

## Utilization of Radiology Service at Dungun District Hospital in Malaysia

San Thitsa Aung <sup>1\*</sup>, San San Oo <sup>2</sup>, M. Kamil <sup>3</sup>, Zay Soe <sup>4</sup>, Zaw Aung <sup>5</sup>, Aung Zin Oo <sup>6</sup>, Yin Moe Han <sup>7</sup>

<sup>1</sup>Senior Lecturer, Department of Paediatrics, UCSI University, Malaysia

<sup>2</sup>Senior Lecturer and Head of the Woman, Child and Family Health Department, UCSI University, Malaysia

<sup>3</sup>Professor and Deputy Dean of UCSI University, Malaysia

<sup>4</sup>Associate professor and Head of the Internal Medicine department, UCSI University, Malaysia

<sup>5</sup>Senior Lecturer, Department of Internal Medicine, UCSI University, Malaysia

<sup>6</sup>Senior Lecturer, Department of Anaesthesiology, UCSI University, Malaysia

<sup>7</sup>Senior Lecturer, Department of Obstetrics and Gynaecology, UCSI University, Malaysia

\* **Corresponding Author:** San Thitsa Aung  
M.B.,B.S. M.Med.Sc (Pediatrics),  
Senior Lecturer  
UCSI University, Malaysia  
Email: dr.santhitsaung@gmail.com

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### Abstract

**Introduction:** District hospitals in Malaysia, like other district hospital all over the world, function as important gateway between primary and tertiary health care systems. Dungun hospital, one of the district hospitals in Terengganu state, provides services to accidents and emergency, inpatients and outpatients including referrals from community and primary health care services. In addition, it serves as referral hospital to get tertiary health care from Terengganu State hospital. Dungun hospital is equipped with three X-ray units and three ultrasound machines for 24-hour service. Being a district hospital, Dungun hospital can provide only the generalist service without radiologist. Yet the radiology service is accessible for all demands.

**Objective:** To explore the utilization of radiology services at Dungun District Hospital, Terengganu State, Malaysia.

**Methods:** Retrospective one-year record review study was conducted. X-ray request forms and registration books between 1<sup>st</sup> January 2011 and 31<sup>st</sup> December 2011 were reviewed and double checked by pediatrician, physician, surgeon, obstetric and gynecologist, radiologist, staffs from radiology unit of Dungun Hospital, public health professionals and matron who sit and made consensus altogether to enter data properly. Data management for 13649 X-rays cases was done within 4 months from September, 2012 to December, 2012.

**Results:** Dungun Hospital is a 100-bedded hospital in which (11) medical officers, (378) total staffs, (315) clinical staffs and (9) visiting specialists are attached. Radiology unit equipped with

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(1) Static X-ray machine, (2) Portable machines, (5) radiographers and additional (2) PPKs (Pembantu Perawatan Kesehatan) and (15) trainee radiographers. Out of a total of 13649 radiological examinations, the highest number (5603) was contributed by the extremities X-rays followed by the chest X-ray (5355), the spine X-ray (1090), the skull X-ray (1082) and the abdominal X-ray (519) respectively. Among the study group, 8451 were males, (3685) of them took extremities X-ray and (3063) took chest X-ray. Out of 5198 females, chest X-ray and extremities X-ray were taken by (2292) and (1918) respectively. The age range in the study group was from 1 to 99 years. The mean age was 32.01 years (32.01±20.92). Out of 13649 examinations, majority (6324) was requested from A & E Department, followed by (3438) from out-patient department, (1462) for Routine Medical Examination (RME), (1061) from specialist clinic referral, (822) for in-patients in various wards and (542) utilized as portable X-ray. Amongst total utilization of Chest X-ray, 75.3% had properly and completely filled the request form (properly given relevant information on request form). It was found that 71.9% in Abdominal X-ray utilization, 78.2% in skull X-ray utilization, 73.9% in Extremities X-ray request and 74.1% in Spine X-ray services filled the forms properly and completely as well.

**Conclusion:** According to operational definition of appropriateness of this study, findings can be concluded that the radiology services at Dungun District Hospital were appropriately utilized.

