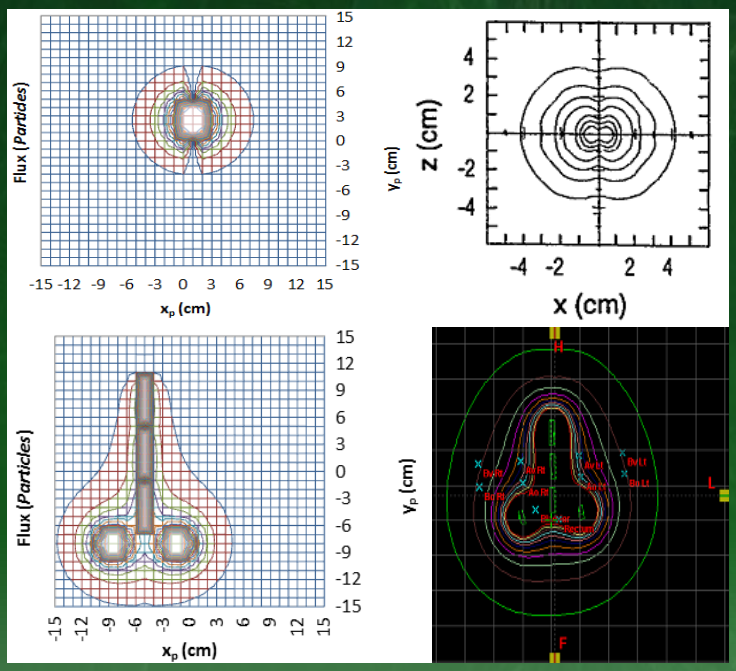
# JOURNAL of MEDICAL PHYSICS AND BIOPHYSICS

VOLUME 2, NUMBER 1
FEBRUARY 2015

ISSN 2355-2727
ONLINE ACCESS: http://jmpb.org


Simple radiation flux calculation for brachytherapy. See more at pp. 36-39


Journal of Medical Physics and Biophysics is a publication media for research on developments, applications, and advances in Medical Physics and Biophysics, serving as official journal of the Indonesian Association of Medical Physics and Biophysics.

ISSN 2355-2727
9 772355 272005

JOURNAL of MEDICAL PHYSICS AND BIOPHYSICS

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JOURNAL of MEDICAL PHYSICS AND BIOPHYSICS

**Volume 2, Number 1** **ISSN 2355-2727**

**February 2015** **Online Access: http://jmpb.org**

# MEDICAL PHYSICS EDUCATION AND PROFESSION IN SOUTH-EAST ASIA: CHALLENGES FOR THE REGION

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Diversity, being the gem of pride in the South-East Asia region in reference to the abundance of culture and cuisine, becomes quite an issue when it comes to educational and professional standard. As faced by other regions, diversity lies in curricula, degree systems, as well as regulations. With specific international directives and recommendations, a spectrum in the system presents the region with lengthy difficulties in striving for recognition. As indicated by IOMP in its policy statements, a successful medical physics educational and professional state includes availability of formal education on postgraduate levels, working system of structured clinical training, procedure of certification and registration under national/internationally-recognized boards. In the region, there exists a challenging circumstances in which structured clinical training, standardized academic curricula, and regional accreditation system are all but exist.

As a member of the region, Indonesian medical physics community faces the challenges as well as invents new ways to subdue them. Academically, universities like University of Indonesia held workshops featuring world-renowned experts within the fields of radiation oncology, diagnostic radiology, and nuclear medicine. While the years 2005 – 2013 witnesses 20 visits from Medical Physics experts to University of Indonesia, 10 world-renowned scientists shared their expertise in year 2014 alone to update the knowledge of the community. A one-of-a-kind clinical postgraduate program is currently under its way to establishment, foreseeing itself to operate the nation's professional training. On legal basis, a bill passed on 2014 presents governmental recognition of Medical Physics profession as to having 'medical physicist' enlisted under 'biomedical technology' category. Legal aspects are also being prepared to accommodate the effort of meeting the international standard; the Ministry of Education is currently preparing a set of academic rules, in which Medical Physics reserves a slot in postgraduate level. The rules, due published in 2015, will allow an opportunity to enhance the academic standard of Medical Physics in Indonesia.

Indonesia's case may, most probably, not apply elsewhere, even within the region of South-East Asia. There lies unique situation in each country, presenting medical physicists communities with broad range of different challenge and issues. The diverse opportunity and circumstances in South-East Asian region will present more chances encouraging to work together in harmony and common-fate spirit; which will be another gem for the region to be proud of.

Supriyanto Ardjo Pawiro, Ph.D
*Chief Editor*
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# ORGAN AND EFFECTIVE DOSES FROM A MULTIDETECTOR COMPUTED TOMOGRAPHY IN CHEST EXAMINATION

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**Abstract:** The growth of Multidetector Computed Tomography (MDCT) associated with the large number of images per examination offers many clinical benefits. It is easy to use for radiologist and physician, and these reasons are the cause of increasing exposure for populations rapidly. Organ and effective doses from CT examination are the important quantities to assess radiation risk. The objective of this study is to calculate the organ and effective doses from patient data. The beam data was collected for 30 cases of patient over 20 years old underwent 64 slices GE VCT MDCT scanner in the chest examinations. The computed tomography dose index (CTDI) values were measured in air and in body phantom with SOLIDOSE ionization chamber then the CTDI values and the exposed parameters were entered in ImPACT CT Patient Dosimetry Calculator version 1.0 for calculation of organ and effective doses. The exposure parameters of chest protocol were 120 kVp, 330 mA, 0.6 sec rotation time, and 1.375 pitch. The average scan length was 34.9 cm for the range of 23.1 to 56.5 cm. The high organ doses in the irradiated field occurred in lung, breast, esophagus, heart, stomach, liver, adrenal gland, kidney, pancreas, spleen and small intestine, the maximum dose ranged from 15 to 23.0 mGy. The average effective dose was 8.6 mSv with the range of 5.7 to 13.0 mSv. The maximum number of scan series of examination was three which made the maximum effective dose of 39.0 mSv. The scan length was one of the variable factors that made the higher organ and effective doses in CT examination. The more series of examination was another factor to increase the organ and effective doses. The estimated radiation risk for cancer and hereditary effect for chest CT examination was about 5 cases for 10,000 populations. This study has shown that the CT doses used in clinical practice are not higher than commonly report but the careful used of radiation must be considered. Estimated organ and effective doses in chest MDCT scanning are a guide line for radiologists and physicians in order to judge the frequency of scan and suitable scan length.

***Keywords****: organ dose, effective dose, Computed Tomography Dose Index, Multidetector Computed Tomography*

Received: 19 September 2014
Revised: 21 September 2014
Accepted: 05 February 2015
Published: 23 February 2015

## I. INTRODUCTION

The Multidetector Computed Tomography is one of the most important methods of radiological diagnosis. It displays cross-sectional images of the body, scans large anatomic range, makes faster scan, and reduces examination times. The growth of MDCT associated with the large number of images per examination offers many clinical benefits and these reasons are the cause of increasing exposure for populations rapidly. The higher dose in CT examination than other x-ray diagnostic procedures must be considered for the safety used, Fred et.al [1] reported the estimated of the NCRP Scientific Committee 6-2 subgroup that in 2006 the per capita dose from medical exposure has increased almost 600%. The largest contributions and increases have come primarily from CT scanning and nuclear medicine. The 67 million CT scans account for 15% of the total medical radiation procedures and about 50% of collective dose.

Effective dose which focus on dose to individual organs and tissues is the important quantity using for estimating risk of radiation-induced cancers. The individual CT patient dose is not possible to be measured for the exact organ dose. One common method for estimating organ and effective doses is the dose calculation from CTDI or DLP and conversion factors.

Another method employed the Monte Carlo radiation transport code which was developed to simulate photon interaction within mathematical model of human body in CT examinations; the common used is the IMPACT CT Patient Dosimetry Calculator (ImPACT, London, England). Many studies [2] demonstrated the agreements of calculation and measurement using this IMPACT software. It was noted that high dose was most likely in multiphase studies [3]. The patient effective dose will be directly proportional to the number of phase that is performed when scanning are the same for each phase. Factors that affect the patient effective dose include the techniques (mAs and pitch) scan length, and voltage. Individual dose are also affected by patients characteristics.

The objective of this study is to calculate the organ and effective doses from patient data of chest examination of 64 slice CT scan using ImPACT Calculator Program.

## II. MATERIALS AND METHODS

### *A. CT unit*

In this study, the machine used was 64 slices GE VCT MDCT scanner. (General Electric Medical Systems,

Waukesha, WI, USA). The exposure parameters employed in chest examination is shown in Table 1 and the operating voltage was 120 kVp in all cases.

**Table 1.Exposure parameters of chest protocol.**

| mA | Rotation time (sec) | Pitch (mm/ rotation) | Collimation (mm) | Slice width (mm) |
|---|---|---|---|---|
| 330 | 0.6 | 1.375 | 40 | 5 |

### B. CT dosimetry

The computed tomography dose index (CTDI) was measured by 100 mm long pencil ionization chamber: DCT 10 with digital dosimeter: SOLIDOSE, Model 400 (RTI Electronics AB, Molndal, Sweden). The cylindrical phantom was 32-cm diameter Polymethyl Methacrylate (PMMA). The doses were measured in air at the isocenter of gantry and in phantom at the center and peripheries at 12, 3, 6, 9 o'clock, respectively.

