facilities in Ghana. As in other developing countries, in Ghana urban health facilities offer better housing, more modern equipment, and a wider range of social amenities than are usually found in rural settings. Furthermore, the average workload for X-ray operators in the mission hospitals in this survey was 4.3 examinations, i.e., approximately 1 hour of work per day. This lower radiological workload than in busier urban health facilities creates a clear disincentive to X-ray technicians considering a rural post.

Two findings on utilization of radiological personnel in the surveyed mission hospitals merit further consideration; first, the potential for recruiting X-ray technicians to rural health facilities was low; and second, the overall quality of radiological examinations carried out by non-technician X-ray operators was adequate in most cases. The presumed staffing requirement in Ghana’s rural hospitals — highly trained X-ray technicians for the provision of basic radiological services — may therefore require review.

Most of the 26 X-ray machines seen were more than 20 years old. It is therefore remarkable that 21

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⁴ Calculated assuming 312 working days a year, i.e., six working days per week.
Radiological services in rural Ghana

### Table 1: Mean total number of radiological examinations performed per reporting mission hospital in Ghana, 1986–90

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<tbody>
<tr>
<td>No. of hospitals reporting data</td>
<td>7</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>11</td>
<td>—</td>
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<tr>
<td>Total examinations reported</td>
<td>11 208</td>
<td>11 956</td>
<td>12 881</td>
<td>11 079</td>
<td>12 625</td>
<td>11 950</td>
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<tr>
<td>Mean examinations per hospital</td>
<td>1 601</td>
<td>1 495</td>
<td>1 288</td>
<td>1 108</td>
<td>1 148</td>
<td>1 328</td>
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</table>

### Table 2: Relative frequency of chest X-ray examinations performed per reporting mission hospital in Ghana, 1986–90

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<tbody>
<tr>
<td>No. of hospitals reporting data</td>
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<td>4</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Total examinations reported</td>
<td>979</td>
<td>1 050</td>
<td>709</td>
<td>544</td>
<td>577</td>
<td>772</td>
</tr>
<tr>
<td>Mean examinations per hospital</td>
<td>1 864</td>
<td>1 764</td>
<td>1 295</td>
<td>1 053</td>
<td>1 097</td>
<td>1 415</td>
</tr>
<tr>
<td>Relative frequency of chest X-ray examinations (%)</td>
<td>52</td>
<td>60</td>
<td>55</td>
<td>52</td>
<td>53</td>
<td>54</td>
</tr>
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* Those hospitals that were able to report both total and chest X-ray examinations.

### Table 3: Distribution of the number of X-ray machines, by manufacturer, operational status, estimated mean age, and radiation protection device for the 15 mission hospitals, Ghana, 1992

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>No.</th>
<th>Operational status:</th>
<th>Estimated mean age (years)$^b$</th>
<th>No. with a radiation protection device$^c$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>NI–O</td>
<td>NI–M</td>
</tr>
<tr>
<td>Siemens (Germany)</td>
<td>10</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Philips (Netherlands)</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Enraf (Netherlands)</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td>Watson (United Kingdom)</td>
<td>3</td>
<td>2</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Radiologia (Spain)</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Chirama (Czech Republic)</td>
<td>1</td>
<td>—</td>
<td>1</td>
<td>—</td>
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<tr>
<td>Picker (USA)</td>
<td>1</td>
<td>1</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Shimadzu (Japan)</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Tanaka (Japan)</td>
<td>1</td>
<td>1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Akoma (Japan)</td>
<td>1</td>
<td>—</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td></td>
<td>15</td>
<td>6</td>
</tr>
</tbody>
</table>

$^a$ I = in use; NI–O = not in use because of lack of operator; NI–M = not in use because of a mechanical fault; NI–O+M = not in use because of both lack of operator and a mechanical fault. "In use" refers to functioning X-ray machines only; this is no indication of any level of operational quality.

$^b$ Crude estimates only, based on verbal reports from hospital management and on-site operational assessment.