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**Key words:** Utilization, Radiology Service, District Hospital, Health Care

## **Introduction**

Diagnostic radiology is a major growth industry in the healthcare sector worldwide, but most citizens in rural and impoverished areas currently lack access to any form of imaging. While 96% of emergency departments in the United States have CT scanners, large swaths of rural populations in resource-poor countries lack access to basic ultrasound and X-Ray. Unfortunately, very little solid data exist that provide an accurate picture of the current global neglect.<sup>3</sup> In 1986, Tole did a study on frequency of diagnostic X-ray examinations in 67 medical centers in Kenya. Thirty one district and sub-district hospitals were included in the study. The results indicated that the estimated annual frequency of X-ray examination was one-tenth of a typical industrialized country and the bulk of the examination was constituted by limb and chest radiography.<sup>6</sup> Other studies on radiological service include a study done by Sekiguchi and Collens (1995) on radiological service in first referral hospitals in Ghana and 2 Spanish studies; one on radiology demand in primary health care carried out by Belle'et al (1992) at Public Health Care Center Poblenu, in Barcelona and a study by Delgado Nicolás and Peces Morate (1996) which analysed the quality of requests in primary health care for radiological investigation.<sup>5</sup>

This project was carried out to study how the radiology service is utilized with currently available physical and human resources in fulfilling the demands of community by the district health care providers. The study was a retrograde study of the hospital records and registry using structured proforma. The data between 1<sup>st</sup> January 2011 and 31<sup>st</sup> December 2011 were collected.

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District hospitals in Malaysia, like other district hospital all over the world, function as important gateway between primary and tertiary health care systems. Dungun hospital, one of the district hospitals in Terengganu state, provides services to inpatients and outpatients including referrals from community and primary health care services. On the other hand, it serves as referral hospital to get tertiary health care from Terengganu State hospital. Dungun hospital is equipped with three X-ray units and three ultrasound machines for 24-hour service. Being a district hospital, Dungun hospital can provide only the generalist service without radiologist. Yet the radiology service is accessible for all demands.

According to the annual report by Ministry of Health Malaysia, there are 1,920 community clinics, 808 health clinics, 90 maternal and child clinics and 130 government hospitals for a population of 28.31 million with an average population growth rate of 2.1 per 100 populations.<sup>2</sup> Out of 130 government hospitals 74 are non-specialist hospital. Dungun district hospital is one of the four non-specialist hospitals in Terengganu state providing secondary health care service to the community of (53674).<sup>1</sup>

Dungun hospital is 92-bed hospital and the diagnostic services such as radiology and laboratory services play essential supportive role in its health care provision to the community. There is very few literature on these supportive services internationally and locally.

This study was intended to do survey on the facilities, human resource and utilization of radiology service in the last one year at Dungun hospital. The results from our study will be a preliminary database for future extended studies on the supportive services in other non-specialist hospitals in Terengganu state and in other states in Malaysia. The results will positively highlight the areas to be improved in the current radiology service at Dungun hospital.

These results can be useful for setting norms and standards for district hospital services in the state or in the country. Other district hospitals could benefit from our results in future improvement planning. Findings on adequacy of currently available physical and human resources will positively enhance improvement in future development plan of Dungun district hospital. Those things are call for doing this research at Dungun District Hospital, Terengganu State, Malaysia.

## **Objectives**

### ***General Objective***

To explore the utilization of radiology services at Dungun District Hospital, Terengganu State, Malaysia.

### ***Specific Objectives***

1. To identify the radiological examinations performed for patients who took health care services from Dungun hospital between 1<sup>st</sup> January and 31<sup>st</sup> December 2011.

2. To describe the types and nature of utilization of radiological service
3. To review the reasons of utilizing radiological examinations on 24-hour basis.
4. To identify the completeness of X-ray request form by non-specialists health care providers at Dungun Hospital.
5. To identify the appropriate utilization of radiological examinations by type of radiological examination at Dungun Hospital
6. To describe the facilities for radiology service at Dungun hospital.

## **Research Methodology**

**Study design:** Retrospective one-year record review study.

**Study population:** Hospital records and registry between 1<sup>st</sup> January 2011 and 31<sup>st</sup> December 2011.

**Procedure of data collection:** The hospital director and the management of Dungun district hospital was explained in details about the aim and objectives of the study, information and data required for the study. First, approval from Director of Terengganu State Health was obtained and then from the Hospital Director. With the approval of the University research committee and ethical clearance by hospital authorities, data retrieval was performed using well-structured proforma, according to the objectives of the study after getting informed consent from the person(s) concerned (appendix B).

### ***Inclusion criteria***

All the cases registered in Dungun Hospital Radiology Register book from 01.01.2011 to 31.12.2011.