### C. The ImPACT CT Patient Dosimetry Calculator

The ImPACT Calculator Program version 1.0 is a free download program. It simulates almost all of the commercial CT scanner. The data needed to enter in the program are: the CTDI value at center and the average value at periphery of the phantom together with exposure parameters, type and model of CT and the scan length in each patient were put into the ImPACT Calculator Program version 1.0 in order to calculate organ and effective doses. The ImPACT CT software package coupled organ weighting factors of International Commission on Radiological Protection (ICRP) publication 103.

### D. Effective dose, E

The effective dose is the sum over all the organs and tissues of the body of the product of the equivalent doses, $H_T$, to the organ or tissue and a tissue weighting factor, $W_T$ for that organ or tissue.

$$E = \sum_T W_T H_T \quad (1)$$

The unit for the effective dose is Sv.

Organ and effective dose can be estimated using IMPACT software that precalculated the dose distribution for specific commercial CT scanner.

### E. The data collection

The exposure of chest protocol examination (Table1) and patient parameters were collected for11 male and 19 female patients over 20 years old.

## III. RESULTS AND DISCUSSION

The minimum, maximum and average scan length and effective dose for 30 patients in chest examination are listed in Table 2. The average scan length was 34.9 cm with the range of 23.1 to 56.5 cm and the average effective dose was 8.6 mSv with the range of 5.7 to 13 mSv. The maximum effective dose was 39 mSv from three scan series (phases) of chest scanning.

**Table 2.Calculated effective dose and scan length in routine chest CT protocol technique.**

| | *N | Min | Max | Aver. | SD |
|---|---|---|---|---|---|
| Scanlength (cm) | 30 | 23.1 | 56.6 | 34.9 | 6.6 |
| ED (mSv) | 30 | 5.7 | 13.0 | 8.6 | 1.5 |

N = number of cases, ED = Effective Dose, SD = Standard Deviation

The various organ doses for chest examination are shown in Table 3. The high doses in the irradiated field occurred in lung, breast, esophagus, heart, stomach, liver, adrenal gland, kidney, pancreas, spleen and small intestine, the maximum dose ranged from 15 to 23 mGy.

**Table 3.The calculated organ doses (mGy) in chest examination**

| Organ/dose(mGy) | Min | Max | Aver. | SD |
|---|---|---|---|---|
| Lung | 15.0 | 20.0 | 19.5 | 1.0 |
| Breast | 14.0 | 15.0 | 14.9 | 0.2 |
| Esophagus | 22.0 | 23.0 | 22.6 | 0.5 |
| Heart | 12.0 | 20.0 | 19.2 | 1.5 |
| Stomach | 0.5 | 19.0 | 8.5 | 5.4 |
| Liver | 1.2 | 18.0 | 10.4 | 4.5 |
| Adrenal gland | 1.4 | 17.0 | 12.9 | 4.7 |
| Kidney | 0.1 | 20.0 | 6.4 | 6.2 |
| Pancreas | 1.2 | 16.0 | 10.0 | 4.7 |
| Spleen | 0.9 | 17.0 | 9.9 | 5.3 |
| Small intestine | 0.0 | 16.0 | 1.3 | 3.1 |

The main variable factor that makes higher organ and effective doses in CT examination was the scan length, the routine of chest scans started from apex of lung ended at first lumbar spine. Two series of the scan for non contrast and with contrast were undertaken as the routine chest examination. In some cases, the radiologist wanted to observe the portal vein or the contrast could not be filled in aorta properly, the extra scan series with the increasing of scan length was ordered. However, the over scanning and incorrect protocol including scout for scan planning had an effect on organ dose. These factors were extra dose that increased patient dose.

Our study revealed the average effective dose for chest examination of 8.6 mSv per series with the risk of about 5 cases for 10,000 population (risk estimates for cancer and hereditary effect was $5.7\%Sv^{-1}$) [4] which agreed with the Dendy et.al study [5], they showed effective dose of 8 mSv,

Fujii et al [6] measured the dose in adult anthropomorphic phantom for 64 slice CT examination , the organ dose and the estimated effective dose were 8-35 mGy, and 7-18 mSv, respectively. Our result showed less maximum organ dose of 15-23 mGy and less effective dose of 5.7-13 mSv.

This work employed the patient data and the measured standard CTDI value to estimate organ and effective doses by the calculation software, the dose verification with the measurement was not performed. However, the other studies [3] and the previous work of Nerysungnoen B [7] in our institute supported that the organ and effective doses could be estimated by Impact software with the accuracy within 20%.

## IV. CONCLUSION

This study has shown that the organ and effective doses of patient in clinical practice are not higher than commonly report but the careful used of radiation must be considered. These include the optimal of exposure parameters, the scan length and the series of scan.

## V. ACKNOWLEDGMENTS

I would like to thank Radiologist and staff in Department of Radiology, Rajavithi Hospital, all staff in Division of Therapeutic Radiology and Oncology, Department of Radiology, King Chulalongkorn Memorial Hospital for their kind support of this study.

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# MEAN GLANDULAR DOSE AND CDMAM PHANTOM IMAGE QUALITY FOR SIEMENS MAMMOMAT INSPIRATION

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**Abstract:** In performing breast screening, a mammography must be capable of imaging microcalcifications with the smallest possible size. However, the mean glandular dose (MGD) should not exceed the recommended limits. To achieve the goal, the utilization of target/filter combination should be adjusted to the thickness of the breast. The evaluation of image quality against variations in target/filter combinations can be done by using CDMAM phantom. There are two methods of CDMAM phantom image quality assessment, and the digital method is considered superior to the manual one. In addition to the evaluation of image quality, MGD received by the phantom was also calculated by multiplying the air kerma value at each thickness with the air kerma conversion factor into MGD. The calculation of MGD follow the equation and conversion factor published by IAEA Human Health Series No. 17 – Quality Assurance Programme for Digital Mammography, then being compared with three other publications. The best image quality for the phantom thickness below 32 mm achieved by using Mo/Mo target/filter combination, and Mo/Rh for the phantom thickness above 45 mm.

***Keywords**: mammography, mean glandular dose, CDMAM phantom, Siemens Mammomat Inspiration*

Received: 19 September 2014
Revised: 21 September 2014
Accepted: 05 February 2015
Published: 23 February 2015

## I. INTRODUCTION

Mammography is one of the diagnostic modality of producing low-energy X-ray which can detect changes in breast tissue composition. As with other diagnostic modality using X-rays, the small potential risk of cancer growth cannot be avoided. Therefore it is important to evaluate the risk of X-ray dose given during the examination of mammography. American College of Radiology (ACR) recommended the MGD (mean glandular dose) values to 4.5 cm of a compressed breast should not exceed 3 mGy. The dose is the combined dose of imagery Craniocaudal (CC) and Mediolateral Oblique (MLO) for the breast [4].

MGD is obtained by multiplying the measurements of air kerma with some correction factors. There are few studies which focus on determining the method of calculating MGD and the use of the correction factor. In this study, MGD value will be calculated based on four different publications, which are the publication of Wu et al. (1991), Klein et al. (1997), Dance et al. (2000), and the IAEA Human Health Series No. 17-Quality Assurance Programme for Digital Mammography. Performance evaluation of mammography will also be done by using Contrast-Detail Mammography (CDMAM) phantom. CDMAM phantom is considered superior to others because the objects inside it is represented in the shape of dot, which likely the shape of microcalcifications. CDMAM phantom consists of matrix with gold plate in various size and contrast is planted inside. There are two gold plates of the same size in every 205 matrix cells, one of which is located in the central part and the other will randomly be in one of the corner of the cell [13].

CDMAM phantom special configuration could create images which the object contrast and the spatial resolution allowed being analyzed based on exposure method used. The phantom image of digital mammography will be analyzed manually or digitally. Phantom exposures performed by varying the combination of target/filter (W/Rh, Mo/Mo, and Mo/Rh) and the thickness of the phantom (2 cm, 3 cm, 4 cm, 4.5 cm, 5 cm, and 6 cm). This is done in order to determine the combination of target/filter that can produce the best image quality for any thickness variations.

## II. MATERIALS AND METHODS

The study was conducted in Dharmais Cancer Hospital, used Siemens Mammomat Inspiration with model / serial number control 3122509, tube type P 40 Mo W, and tube serial number 501635 which produced in July 2011, the maximum condition is 32 kV and 200 mAs. Image view system using digital radiography (DR) and stored as DICOM. Air kerma was measured using Unfors Xi R / F Mammo detectors which is able to measure kVp, dose, dose rate, irradiation time, and HVL. The CDMAM phantom that is used for images evaluation is the output product of Artinis, CDMAM 3.4 with serial number 2031.