$^c$ Beam-limiting device for chest X-ray examinations only.

$^d$ Figures in parentheses are percentages.

$^e$ Average value.
(80%) of these machines were still functional at the time of the survey. In most cases, emissions from the X-ray tubes were adequate but weak. Also, the low proportion (23%) of X-ray machines that had a beam-limitation device for chest X-ray examinations may indicate a radiation risk to operators and patients. As a result, most of the mission facilities visited in the survey were advised to replace their X-ray machines at the earliest feasible opportunity.

It has been reported that the WHO Basic Radiological System (WHO–BRS), which has been well documented since the early 1980s (6–10), avoids many of the difficulties observed and discussed in this survey (11). Three features of the WHO–BRS provide considerable assistance in improving basic X-ray services at rural first-referral level hospitals in many developing countries. First, operators need only a short training period (2 weeks to 3 months) to produce high-quality radiographs of all parts of the body. This allows busy X-ray departments in larger urban hospitals to use highly trained X-ray technicians and expensive equipment for more complex examinations. Second, because of its lower purchase price and maintenance costs the WHO–BRS is more cost-effective than standard X-ray equipment. Third, the beam limitation of the WHO–BRS reduces the risk of harmful irradiation of patients and operators.

\[b\] Guidelines for the installation of the WHO basic radiological system (BRS). Unpublished WHO document RAD/86.1. 1986.

Acknowledgements

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Résumé

Services radiologiques dans les hôpitaux de mission situés en zone rurale au Ghana


Le nombre moyen d’examens radiologiques (total des examens) pratiqués dans chaque hôpital de mission participant à l’enquête pour la période 1986–1990 était de 1328 (environ 4,3 examens par hôpital et par jour). Bien que ce chiffre soit remarquablement voisin de celui relevé dans les hôpitaux de mission au Kenya en 1986, on a observé au Ghana une baisse de 28% du nombre total moyen d’examens par hôpital sur la période de 5 ans étudiée. Ce fait a été attribué en partie à la baisse de fréquentation (51%) des consultations externes pendant cette même période. La proportion de radiographies pulmonaires par rapport à l’ensemble des radiographies a été en moyenne de 54% de 1986 à 1990.

Sur les 16 techniciens en radiologie vus et interrogés, 3 seulement (19%) avaient suivi une formation officielle complète de 3 ans. Les autres, soit 81%, n’avaient qu’un diplôme sanctionnant une formation de 6 mois en éléments d’imagerie médicale ou n’avaient reçu qu’une formation en cours d’emploi.

Au total, 26 appareils de radiographie ont été vus dans les 15 hôpitaux. Seuls 15 d’entre eux étaient en état de fonctionner au moment de l’enquête; les 11 autres étaient inutilisables par manque d’opérateur ou en raison d’une panne mécanique. Sur les 26 appareils, 6 (23%) étaient un dispositif de protection contre les rayonnements (limitation du faisceau pour les radiographies pulmonaires).

La baisse de 28% du nombre total d’examens radiologiques effectués de 1986 à 1990 dans les hôpitaux visités et la baisse correspondante de 51% du total des consultations externes pendant cette même période devront être éclaircies. La proportion de radiographies pulmonaires (54%) par rapport à l’ensemble des radiographies effectuées de 1986 à 1990 est analogue à celle qui est rapportée dans les hôpitaux de mission d’autres pays en développement.

Dans les 15 hôpitaux visités, il est depuis longtemps difficile de recruter et de garder des techniciens en radiologie ayant reçu une formation complète. Les mauvaises conditions de logement, l’absence d’avantages sociaux et la faible charge quotidienne de travail rebutent nombre de techniciens qualifiés candidats à un poste dans un hôpital rural.
Le système radiologique de base de l’OMS (WHO-BRS) pourrait offrir une solution aux nombreux problèmes liés à la fourniture de services radiologiques de base dans les hôpitaux ruraux de premier recours tels que ceux que nous avons visités.

References