### ***Exclusion criteria***

Cases which are not included in this study are:

- put in foot note (E.g.; \* 11163 in foot note of registration book, but not in X-ray request form)
- can't be read because of improper hand writing

### ***Data collection tools and methods***

Data collection tools

1. Two structured proforma
2. X-ray request forms (12 months)

### 3. Radiology Registration book (01.01.2011 to 31.01.2011)

Data collection method was observation of all X-ray request forms and registration books. Double check was done. After getting approval letter from State Health Office, data collection team including pediatrician, physician, surgeon, obstetric and gynecologist, radiologist, staffs from radiology unit of Dungun Hospital, public health personals and matron who sit and made consensus altogether to enter data properly. Data management for 13649 X-rays cases was done within 4 months from September, 2012 to December, 2012.

For the study on utilization of radiological services at district hospital, two proforma was constructed. Form 1 comprised of socio-demographic data of patients, number of view in single radiological examination, types of radiological examination by months, nature of request for radiological examination, reasons for requesting radiological examination, completeness of request form by non-specialists health care providers and appropriate request of radiological examinations by type of radiological examination. Form 2 consists of facts and facilities of Dungun Hospital and radiology service between 01.01.2011 and 31.12.2011.

#### *Data processing and data analysis*

Data analysis was done by SPSS 16.0 software applying the descriptive summary statistic method and making frequency tables. Incompleteness and inconsistencies was checked and corrected. After checking the missing data and inconsistencies, data analysis was conducted.

#### *Ethical consideration*

The study was conducted through the permission of ethical board of UCSI University Faculty of Medicine and Health Sciences, Research Department and National Malaysia Research Team. Before asking for required documents, each and every official concerns from Dungun Hospital were explained about the study, the research purposes and their agreement and permission and allowance was obtained to use those registration. The name of the study respondent was not required on the form to ensure confidentiality.

#### *Operational definitions*

As shown in Appendix A.

## **Results**

### **Introduction**

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***Facts and facilities of Dungun Hospital and Radiology Unit between 01.01.2011 to 31.12.2011  
[this paragraph needs to be removed to the introduction of the results]***

Dungun Hospital is 100-bedded hospital and (11) medical officers, (378) total staffs, (315) clinical staffs and (9) visiting specialists are working there. The existing radiological facilities at Dungun Hospital. There are (1) Static X-ray machine, (2) Portable machine, (5) radiographer and additional (2) PPK (Pembantu Perawatan Kesehatan) and (15) trainee radiographers.

***Age distribution***

The cases ages ranged from 1 to 99 years old. The mean age was found to be 32.01 years old (32.01±20.92) and the standard error of mean is 0.179. (Figure 1)

***Gender distribution***

Based on the data that was collected, more male cases were found than female, with 61.92% and 38.08% respectively. The male to female ratio is 1.63:1. (Figure 2)

***Distribution of types of Radiological services by Gender***

Among total 13649 radiological examinations, 5355(39.2%) were Chest X-ray, 519(3.8%), Abdominal X-ray, 1082(7.9%) Skull X-ray, 5603(41.1%) Extremities X-ray and 1090(8.0%) Spine X-ray. In addition, out of 8451 males, 43.6% has taken extremities X-ray, followed by 36.2% took Chest X-ray. Among 5198 females, 44.1% took Chest X-ray and 36.9% extremities X-ray. (Table 1)

***Number of views in single radiological examination***

The number of views in single radiological examination revealed that all types of radiological services were done by staffs at Dungun Hospital according to standardized views.

***Distribution of types of Radiological services by month***

Regarding distribution of types of radiological services by months shown in table (5), the majority of Chest X-ray was taken in July with 49.2% followed by 45.2% in May, 44.4% in January, 41% in December and 40.1% in August respectively. Chest X-ray cases contributed by 39.2% of the total radiological utilization. Abdominal X-ray utilized in November by 5.8% and by 4.9% in September. Abdominal X-ray cases were contributed by 3.8% of total radiological utilization. Majority of Skull X-ray utilization in September was 10.3%, followed by 9.5% in April and less 6.4% in January. Total utilization of Skull X-ray was 1082(7.9%). The most utilization of radiological services at Dungun Hospital from 01.01.2011 to 31.12.2011 was Extremities X-ray cases. Out of (13649), 5603(41.1%) was Extremities X-ray utilization. Among total utilization of Extremities X-ray services, majority was in April with 49.9%, followed by 45.9% in October and less in July by 31.5%. The Spine X-ray was utilized by 8% of total

radiological services, out of them, 9.8% in October, 9.5% in January and March and 9.2% in September were done respectively. (Table 2)

### ***Nature of Request by types of radiological service***

Regarding nature of request according to types of radiological services, majority of request from A & E Department with 6324/13649(46.33%), followed by 3438/13649(25.19%) from Out-patient Department, 1462/13649(10.71%) from Routine Medical Examination (RME), 1061/13649(7.8%) from Clinic referral, 822/13649(6.0%) from In-Patient Department and 542/13649(0.04%) utilized as portable X-ray. (Table 3)