Since the mammography shall be ensured in good condition, it performed several test suitability before data collection. The tests performed include;

- Collimation and compression equipment
- Generators and X-ray tube (kVp accuracy, kV reproducibility and output, output linearity, determination of HVL, and AEC)

Data collection was divided into two parts. The first part, aims to acquire phantom images, the exposure is done by using the CDMAM phantom. The second part is done without the use of phantom with the aim to measure the value of the air kerma (Ki) of each thickness using Unfors Xi detector. The exposure parameters which varied in the first and second parts are created equal. The air kerma values

measured in the second part will be used to calculate the MGD value for each measurement.

Data collection was performed by varying the thickness of the PMMA phantom used in the first part, which are 2 cm, 3 cm, 4 cm, 4.5 cm, 5 cm, and 6 cm. Based on the publication of the IAEA Human Health Series No. 17 - Quality Assurance Programme for Digital Mammography, the thickness of the PMMA phantom used is equivalent to a compressed breast thickness of 2.1 cm, 3.2 cm, 4.5 cm, 5.3 cm, 6 cm, and 7.5 cm. The compressed breast thickness will be used in the measurement of air kerma (*Ki*) in the second part data collection.

Each thickness exposed three times. First exposure performed using AEC mode while for the rest two performed using manual mode. Target/filter used when using manual mode are differentiated by the AEC mode, while the exposure parameters created equal. Air kerma measured using the Unfors Xi detector, performed using 2 cm thick PMMA phantom. PMMA was applied with the aim to protect the mammography detector so it is not exposed by the direct X-ray from the tube. Unfors Xi detector laying on the top of the PMMA surface, it made such that it is in the middle of the field of radiation with the distance between the chest wall and the center of the detector is 6 cm.

Exposing performed 18 times with varying target/filter combinations and kVp/mAs correspond to the option in AEC mode (Table 1). Unfors Xi detector will measure kVp, dose (air kerma), the dose rate, irradiation time, and HVL. Location of the detector and the phantom does not change for each measurement, and the value of the air kerma at the desired thickness will be calculated using inverse square law, while the HVL value will be relatively the same at each thickness.

**Table 1 kVp and mAs settings used for the exposure using manual mode**

| Phantom thickness (mm) | kVp setting | mAs setting |
|---|---|---|
| 21 | 26 | 36 |
| 32 | 27 | 50 |
| 45 | 28 | 80 |
| 53 | 29 | 80 |
| 60 | 30 | 125 |
| 75 | 31 | 180 |

The image phantom then analyzed with the manual and digital methods. The results will be compared to determine differences in the performance of both. The quality of the image can be seen from the ratio of the number of cells indicated correctly of the overall total of the cell:

$$Observation\ ratio = \frac{Correctly\ indicated\ cells}{Overall\ total\ cells} \times 100\% \qquad (1)$$

Another method of determining image quality is to calculate the value of IQF (Image Quality Figure). IQF of an image represents the quality of the image, the higher the value the better the quality.

Manual method done by identifying the location of gold plates in each column of the cell to the minimum diameter of the contrast that can still be seen. Observer errors in identifying the location of the plate indicates the inability of the observer to see the object contrast of the particular size, or the exposure techniques with exposure parameters that is used produce poor image quality. To anticipate the errors of observation, the observer was asked to keep identified two additional cells (per column) after the cell with the object contrast can still be observed easily.

The equation used to calculate IQF manually is as follows:

$$IQF = \frac{n}{\sum_{i=1}^{n} C_i \times D_{i,min}} \qquad (2)$$

$D_{i,min}$ is the smallest diameter of the gold plates identified correctly in the column $C_i$. $C_i$ is the thickness of the gold plate, while $n$ is the number of columns that can still be observed correctly. The bigger the IQF indicates the better image quality produced.

There is a difference equation in calculating IQF when evaluated using digital image [12]. Evaluation of the digital method is done by using the following equation:

$$IQF_{inv} = \frac{100}{\sum_{i=1}^{16} C_{i,th} \times D_i} \qquad (3)$$

$C_{i,th}$ is the smallest thickness of gold that still can be evaluated on the column diameter *Di.* Contrast computed in µm while the diameter in mm. In contrast to the manual evaluation which can only evaluate the available cells in the phantom, digital methods using special software also evaluates the cells that are missing on the top and bottom of the phantom.

The calculation of MGD is done with reference to four journal publications, the publication of Wu *et al.* (1991), Klein *et al.* (1997), Dance *et al.* (2000), and the IAEA Human Health Series No. 17 - Quality Assurance Programme for Digital Mammography. The results of the calculations will be compared to be able to see the difference, the equation used is as follows

Wu *et al.* (1991) ➔ $MGD = X_{ESE} \times D_{gN}$ (4)

Kleint *et al.* (1997) ➔ $MGD = K \cdot g$ (5)

Dance *et al.* (2000) ➔ $MGD = K \cdot g \cdot c \cdot s$ (6)

$X_{ESE}$ is the value of ESAK (entrance surface air kerma) were measured in Roentgens (R), while $K$ is the air kerma in units of mGy. Both are measured on the surface of the phantom without backscatter. $D_{gN}$ is air kerma conversion factor into MGD with units of mGy/R or mrad/R [1]. $D_{gN}$ factor and $g$ conversion factor on Kleint et al. (1997) are both dependent on the quality of the beam, target / filter combination, thickness and composition of the breast [11].

In Dance *et al.* (2000), $g$ factor is specific only for the breast with a composition of 50% glandular and 50% fat and only depends on the thickness and HVL. Furthermore, factor $c$ will convert breast with a different composition, the value depends on the thickness, while $s$ is a correction factor for the combination of target/filter used [2]. Equation by Dance *et*

*al.* (2000) also used by the IAEA. Slightly different from Dance *et al.* (2000), the value of *g* and *c* on Human Health Series No. 17 - Quality Assurance Programme for Digital Mammography displayed in the one value of multiplication

# III. RESULTS AND DISCUSSION

## *A. Compliance test result*

Some compliance tests that conducted before the data collection was the evaluation of the light beam collimation, compression equipment, generators and X-ray tube, and the AEC system. The compliance tests performed by following the criteria of Perka BAPETEN No. 9 of 2011.

Room light illumination (background) were measured at 62.21 lux, while the average collimation light illuminations of four field area is 299.55 lux. The collimation illumination is obtained by reducing the collimation light illuminations with room light illumination, the amount is 237.34 lux. The maximum difference allowed between the collimation field with the X-ray beam, collimation field with the image receptor, and the X-ray beam with image recertor is equal to 2% of the distance SID. The test results showed that the difference between the three is still below the limit of tolerance.

Voltage accuracy test was performed to see the accuracy of the X-ray voltage generated by the voltage of the panel selected. Average discrepancy of measured detector voltage is equal to 3.23%. The deviation is relatively large but still below the tolerance limit of 6%. The coefficient of variation (COV) obtained for the reproducibility of the voltage is equal to 0.002, while the COV of output reproducibility test obtained is 0.003 with a COV maximum allowed is 0.05. Radiation output generated at the output radiation test is considered quite good because the linearity coefficient obtained is 0.026, while the maximum value that is allowed is 0.1. Therefore, it can be said that the output radiation generated X-ray tube is quite linear. The value of CNR (Contrast to Noise Ratio) on the evaluation system for the AEC phantom thickness of 2 cm, 4 cm and 6 cm respectively are 1.32, 0.98, and 0.74. The thicker the phantom used obtained a smaller CNR value.

## *B. CDMAM image quality comparison by using manual and digital method*

The results of image evaluation is shown in Table 1, Table 2 and Table 3. Although IQF and detection percentage values obtained fluctuated, but it appears that the two methods produce the same trend value. The greater the thickness of the phantom produced the smaller IQF and detection percentage, represents the declining quality of the image.

Because of the difference of equation used to calculate IQF in both methods, then the comparison between two methods can be seen from the percentage of gold plate detected, its value is obtained by using Equation (1). Comparison of detection percentage of manual and digital method for the use of the three target/filter combination can be seen in Figure 1.

Percentage value of the digital method is much higher than the percentage value of the manual method. The difference of the detection percentage of both methods for the three target/filter combinations used is increase with the increase of phantom thickness. With an average value of 42.82 ± 7.19% (W/Rh), 39.45 ± 7.92% (Mo/Mo), and 42.18 ± 5.77% (Mo/Rh), it can be said that the performance evaluation of manual method decrease with the increase of the phantom thickness.