### ***Reasons for requesting radiological examination***

The reasons for requesting radiological examination that observed through X-ray request form by health care providers. Results revealed that majority 41.05% of total radiological examinations were requested by health care providers as Extremities X-ray with reasons of trauma (self), trauma (assault) and MVAs (99.6%). Second most was Chest X-ray 39.2% and was requested with reasons of chest pain, shortness of breath, cough and related symptoms and fever (98.6%). The rest were 7.3% of reasons of headache and dizziness and loss of consciousness and neurological deficits and 3.5% of abdominal pain, fever, suspicious bowel obstruction and hematuria etc. (Table 4)

### ***Complete filling (Properly given information on) request form of radiological examination by health care providers at Dungun Hospital***

It was found that 10198/13649(74.7%) filled request form properly and completely such as relevant reasons, signs and symptoms and provisional diagnosis. Only 3451/13649(25.3%) filled the form improper and incompletely. Amongst total utilization of Chest X-ray, 75.3% properly and completely filled the request form, 71.9% of total Abdominal X-ray utilization, 78.2% of total skull X-ray utilization, 73.9% of total Extremities X-ray request and 74.1% of total Spine X-ray services filled the forms properly and completely. Only round about 25% filled the forms improperly and incompletely in almost all types of services. (Table 5)

### ***Appropriateness of request form of radiological examination by health care providers at Dungun Hospital***

Selected criteria were, according to type of radiological services, if there was proper and complete filling the forms with sound and relevant reasons considered as appropriate utilization of respective service and if not considered as inappropriate utilization of specific service. 74% of total Chest X-ray, 64.5% of total Abdominal X-ray, 70.8% of total Skull X-ray, 73.6% of total



Extremities X-ray, 71.2% of total Spine X-ray was utilized by health care providers appropriately at Dungun Hospital. On the other hand, 26% of Chest X-ray, 35.5% of Abdominal X-ray, 29.2 % of Skull X-ray, 26.4% of Extremities X-ray and 71.2% of spine X-ray were utilized inappropriately. Overall 72.9% were utilized appropriately and only 27.1% of radiological services utilized inappropriately at Dungun Hospital. (Table 6)

## **Discussion**

### *Socio-demographic data*

Since district hospitals in Malaysia are equipped with basic diagnostic facilities to provide secondary health care to the community, findings on demands and appropriate utilization of radiology service from this research would be used as preliminary survey. According to registration of Radiology Department of Dungun hospital total 13649 radiology examination cases were analyzed. It was observed that are more male respondents in comparison to their female counterparts. It seemed to be because of Terengganu State's demographic pattern as well as emergency admitted case pattern of male population.

### *Types of Radiological examinations*

In this study extremities X-ray was the commonest one. Chest X-ray was taken after that and followed by Spine-Xray, Skull X-ray and abdominal X-ray. Spanish study by Delgado Nicolás and Peces Morate (1996) analysed the quality of requests in primary health care for radiological investigation and results showed bone(41.87%) and thorax(25.12%) radiological examinations were the commonly requested examinations and of all 203 radiological examinations pathology was found in 67.98%. A study, published in Spanish, on radiology demand in primary health care was carried out at Public Health Care Center Poblenou, in Barcelona found out that pathology was found in 43% of the examinations in that study. The reasons behind that why male have more extremities X-ray and female have more Chest X-ray utilization might be due to trauma cases among male population to take Extremities X-ray and RME for job application among female population has taken more Chest X-ray.<sup>3</sup>

### *Nature of request*

In this study, nature of request according to types of radiological services, majority of request from A & E Department followed by Out- patient Department, Routine Medical Examination (RME), Clinic referral, In-Patient Department and 0.04% utilized as portable X-ray. Holm T 1983 cited in Maru et al 2010 stated that while 96% of emergency departments in the United States have CT scanners, large swaths of rural populations in resource-poor countries lack access to basic ultrasound and X-Ray. Moris et al 2009., Ribeiro et al 2008., Chen ., Moore 2007 cited in Maru et al 2010 also mentioned that very little solid data exist that provide an accurate picture



of the current global neglect. In this study, main pathology is Accident and Emergency conditions derived from trauma and MVA cases.<sup>3</sup>

***Number of views, reasons for request, completeness of filling (properly given information on) request form and appropriateness of radiology service utilization***

Regarding reasons for request results revealed that majority of total radiological examinations were requested by health care providers as Extremities X-ray with reasons of trauma (self), trauma (assault) and MVAs. Chest X-ray were requested with reasons of chest pain, shortness of breath, cough and related symptoms and fever. The rest were reasons of headache and dizziness and loss of consciousness and neurological deficits and 3.5% of abdominal pain, fever, suspicious bowel obstruction and hematuria etc. Amongst total utilization of Chest X-ray, 75.3% properly and completely filled the request form, 71.9% of total Abdominal X-ray utilization, 78.2% of total skull X-ray utilization, 73.9% of total Extremities X-ray request and 74.1% of total Spine X-ray services filled the forms properly and completely. Only 25% filled the forms improperly and incompletely in almost all types of services.

Pérez and Guillén in 2007 did a cross sectional study of a cluster sample of 23 health centers of Navarre in March 2004 to determine the characteristics of those making requests for radiological tests (general radiology and echography) and to quantify the unnecessary tests in primary care. They found out that the radiological examination requested with greatest frequency was osseous (48.9%). It was mentioned that 24.7% were unnecessary tests and in 15.2% there was pressure from the patient in the request. Although pathology was found in high percentage of the radiological examination, only 19% was relevant in changing the doctors' therapeutic approach and diagnostic opinion.<sup>2</sup>

Regarding appropriateness of radiology service utilization, overall 72.9% were utilized appropriately and only 27.1% of radiological services utilized inappropriately at Dungun Hospital. One study carried out a records based survey of radiological coverage in many tropical countries and concluded that radiology was used about 30-times less frequently per capita than in industrialized nations.<sup>4</sup> Majority of Chest X-ray, Abdominal X-ray, Skull X-ray and Extremities X-ray were utilized appropriately, it means that radiological request form filled properly according to case mix pattern and RME request for Chest X-ray cases.

In 1986, Tole did a study on frequency of diagnostic X-ray examinations in 67 medical centers in Kenya. The results indicated that the estimated annual frequency of X-ray examination was one-tenth of a typical industrialized country and the bulk of the examination was constituted by limb and chest radiography. Kahn Jr, *et al.* 1995 did Appropriateness of imaging procedure requests. In that study they reviewed 318 non-interventional CT, sonographic, MR imaging, and nuclear medicine procedures ordered at a general internal medicine clinic during 8 months in 1995.<sup>6</sup> Five subspecialty radiologists used data from the radiology request form and clinic notes to independently rate the appropriateness of each requested imaging procedure on a four-point scale. The radiologists were unaware of the results achieved by each procedure. Each case was reviewed by at least three radiologists, of whom at least one had relevant subspecialty expertise.

Agreement among radiologists was analyzed using Cohen's kappa statistic and weighted kappa statistics and Cronbach's alpha statistic. They found out statistically significant agreement among radiologists about the appropriateness of individual requests for imaging procedures. Based on literature definition and findings, measurement of appropriateness of utilization of radiology service in this study seemed to be relevant to some extent.

A study done in Ghana also reported the results 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.<sup>5</sup> They mentioned that the radiological workload at the reporting hospitals was low and declined by more than 50% over the study period.

## **Conclusion**

In conclusion, there are high utilization of radiological services in Dungun Hospital with relatively high workload with limited man power and facilities. Major portion of radiology services utilization at Dungun District Hospital were appropriately utilized according to operational meaning of this study.

## **Recommendation**

Based on findings on demands and appropriate utilization of radiology service from this research can be used as preliminary survey data for future extended survey in the whole Terengganu state.

These extended surveys and data will be useful in setting norms and standards for appropriate usage of diagnostic facilities at district hospital levels in Malaysia.

Findings on adequacy of currently available physical and human resources will positively enhance improvement in future development plan of Dungun district hospital.

As appropriate high utilization of radiology services at District level, capacity building, recruitment of human resources and necessary facilities should be promoted.

**Conflict of Interest:** None declared.

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**Table 1:** Distribution of types of radiological services by gender

Types of radiological service	Male n(%)	Female n(%)	Total n(%)
Chest X-ray	3063 (36.2)	2292 (44.1)	5355 (39.2)
Abdominal X-ray	326 (3.9)	193 (3.7)	519 (3.8)
Skull X-ray	710 (8.4)	372 (7.2)	1082 (7.9)
Extremities	3685 (43.6)	1918 (36.9)	5603 (41.1)
Spine	667 (7.9)	423 (8.1)	1090 (8.0)
<b>Total n(%)</b>	<b>8451 (100.0)</b>	<b>5198 (100.0)</b>	<b>13649 (100.0)</b>