**Table 1 Image evaluation for manual and digital methods using W/Rh target/filter**

| Compressed breast thickness (mm) | IQF | | Percentage (%) | |
|---|---|---|---|---|
| | Manual | Digital | Manual | Digital |
| 21 | 7.44 | 155.4 | 39.5 | 81.0 |
| 32 | 8.90 | 156.9 | 44.4 | 77.6 |
| 45 | 8.19 | 134.6 | 41.0 | 77.3 |
| 53 | 5.36 | 185.9 | 31.2 | 79.5 |
| 60 | 4.87 | 132.3 | 28.3 | 73.9 |
| 75 | 3.95 | 131.4 | 22.9 | 74.9 |

**Table 2 Image evaluation for manual and digital methods using Mo/Mo target/filter**

| Compressed breast thickness (mm) | IQF | | Percentage (%) | |
|---|---|---|---|---|
| | Manual | Digital | Manual | Digital |
| 21 | 12.6 | 164.8 | 53.7 | 82.4 |
| 32 | 8.67 | 197.5 | 45.4 | 82.0 |
| 45 | 8.02 | 127.3 | 42.0 | 75.9 |
| 53 | 5.81 | 154.6 | 33.2 | 74.6 |
| 60 | 5.24 | 144.5 | 29.3 | 75.4 |
| 75 | 3.92 | 124.1 | 22.4 | 72.4 |

**Table 3 Image evaluation for manual and digital methods using Mo/Rh target/filter**

| Compressed breast thickness (mm) | IQF | | Percentage (%) | |
|---|---|---|---|---|
| | Manual | Digital | Manual | Digital |
| 21 | 9.38 | 188.4 | 45.9 | 82.0 |
| 32 | 9.10 | 176.5 | 45.9 | 80.7 |
| 45 | 5.84 | 176.7 | 34.1 | 78.5 |
| 53 | 6.29 | 155.8 | 35.1 | 76.8 |
| 60 | 4.69 | 144.1 | 27.3 | 74.6 |
| 75 | 4.63 | 141.0 | 26.3 | 75.1 |

Evaluation using manual method has some weakness so that the results are no better than digital method. Since there were a lot of images that should be evaluated, then the observer may experience eye fatigue that affects the accuracy of the readings at the end of the observation. In addition,

learning effects can arise due to the repeated observation, allowing observer familiar with the pattern of laying gold.

Figure 2 shows CDMAM phantom image with breast equivalent thickness of 21 mm using a Mo/Mo target/filter, while Figure 3 displays the results of the evaluation of the same image using the software. Contrast score detail diagram in Figure 3 shows the number of gold were detected. Red dots on each cells indicates that 2 of 2 gold plates in the cell can be detected. While the pink circle indicates that only one of the gold plates that can be detected. Contrast detail curve obtained by plotting the smallest thickness of the gold plate detected for each column diameter gold plate.

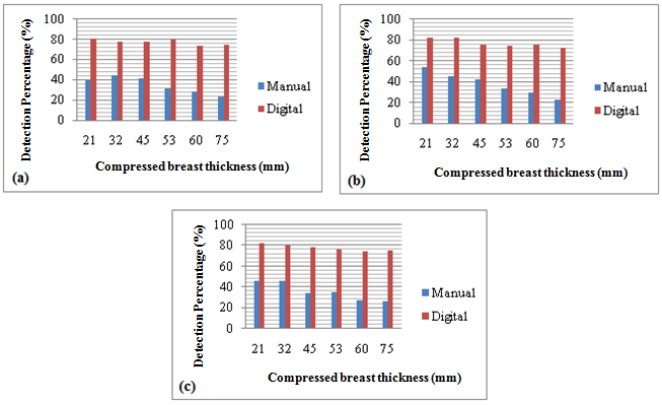


**Figure 1 Detection percentage comparison chart of manual and digital method on the use of (a) W/Rh, (b) Mo/Mo, (c) Mo/Rh**


**Figure 2 The image of 21 mm breast equivalent phantom using Mo/Mo target/filter**

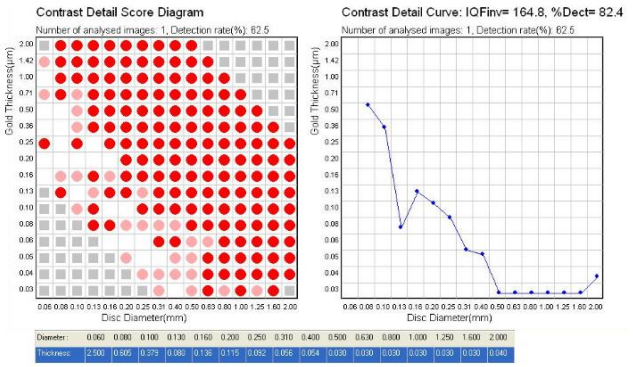


**Figure 3 Image evaluation of phantom images in Figure 2 by using software**

Evaluation using digital method generate greater detection percentage because computer program detecting image per pixel, so the result is much better and accurate. Manual calculations is inefficient because it spends a lot of time. Variations readings can occur by different observers (inter-reader variability) as well as the reading of the image that is repeated by the same observer (intra-reader variability) [13].

## C. MGD comparison based on different MGD determination recommendations

Conversion factor that converts air kerma to MGD determined by interpolation because the exposure parameters given during data collection is not entirely available in the reference publication. HVL values are relatively not constant over the same exposure parameters so that interpolation between the two data should be done.

MGD calculation is done with reference to the publication of IAEA Human Health Series No. 17 - Quality Assurance Programme for Digital Mammography, then the result is used as a benchmark for later comparison with the calculated MGD based on Dance *et al.* (2000), Klein *et al.* (1997), and Wu *et al.* (1991) publications. MGD values were calculated using Equations (4), (5), and (6). Conversion factors contained in the publication of Klein *et al.* (1997) and Wu *et al.* (1991) isn't as complete as the publication of IAEA and Dance *et al.* (2000). As a consequences, there are some exposure parameters that can not be calculated. Just like publication of Wu *et al.* (1991) which does not measure the conversion factor for the use of the target/filter W/Rh, moreover the HVL value is restricted between 0.24 to 0.43 mmAl.

From the graph shown in Figure 4, it appears that the MGD of calculations based on the publication of the IAEA and Dance *et al.* (2000) are not too different. It caused by the publication of the IAEA Human Health Series No. 17 - Quality Assurance Programme for Digital Mammography refers to Dance *et al.* (2000), only the display table are changed so that reading becomes easier. IAEA publications show the conversion factor *g* and *c* in the one table and based on thickness variations of PMMA. For a given thickness of PMMA, the value of equivalent thickness and breast glandularity are always the same, so the breast glandularity has no effect to the conversion factor. Except for glandularity, the value of *g* and *c* are influenced by the same factors, breast thickness and beam HVL, so both of these factors can be displayed in one table.

On Klein *et al.* (1997) and Wu *et al.* (1991), the value of conversion factor is also affected by kVp. However, tube voltage won't cause bigger affect than HVL beam, because the same tube voltage can be generated different HVL values. MGD calculation refers to the publication of the IAEA. Table 4, Table 5 and Table 6 show MGD discrepancy (%) on mammography display, and MGD that obtained by Dance *et al.* (2000), Klein *et al.* (1997), and Wu *et al.* (1991) publication against to MGD that were obtained based on IAEA publication for three variations target / filter combination. The maximum display MGD discrepancy that still allowed is 6%.

Mammography performance in determining MGD when using the W/Rh target/filter is quite good at low thickness (under 45 mm), along with the increased of compressed breast thickness then the discrepancy becomes higher. Even though, the discrepancy at 21 mm is also fairly high, reaching 9.40%.

In contrast to the use of the W/Rh target/filter, when the Mo/Mo and Mo/Rh target/filter is used, the MGD discrepancy of mammography display obtained fairly good on compressed breast thickness above 53 mm. Discrepancy tends to decrease against increase in thickness although the average is still above 6%. Meanwhile, in the use of Mo /Rh target/filter, the discrepancy obtained for 6 and 7.5 cm thickness is below the maximum value, respectively 4% and 5%.

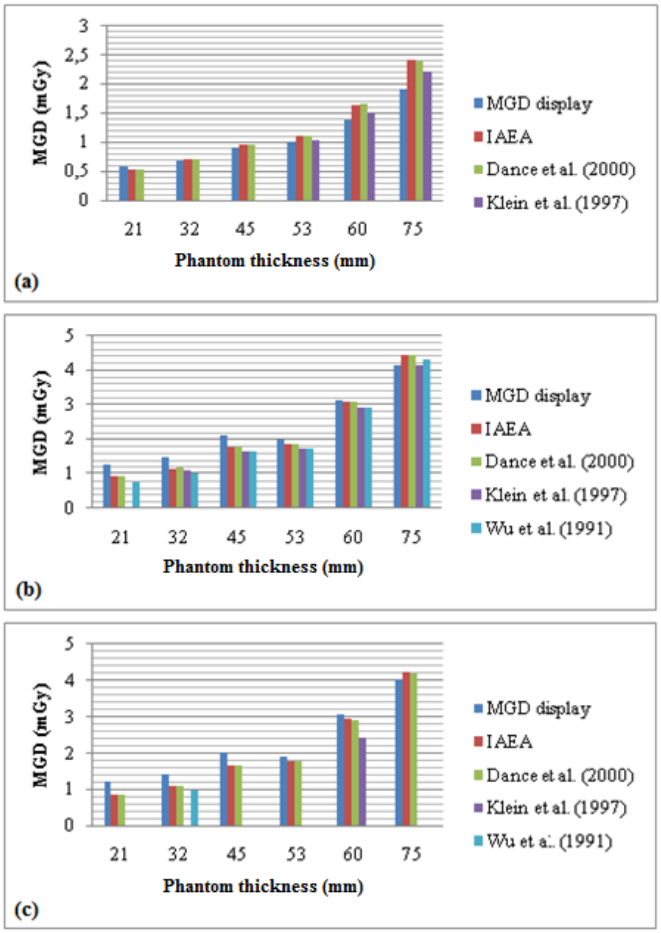


**Figure 4 MGD against to the breast thickness using (a) W/Rh, (b) Mo/Mo, (c) Mo/Rh target/filter**

**Table 4 MGD discrepancies against to MGD calculation (refers to IAEA) using W/Rh target/filter**

| Breast thickness (mm) | Display | Dance *et al.* (2000) | Klein *et al.* (1997) | Wu *et al.* (1991) |
|---|---|---|---|---|
| 21 | 9.40% | 0.20% | - | - |
| 32 | 1.13% | 0.06% | - | - |
| 45 | 4.87% | 0.16% | - | - |
| 53 | 8.69% | 0.47% | 6.89% | - |
| 60 | 16.03% | 1.46% | 8.14% | - |
| 75 | 20.38% | 0.32% | 8.25% | - |