**Table 2:** Distribution of types of radiological services by month

Types of Radiological examination	Jan n(%)	Feb n(%)	Mar n(%)	Apr n(%)	May n(%)	Jun n(%)	Jul n(%)	Aug n(%)	Sep n(%)	Oct n(%)	Nov n(%)	Dec n(%)	Total n(%)
Chest XR	512 (44.4)	379 (36)	402 (36.1)	352 (30)	580 (45.2)	542 (4.3)	648 (49.2)	451 (40.1)	351 (33.5)	352 (32.3)	353 (36.2)	433 (41)	5355 (39.2)
Abdominal	39 (3.4)	33 (3.1)	44 (3.9)	37 (3.2)	48 (3.7)	35 (2.8)	54 (4.1)	36 (3.2)	51 (4.9)	44 (4.0)	57 (5.8)	41 (3.9)	519 (3.8)
Skull-XR	74 (6.4)	91 (8.6)	92 (8.3)	111 (9.5)	84 (6.5)	97 (7.7)	89 (6.8)	104 (9.2)	108 (10.3)	86 (7.9)	76 (7.8)	70 (6.6)	1082 (7.9)
Extremity-XR	418 (36.3)	463 (43.9)	471 (42.2)	586 (49.9)	488 (38)	483 (38.3)	414 (31.5)	441 (39.2)	442 (42.2)	500 (45.9)	451 (46.3)	446 (42.3)	5603 (41.1)
Spine-XR	110	88	106	86	84	103	111	94	96	107	38	65	1090

	(9.5)	(8.3)	(9.5)	(7.5)	(6.5)	(8.2)	(8.4)	(8.3)	(9.2)	(9.8)	(3.9)	(6.2)	(8.0)
<b>Total n(%)</b>	<b>1153 (100)</b>	<b>1054 (100)</b>	<b>1115 (100)</b>	<b>1174 (100)</b>	<b>1284 (100)</b>	<b>1260 (100)</b>	<b>1316 (100)</b>	<b>1126 (100)</b>	<b>1048 (100)</b>	<b>1089 (100)</b>	<b>975 (100)</b>	<b>1055 (100)</b>	<b>13649 (100.0)</b>

**Table 3:** Nature of request by types of radiological service

Types of Radiological examination	A&E n(%)	Out pt n(%)	In pt n(%)	RME n(%)	Clinic n(%)	Portable n(%)	Total n(%)
CXR	1720 (27.2)	1162 (33.8)	572 (69.6)	1238 (84.7)	279 (26.3)	384 (70.8)	5355 (39.2)
AXR	226 (3.6)	184 (5.4)	33 (4.0)	20 (1.4)	26 (2.5)	30 (5.5)	519 (3.8)
Skull-XR	813 (12.9)	174 (5.1)	17 (2.1)	17 (1.2)	44 (4.1)	17 (3.1)	1082 (7.9)
Extre-XR	3029 (47.9)	1570 (45.7)	162 (19.7)	162 (11.1)	600 (56.6)	80 (14.8)	5603 (41.1)
Spine-XR	536 (8.5)	348 (10.1)	38 (4.6)	25 (1.7)	112 (10.6)	31 (5.7)	1090 (8.0)
<b>Total n(%)</b>	<b>6324 (100.0)</b>	<b>3438 (100.0)</b>	<b>822 (100.0)</b>	<b>1462 (100.0)</b>	<b>1061 (100.0)</b>	<b>542 (100.0)</b>	<b>13649 (100.0)</b>

**Table 4:** Reasons for requesting radiological examination

Reasons	CXR n(%)	AXR n(%)	Skull n(%)	Extremities n(%)	Spine n(%)	Total n(%)
chest pain & shortness of breath & cough and related symptoms & fever	5278 (98.6)	1 (0.2)	1 (0.1)	16 (0.3)	3 (0.3)	5299 (38.8)
abdominal pain and fever and suspicious bowel obstruction and hematuria	5 (0.1)	470 (90.6)	0 (0.0)	8 (0.1)	0 (0.0)	483 (3.5)
Headache & Dizziness and loss of	4 (0.1)	0 (0.0)	998 (92.2)	0 (0.0)	1 (0.1)	1003 (7.3)