**Table 5 MGD discrepancies against to MGD calculation (refers to IAEA) using Mo/Mo target/filter**

| Breast thickness (mm) | Display | Dance *et al.* (2000) | Klein *et al.* (1997) | Wu *et al.* (1991) |
|---|---|---|---|---|
| 21 | 36.67% | 0.30% | - | 17.68% |
| 32 | 28.14% | 0.46% | 6.54% | 11.34% |
| 45 | 19.59% | 0.49% | 6.84% | 7.77% |
| 53 | 6.80% | 0.64% | 6.93% | 7.39% |
| 60 | 1.84% | 0.66% | 5.44% | 4.95% |
| 75 | 6.88% | 0.68% | 7.06% | 3.43% |

**Table 6 MGD discrepancies against to MGD calculation (refers to IAEA) using Mo/Rh target/filter**

| Breast Thickness (mm) | Display | Dance *et al.* (2000) | Klein *et al.* (1997) | Wu *et al.* (1991) |
|---|---|---|---|---|
| 21 | 42.02% | 1.11% | - | - |
| 32 | 31.32% | 0.23% | - | 10.78% |
| 45 | 20.24% | 0.47% | - | - |
| 53 | 6.93% | 1.28% | - | - |
| 60 | 4.00% | 0.49% | 17.32% | - |
| 75 | 5.00% | 1.24% | - | - |

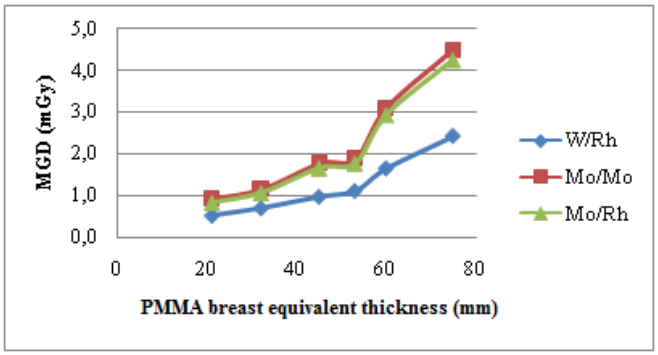


**Figure 5 MGD charts against the increase of PMMA breast equivalent thickness for W/Rh, Mo/Mo, and Mo/Rh target/filter**

## *D. MGD and image quality comparison based on target/filter combination variations*

Basically, breast thickness will affect the dose received by the tissue. The thicker the compressed breast, the more scattered radiation that occurs, as a consequence the dose becomes larger. Figure 5 is a graph showing the increase in the value of MGD against compressed breast thickness for the three target/filter combinations varied in the study. The results is in accordance with the theory that MGD increases with increase of the compressed breast thickness.

It can can be seen from the graph in Figure 5 the relation between dose and target/filter combination used. The highest dose was obtained when using Mo/Mo target/filter combination, followed by Mo/Rh and W/Rh. Dose differences in using Mo/Mo and Mo/Rh target/filter was not

significant with an average of 0.105 ± 0.017 mGy. While when using W/Rh target/filter the MGD is low.

MGD when using the Mo/Mo target/filter is the largest compared to the others because of the K shell X-ray characteristic spectrum of the it produces a high intensity, that is equal to 45 x 106 photons/mm$^2$. Slightly higher when compared with the use of Mo/Rh target/filter which is 30 x 106 photons/mm$^2$ [1]. This is affected by the filter used. When using the filter of Rh, the intensity of the Mo K shell X-ray characteristic being more attenuated since at that energy (17.5 keV) the linear attenuation coefficient of Rh is higher than Mo.

The combination of W/Rh target/filter produce low intensity bremsstrahlung spectrum with energy range 10-23 keV. This causes the MGD obtained is lower than the two others targets/filters combinations. Although only bremsstrahlung spectrum formed, but the use of this target/filter combination can produce images good enough because the X-ray energy produced was below 25 keV, there are still attenuation differences between breast glandular and cancerous tissue in this energy. Low energy bremsstrahlung spectrum below 10 keV, which can provide a significant dose to the breast trimmed by the using of the 50 µm Rh filters.

Mo/Mo target/is good for low breast thickness imaging. For phantom thicker than 32 mm, the MGD obtained is under 1.5 mGy with the best image quality is obtained when using Mo/Mo target/filter, detection percentage of digital method is 82.4% for thickness of 21 mm and 82.0% for thickness of 32 mm (Figure 6). The use of Mo/Mo target/filter can produce images with better contrast because the X-ray energy spectrum is low,20 keV

In the low energy X-ray, the attenuation differences between glandular and cancerous tissue becomes larger so that the image will provide high contrast. However, for the larger phantom thickness (≥45 mm) X-ray energy spectrum of the Mo/Mo target/filter does not provide sufficient penetrability, thus requiring the target/filter that produces more energy.

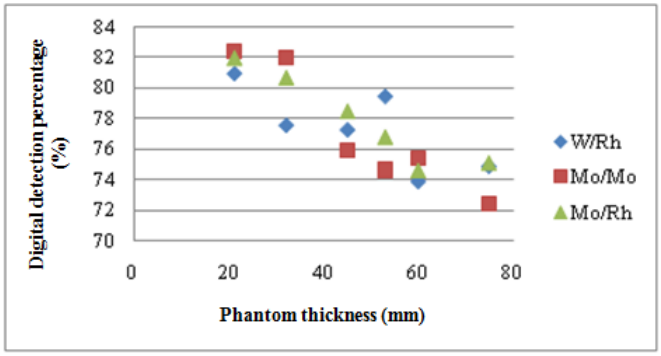


**Figure 6 Graph of image quality against the increase of phantom breast equivalent thickness using W/Rh, Mo/Mo, and Mo/Rh target/filter**

W/Rh and Mo/Rh target/filter spectrum has greater energy than Mo/Mo, up to 23 keV. The difference in attenuation between the glandular and cancerous tissue in that energy is still large enough so that the contrast between the two can still be distinguished. Among W/Rh and Mo/Rh target/filter, the best image quality produced when using the Mo/Rh target/filter. However, MGD values obtained when using the Mo/Rh target/filter is much larger, MGD when using W/Rh target/filter is 40.0 ± 3.6% of Mo/Rh. The MGD of W/Rh target/filter is lower because the X-ray spectrum that is formed has a lower intensity.

Image quality for phantom ≥45 mm when using W/Rh target/filter is not too good because the shape of X-ray spectrum is generated bremsstrahlung. Bremsstrahlung spectrum is less well when used for diagnostic because the spectrum form polienergetik that will reduce the contrast.

## IV. CONCLUSION

From these study obtained some conclusions:

1. X-ray mammography is in standard conditions according to the rules of Perka BAPETEN No. 9 of 2011.
2. The results of digital evaluation of CDMAM image is better than the manual one.
3. MGD values were calculated in this study (based on IAEA) is in accordance with the publication of Dance *et al.* (2000) with a maximum discrepancy of 1.46%, its value is less than 2%, then it said being at good compliance.
4. For thickness below 32 mm, the best image quality is obtained when using Mo/Mo target/filter combination, meanwhile the best target/filter combination for the thickness above 45 mm is Mo/Rh.

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# SIMPLE CALCULATION OF THE RADIATION FLUX DISTRIBUTION FOR *BRACHYTHERAPY* USING *MICROSOFT EXCEL*

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**Abstract:** One of the therapies used to destroy cancer cells is *brachytherapy*. This type of therapy has a radioactive source located in right position or near the cancer cells. In fact, *brachytherapy* is always faced a high risk for patients' safety. Calculation of radiation dose distribution is one tool to optimized therapy. However, mostly people do not understand about it, even medician. This is the background from author to do simple study about calculation of the radiation particle flux distribution and make simple concept about it. The method in this study used coordinate transform to have formula. This calculation based on the geometry of various radioactive sources, being brought closer to the point and line. The formula used to have contour curves with simple computing in *Excel*. Contour curves from this radiation particle flux distribution is in two – dimensional form. The result showed that *isodose* contours curves from research used *excel* were similar with references in quantitatively. This way is very simple and people can easily understand the basic concept of calculate from radiation particle flux distribution.