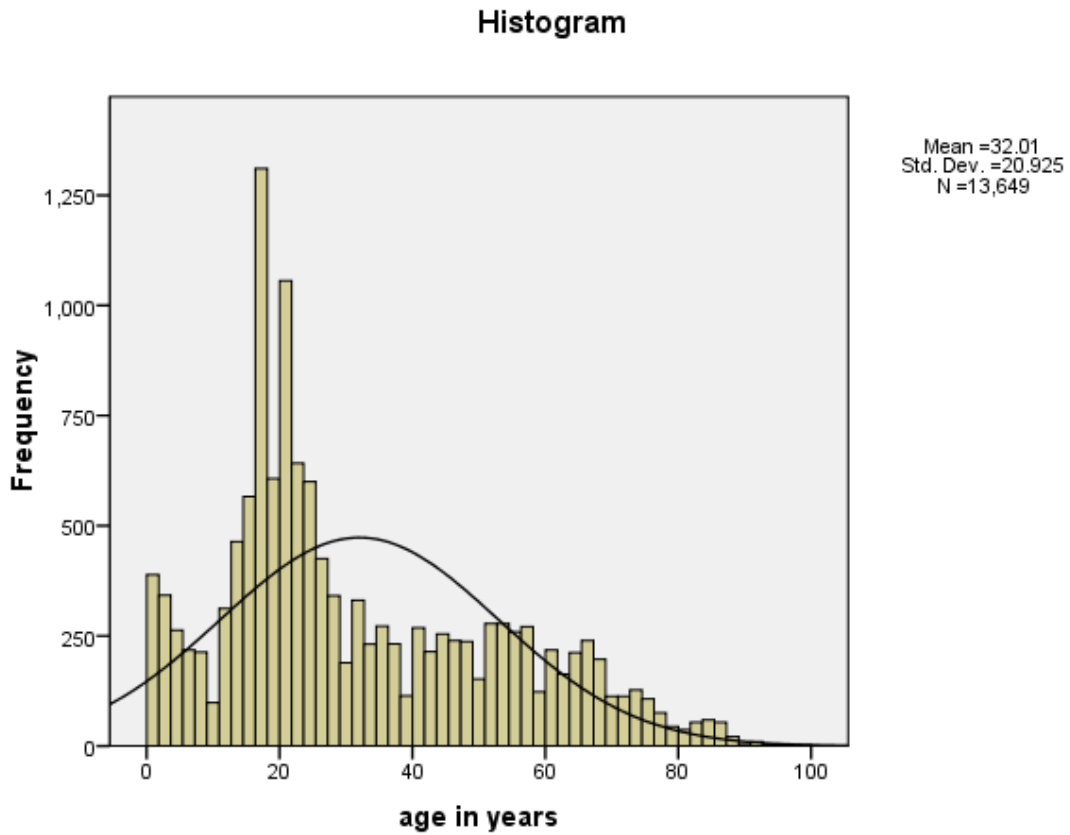
consciousness and neurological deficits						
trauma(self) and trauma (assault) and MVA	68 (1.3)	48 (9.2)	83 (7.7)	5579 (99.6)	1086 (99.6)	6864 (50.3)
<b>Total n(%)</b>	<b>5355 (100.0)</b>	<b>519 (100.0)</b>	<b>1082 (100.0)</b>	<b>5603 (100.0)</b>	<b>1090 (100.0)</b>	<b>13649 (100.0)</b>

**Table 5:** Complete filling (Properly given information on) request form of radiological examination by health care providers at Dungun Hospital

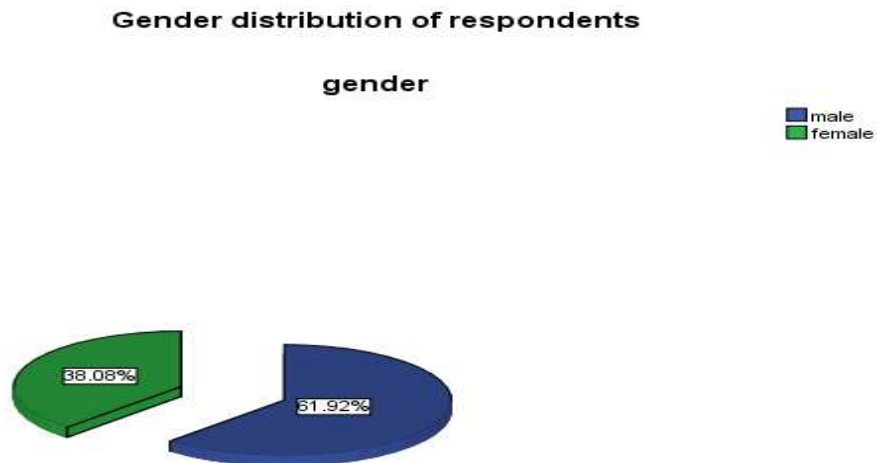
<b>Completeness</b>	<b>CXR n(%)</b>	<b>AXR n(%)</b>	<b>Skull n(%)</b>	<b>Extremities n(%)</b>	<b>Spine n(%)</b>	<b>Total n(%)</b>
Proper and complete filling	4031 (75.3)	373 (71.9)	846 (78.2)	4140 (73.9)	808 (74.1)	10198 (74.7)
Improper and incomplete filling	1324 (24.7)	146 (28.1)	236 (21.8)	1463 (26.1)	282 (25.9)	3451 (25.3)
<b>Total</b>	<b>5355 (100.0)</b>	<b>519 (100.0)</b>	<b>1082 (100.0)</b>	<b>5603 (100.0)</b>	<b>1090 (100.0)</b>	<b>13649 (100.0)</b>

**Table 6:** Appropriateness of request form of radiological examination by health care providers at Dungun Hospital

<b>Appropriateness</b>	<b>CXR n(%)</b>	<b>AXR n(%)</b>	<b>Skull n(%)</b>	<b>Extremities n(%)</b>	<b>Spine n(%)</b>	<b>Total n(%)</b>
In appropriate	1394 (26.0)	184 (35.5)	316 (29.2)	1479 (26.4)	314 (28.8)	3687 (27.1)
Appropriate	3961 (74.0)	335 (64.5)	766 (70.8)	4124 (73.6)	776 (71.2)	9962 (72.9)
<b>Total</b>	<b>5355 (100.0)</b>	<b>519 (100.0)</b>	<b>1082 (100.0)</b>	<b>5603 (100.0)</b>	<b>1090 (100.0)</b>	<b>13649 (100.0)</b>



**Figure 1:** Histogram showing Age distribution



**Figure 2:** Pie Chart showing Gender distribution

**Appendix A**

<b>No.</b>	<b>Variables</b>	<b>Operational Definition</b>	<b>Scale of Measurement</b>
1.	Age	<ul style="list-style-type: none"> <li>• Complete age in years</li> </ul>	Ratio
2.	Gender	<ul style="list-style-type: none"> <li>• Male or female</li> </ul>	Nominal
3.	Types of radiological examination	<ol style="list-style-type: none"> <li>1. Chest X-ray</li> <li>2. Abdominal X-ray</li> <li>3. Skull X-ray</li> <li>4. Extremities X-ray</li> <li>5. Spine X-ray</li> </ol>	Nominal
4.	Nature of request	<p>Requesting X-ray services from</p> <ol style="list-style-type: none"> <li>1. Accidents and Emergency</li> <li>2. Out patient</li> <li>3. Inpatient</li> <li>4. Routine Medical Examination</li> <li>5. Clinic Referral</li> <li>6. Portable X-ray for Out-Patient and In Patient Wards</li> </ol>	Nominal
5.	Number of view	<p>In request form of X-ray Observe the number of view according to type of X-ray</p> <ol style="list-style-type: none"> <li>1. One view</li> <li>2. Two views</li> <li>3. More than two views</li> </ol>	Ordinal
6.	Reasons for request	<p>In request form of X-ray Observe the reasons as follow:</p> <ol style="list-style-type: none"> <li>1. Chest pain</li> <li>2. Abdominal pain</li> <li>3. Shortness of breath</li> <li>4. Cough and related symptoms</li> <li>5. Fever</li> <li>6. Suspicious bowel obstruction</li> <li>7. Haematuria</li> <li>8. Headache and dizziness</li> <li>9. Loss of consciousness</li> <li>10. Neurological deficit</li> <li>11. Trauma (self)</li> <li>12. Trauma (assault)</li> <li>13. MVA</li> <li>14. Foreign body detection</li> </ol>	Nominal



		15. Medico legal purpose 16. Others	
7.	Completeness of request form	In request form of X-ray Observe the completeness of filling form as follow: 1. Proper and complete filling (relevant reasons, relevant signs and symptoms, provisional relevant diagnosis, Relevant requisition) 2. Improper and incomplete filling Unless (relevant reasons, relevant signs and symptoms, provisional relevant diagnosis, Relevant requisition)	Nominal
8.	Appropriate Utilization	In request form of X-ray Identify and analyze the appropriateness of utilization of radiological services as follow: 1. Appropriate utilization (according to type of X-ray services, proper and complete filling the request form and sound and relevant reasons for respective service) 2. Inappropriate utilization Unless (according to type of X-ray services, proper and complete filling the request form and sound and relevant reasons for respective service)	Nominal
11	Facts and facilities	Dungun Hospital (01.01.2011 to 31.12.2011) 1. Number of beds 2. Number of patients 3. Number of doctors 4. Number of staffs Radiology facilities (01.01.2011 to 31.12.2011) 1. Number of X-ray machines 2. Number of radiological examination done 3. Number of staff in radiology unit	Interval