***Keywords***: *Brachytherapy*, Flux, Radioactive Source Geometry, *Isodose*, *Microsoft Excel*

Received 06 August 2014
Accepted 05 February 2015
Published 25 February 2015

## I. INTRODUCTION

In 2008, cancer causes 7,6 million deaths in worldwide. This number increased by 13 percent of total global deaths. *World Health Organization* (*WHO*) predicts that cancer deaths will continue to rise, and is expected to lead to 13,1 million people died of cancer in 2030 [1]. So, It's common if today people are looking for effective therapies to treat this deadly disease.

One of the therapies used to treat cancer is radiotherapy. Radiotherapy is a treatment method using a beam of high – energy from radiation to kill the tumor/cancer cells. Radiotherapy increasingly chosen by the public, as it is considered to have advantages. The advantages of radiotherapy can be seen on one type of radiotherapy, such as *brachytherapy*. In *brachytherapy*, radioactive packed in seed millimeter sized that inserted into the body. Radiation emitted from the seed just being around the area of tumor/cancer cells. Thus, it will reduce damage to normal cells in the body.

When *brachytherapy* performed there will always be greater risk. It's necessary for us to determine the proper dose of radiation to perform a calculation. So, the concept of radiation dose calculation is a fundamental requirement. However, there are still many people, especially medician who still do not understand this concept because it is hard to understand from existing reference. So, the author made this simple paper.

In this paper will be studied the basic concepts from calculation of the distribution flux radiation for *brachytherapy*. It should be noted that this paper is simple discussion that took over quantity aspect and contour in two – dimentional form. In this paper too, author would give example *brachytherapy isodose* contour curves in cases of cervical cancer with *Manchester* system. Tool used is quite simple, because it is only with *Microsoft Excel*. The author hopes from this simple paper can make people, especially medician easily understand the basic concepts from calculation of the radiation flux distribution in *brachytherapy*. So, from this understanding can create many innovations to make a success of radiotherapy with higher optimization.

## II. MATERIALS AND METHODS

### A. Coordinate transform to have formula

The method in this study is used coordinate transform to have the radiation flux formulation. The formula used to have contour curves with simple computing in *Excel*. This calculation based on the geometry of various radioactive sources, being brought closer to the point and line. It should be noted that this analyzed just from **quantity** aspect.

Here is a simple calculation to determine the radiation flux distribution from radioactive sources in the geometry of point and line:

**a. Point – geometry of radioactive source (S)**

Flux density is the number of particles per unit time wide radiation unity [3]:

$$\emptyset = \frac{S}{A_r} \quad (1)$$

with S is the source strength per unit time for a point source and a wide $A_r$ source. Then the radiation flux to a point – geometry of radioactive source, can be given as below [3]:

$$\emptyset = \frac{S}{4\,\pi\,r^2} \quad (2)$$

We must change the formulation into position forms, there are position coordinates *x* and *y*, because it is input that we have from the radiation source and the observer. Here is a figure of the analysis from point – geometry of radioactive source.

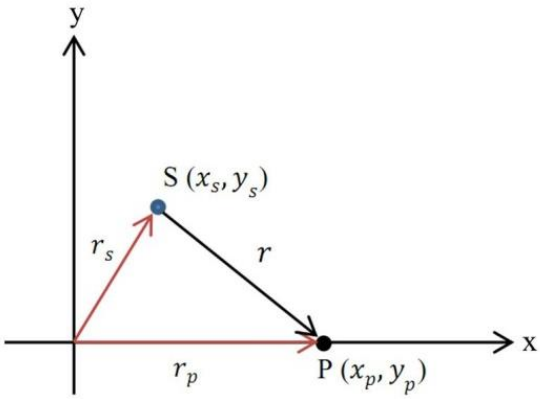


**Figure 1. Point – geometry of radioactive source. S expressed source and P expressed Observers point**

After we did the decline from general formulation, we will get the radiation flux for radioactive source in point – geometry, which can be given as below:

$$\emptyset = \frac{S}{4\pi\left[(x_p - x_s)^2 + (y_p - y_s)^2\right]} \qquad (3)$$

**b. Line – geometry of radioactive source ($S_L$)**

There are three possible positions of the line – geometry of radioactive source; vertical, horizontal and oblique. We must provide boundary conditions in coordinate space in each region. In this paper, author use the orientation of lines in horizontal position. For ease of analysis, we can use the following images:

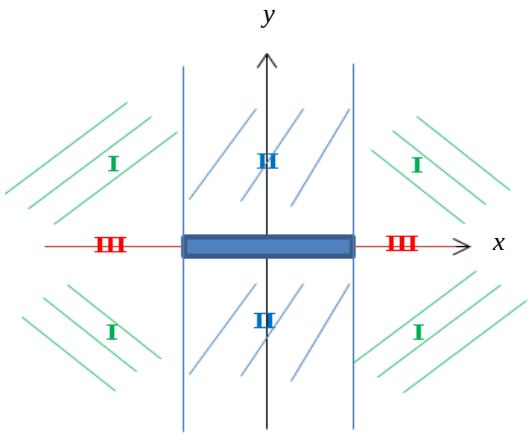


**Figure 2. Dividing coordinate space in three region for line – geometry of radioactive source**

**# For Region II ($P_2$)**

In the case line – geometry of radioactive source, we take the partition (dx), then the formula of the flux density in region II, becomes:

$$d\emptyset_2 = \left|\frac{S_L\, dx}{4\pi r^2}\right| \qquad (3)$$

with $S_L$ is the source strength per unit time for a point source and a wide $A_r$ source.

Then the radiation flux for radioactive sources in the line – geometry region II, can be given as below [3]:

$$\emptyset_2 = \frac{S_L}{4\pi h}(\theta_2 + \theta_1) \qquad (4)$$

**# For Region I ($P_1$)**

In the case line – geometry of radioactive source, we take the partition (dx), then the formula of the flux density in region I, becomes:

$$d\emptyset_1 = \left|\frac{S_L\, dx}{4\pi r^2}\right| \qquad (5)$$

with $S_L$ is the source strength per unit time for a point source and a wide $A_r$ source.

Then the radiation flux for radioactive sources in the line – geometry region I, can be given as below [3]:

$$\emptyset_1 = \frac{S_L}{4\pi h}(\theta_2 - \theta_1) \qquad (6)$$

**# For Region III ($P_3$)**

In the case line – geometry of radioactive source, we take the partition (dx), then the formula of the flux density in region III, becomes:

$$d\emptyset_3 = \left|\frac{S_L\, dx}{4\pi r^2}\right| \qquad (7)$$

with $S_L$ is the source strength per unit time for a point source and a wide $A_r$ source.

Then the radiation dose flux for radioactive sources in the line – geometry region III, can be given as below [3]:

$$\emptyset_3 = \frac{S_L}{4\pi}\left(\frac{1}{x_2} - \frac{1}{x_1}\right) \qquad (8)$$

The radiation flux formulation for line – geometry of radioactive source that have been presented in the form of the equation is still general equation. We have to change into a form that is the position coordinates *x* and *y*.

In the formulation for line – geometry of radioactive source, author use matrix transformation to make simple calculation. Here is a visualization of the transformation from line – geometry of radioactive source:

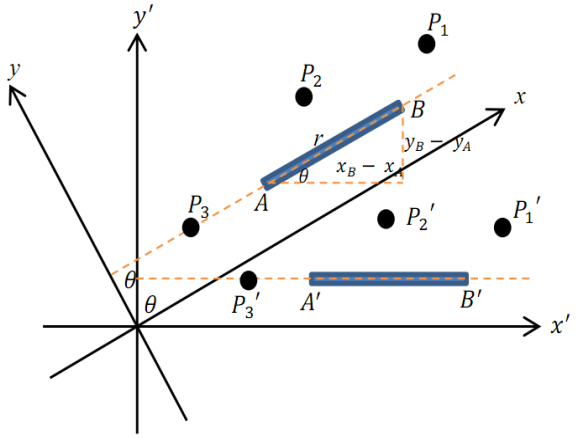


**Figure 3. Coordinate transformation in line – geometry of radioactive source**

Then, we do the analysis based on the transformation of radioactive sources in the line – geometry horizontal position. Since the coordinate transformation has been performed, then this will apply to the other position of lines. After we did the decline of general formulation, we will get as below:

**# For Region II ($P_2$)**

$$\emptyset_2 = \frac{S_L}{4\,\pi\,(y_P{}' - y_A{}')}\left[\arctan\left(\frac{x_P{}' - x_A{}'}{y_P{}' - y_A{}'}\right) + \arctan\left(\frac{x_B{}' - x_P{}'}{y_P{}' - y_A{}'}\right)\right] \quad (9)$$

**# For Region I ($P_1$)**

$$\emptyset_1 = \frac{S_L}{4\,\pi\,(y_P{}' - y_A{}')}\left[\arctan\left(\frac{x_P{}' - x_A{}'}{y_P{}' - y_A{}'}\right) - \arctan\left(\frac{x_B{}' - x_P{}'}{y_P{}' - y_A{}'}\right)\right] \quad (10)$$

The radiation flux formulation for the region I ($P_1$), if we change the sign bit, then the shape will be the same as formula the dose in region II ($P_2$), as below:

$$\emptyset_1 = \frac{S_L}{4\,\pi\,(y_P{}' - y_A{}')}\left[\arctan\left(\frac{x_P{}' - x_A{}'}{y_P{}' - y_A{}'}\right) - \left(-\arctan\left(\frac{x_B{}' - x_P{}'}{y_P{}' - y_A{}'}\right)\right)\right]$$

$$\emptyset_1 = \frac{S_L}{4\,\pi\,(y_P{}' - y_A{}')}\left[\arctan\left(\frac{x_P{}' - x_A{}'}{y_P{}' - y_A{}'}\right) + \arctan\left(\frac{x_B{}' - x_P{}'}{y_P{}' - y_A{}'}\right)\right] = \emptyset_2$$

We can see that the formulation is given the same with radiation dose region I. It can be analyzed that region I and II are **not in line** with the radioactive source.

**# For Region III ($P_3$)**

$$\emptyset_3 = \frac{S_L\ (x_B{}' - x_A{}')}{4\,\pi\,(x_B{}' - x_P{}')(x_A{}' - x_P{}')} \quad (10)$$

Regional observers test points in the region III ($P_3$) is an area that is **in line** with the radioactive source.

## B. *Microsoft Excel for make isodose contours curve*

The formulation in the form of position coordinates are used to get the contour curves. Making the curve *isodose* function to see how large doses of radiation emitted from radioactive sources can also be used to see which would be acceptable dose flux distribution to the target volume and critical organs are located in the surrounding [2]. In this discussion, the contour curves obtained using the simple computing in *Microsoft Excel* and displayed in two – dimensional form.

# III. RESULTS AND DISCUSSION

Here are some examples of the *isodose* contour curves made with simple computing in *Microsoft Excel*.

### a. One point – geometry of radioactive source

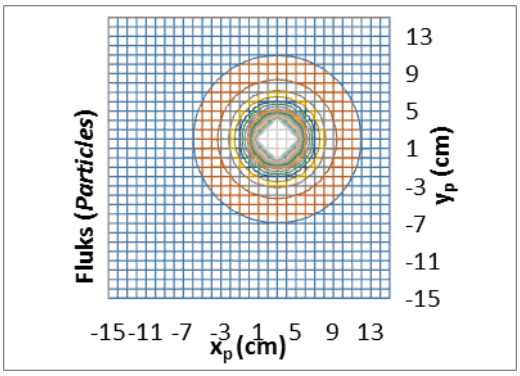


**Figure 4. The *isodose* contour curve for a point – geometry radioactive source**

If we compare the contour in **Figure 4** with theory in references, we can see that similar with theory.

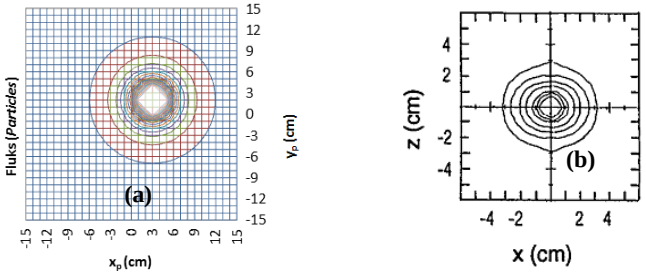


**Figure 5. Comparison from *isodose* contours curve for a point – geometry radioactive source based research (a) and theory (b)**

The *isodose* contour curve from a point radioactive source to form a circular pattern, similar with in theory.

**b. One line – geometry of radioactive source**

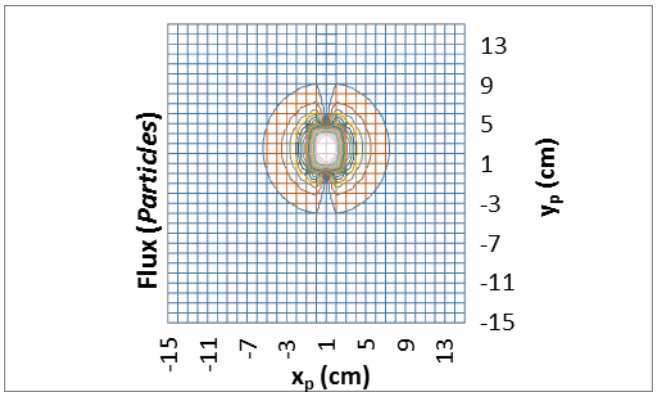


**Figure 6. The *isodose* contour curve for a line – geometry of radioactive source**

If we compare the contour in **Figure 6** with theory in references, we can see that similar with theory.

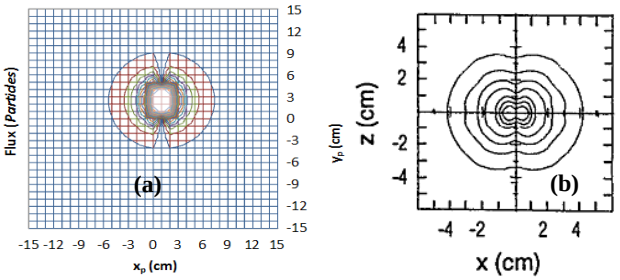


**Figure 7. Comparison from *isodose* contours curve for a line – geometry radioactive source based research (a) and theory (b)**

The *isodose* contour curve from a line radioactive source patterns shaped like butterflies, similar with in theory.

**c. Two point – geometry of radioactive source and three line – geometry of radioactive source**

We can also make contour curve from combination of radioactive sources. If we discussion about rule number of seed in the body, we will know the *Manchester* system (Patterson – Parker system). It is the method by implanting seeds. This implant planning system designed to deliver a uniform dose [4]. *Manchester* system gives specific rules of the table presents the distribution of sources and doses for ideal seed placement [5].

The i*sodose* contour curve can be shown as below:

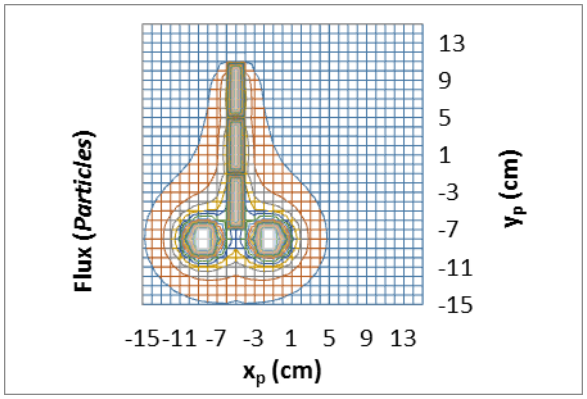


**Figure 8. The *isodose* contour curve shapes a pear – shaped used *Manchester* System. Consist of two points – geometry and three lines – geometry of radioactive sources**

If we compare the contour in **Figure 7** with theory in references, we can see that similar with theory.

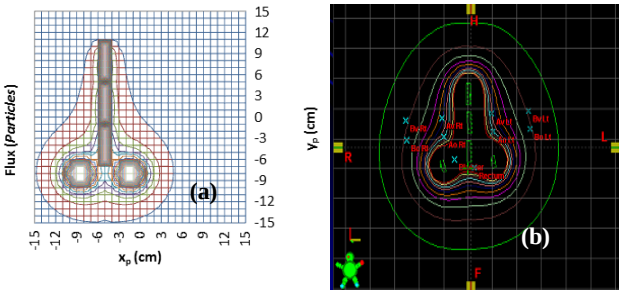


**Figure 8. Comparison from *isodose* contour curve used *Manchester* System based research (a) and theory (b)**

The *isodose* contour curve above is similar with theory in references, because the same pattern forming pear – shaped. In the reference curves pear – shaped used in *brachytherapy* for cervical cancer. The above contour curves are still very simple, but if we do a quantitative comparison with data in the reference, will we get a similar (quantitative).

## IV. CONCLUSION

Calculation of the radiation flux distribution can be created using *Microsoft Excel* and considered quite simple. So, the concept of basic dosimetry in *brachytherapy* can be easily understand for people, especially for medician. This way is very simple and people can easily understand the basic concept of calculate from radiation particle flux distribution.

## IV. ACKNOWLEDGMENTS

The author would like to thank to Bandung Institute of Technology Research (contract number: 156.28/AL-J/DIPA/PN/SPK/2013 ) which help for fund in research.

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# SENSITIVITY OF THE ABSORBANCE AND CAPACITANCE METHODS IN MEASUREMENT THE NUMBER OF CELLS IN-VIVO

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**Abstract:** Have been carried out measurement of the number of cells in vivo by using two methods, namely measuring the absorbance using spectrophotometer and the capacitance of the liquid capacitor is designed himself. The results of both experiments suggests that the capacitance method is more sensitive and transparent than the absorbance method at once proves that it could only be used for a limited range of cell numbers. In contrast, the capacitance method could be used for more wider range of cell numbers.

***Keywords**: E. Coli, Saccaromyces cerevisae, Streptococcus agalactiae, and Aspergillus niger, absorbance, capacitance*

Received: 07 May 2014
Accepted: 23 January 2015
Published: 25 February 2015

## I. INTRODUCTION

Usually microbiologists perform the measurement of the number of cells using absorption spectrophoto-meter method combined with the Total Plate Counting (TPC). By this way they could compare the level of turbidity (absorbance) a solution containing a number of cells [18]. This study seeks to develop the measurement of the number of cells with a totally different way, i.e. using liquid capacitor. Both of these measurement methods have a very different principle altogether. If the measurement via spectrophotometer rely on the interaction of light with matter present in the solution, then through the observation of the cells capacitance measurements performed by the distributed charge in solution and on the surface of the cell itself.

This study tried to compare the extent to which the two methods has a convincing level of sensitivity and transparency, will be discussed in this paper.

### *A. THEORY*

Absorption spectrum measurement using a spectrophotometer based on Lambert-Beer law, that the intensity of light absorbed ($I$) is proportional to the intensity of light source ($I_0$) which varies exponentially as a function of the thickness of samples (the optical path of light, $d$), the concentration of the solution ($c$) and extinction coefficient ($\varepsilon$). If written in the absorbance ($A$):

$$A = \log\left(\frac{I_0}{I}\right) = \varepsilon\, d\, l \qquad (1)$$

Extinction coefficient, $\varepsilon$, depends on the chromo-phore (the molecule has a dipole moment) that interact with light. Absorbance was measured for specific bacteria at 365 nm.

The larger dipole moment of the population, the greater the number of bacteria in solution, the intensity of the absorption will be greater.

In contrast to the spectrophotometer principles, the capacitance of the solution containing cells/bacteria is a reflection of the charge distribution inside the solution and containing bacteria (cells). Because the cells and also the solution used is a dielectric materials, the charge arising in it are induced charge, which are derived by electric field between capacitor plates. Therefore, as the first approximation, the value of the total capacitance ($C_{\text{total}}$) of the capacitor used is the algebraic sum of the value capacitance of the solution ($C_{\text{Solution}}$) and capacitance of the cells ($C_{\text{cell}}$):

$$C_{\text{Total}} \approx C_{\text{Solution}} + C_{\text{cell}} \qquad (2)$$

In accordance with the theory of cell growth during the time $t$, the cells develop according to the equation:

$$N_t = N_0\, e^{\lambda t} \qquad (3)$$

$N_t$ , $N_0$ respectively is number of cells in time $t$ and in $t$ = 0, $\lambda$ is the growth constant of the cell.

## II. MATERIALS AND METHODS

To measure the capacitance of the cells in-vivo by using a capacitor, first one must be made the capacitor by his-own, making it possible to measure the capacitance of the solution. Then this capacitor should be tested by using a known material, it means that the capacitance values of this materials is also known (in this experiment one used distilated water).

- Equipment used in the experiment is as follows:
  - Parallel plate capacitor
  - Capacitance measuring instrument in the form of Dual Display LCR-meter ELC-131D serial number 40,224,023
  - UV-VIS Spectrophotometer Variant 2415
  - Incubator Ogawa Seiki Co., LTD.
  - Waterbath thermologic NVC
  - Autoclave DSK 6508
  - Freezer
  - Maxi Mix II, thermolyne / Barnstead type 37 600 no.3850580
  - Stirrer, thermolyne / 2555 Kerper Boulevard Dubugue Barnstead, Iowa no.757960475604

- General microbiology laboratory equipment.

- Materials:
  - E. coli pure culture (UICC B-14)
  - S. Agalactiae (former veterinary IPB)
  - S. Aurens (former veterinary IPB)
  - Bacterial Cultur Medium (TEB / TEA)
  - Sodium chloride (NaCl)
  - Distilled water
  - Alcohol, peptone, malt extract, yeast extract, glucose, in order

- Measurement procedures:

Measurements were performed by using capacitors as follow:

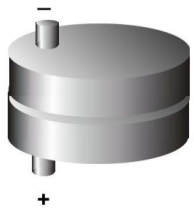


**Figure 1. Diagram of liquid Capasitor**

In general, experiments were carried out in room temperature.

## III. RESULTS AND DISCUSSION

### *A. Calibration capacitor and Capacitance of distilated water*

It is important to check performance of capacitor, before it's being used to mesure capacitance of cells. The capacitor have been tested by using distilled water which we known its capacitance value. Capacitance value of distilled water which measured was 76.3 pF (at room temperature), while in the literature, its values was 77.29 pF (at room tempe-rature). So that the relative error to the literature range about ~ 2%.

Because existence of non-polar molecules in the medium on one side and the Brownian motion on the other hand, the values of liquid capacitance in a moment would be unstable, it would fluctuate for a while. By administering electric field in medium, dipole moment gradually polarized, up to the direct-ion of given electric field (see figure 3).

### *B. Capacitance and Absorbance of Bacteria E.coli*

Dominant component of the macromolecular constituent of cells are dipolar molecules, such as H2O, CO2, H3- etc [19]. Without an electric field, these molecules have permanent dipole moments with random orientation. By administering an electric field, dipole moments will be oriented according to the direction of the field. Influence of the electric field is then created excess charge which may be positive or negative on each surface of the medium as a whole. These induced charges could be distributed at the cell surface and medium. Capacitance values of bacteria in vivo could not be obtained directly, but measurements were made for the bacteria that live in the solution. By knowing the mixed capacitance of live bacteria and its medium, and the capacitance of medium itself, can be calculated the capacitance of bacteria. Capacitance measurement procedure performed bacteria-medium by measuring the variation of capacitance values over the time. As mention above, the growth of cells depend exponentially with time.

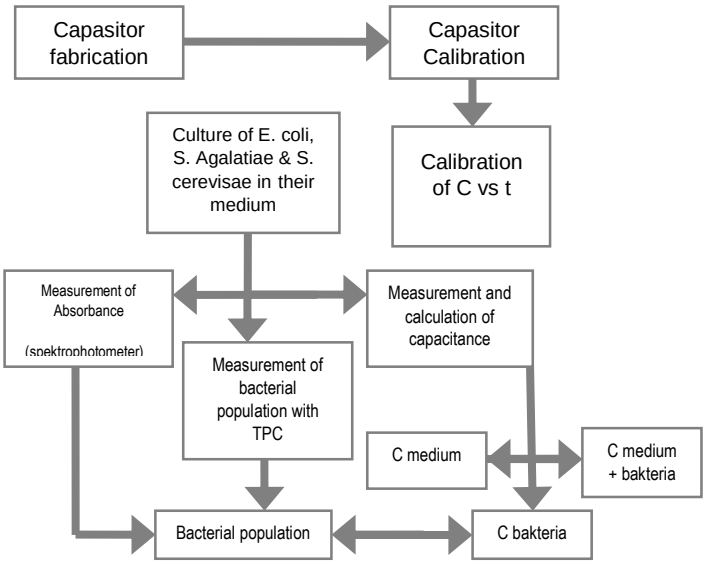


**Figure 2. Measurement diagram and calculation procedures of the cell capacitance and the absorbance measurements of the E. coli in solution**

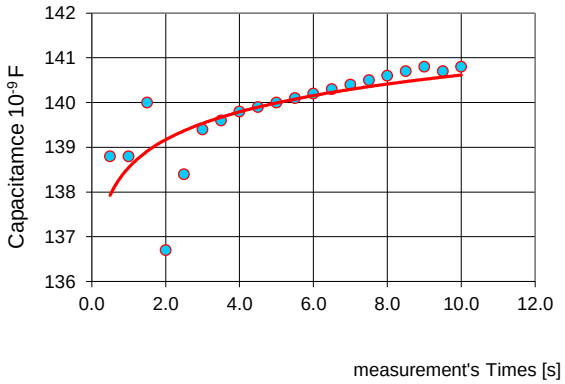


**Figure 3. Variation of capacitance values with respect to time. At the time of the arrangement induced dipole moment corresponds to the direction of the electric field is given, will be obtained the values of capacitance constant. This can be evidenced by Figure 2, the values of distilled water capacitance, C = C (t).**

Figure 4 is illustred the growth of cells during times. These curve also proves that the growth of cells is exponentially proportional throught the time.

From the cuve of cell growth can be concluded that the cell population is proportional to the values of the capacitance (see figure 3), or:

$$C \text{ (Capacitance)} \propto N \text{ (number of cells)}$$

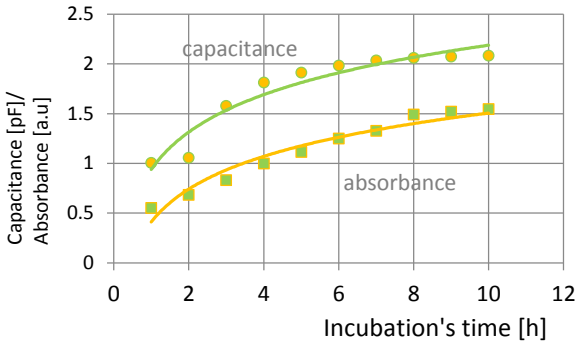


**Figure 4. Sample evidence of capasitance of E.coli versus incubation's times.**

With the increasing growth of bacteria over time, the values of the capacitance also increases, it means that each bacterium and also medium must contribute to the overall values of the capacitance. In assumption that the number of cell capacitance is proportional to the number of cells, it can be proved directly in Figure 4. This figure also shows the comparison of bacterial growth of E. coli of incubation time or the number of bacteria that ilustrated in cell volume. This means that the volume of each cell is identical to the number of cells.

Figure 5 illustrated that the capacitance of cells is proportional directly to the the absorbance and also to the number of cells, if one describe the absorbance, capacitance as a function of number of cells.

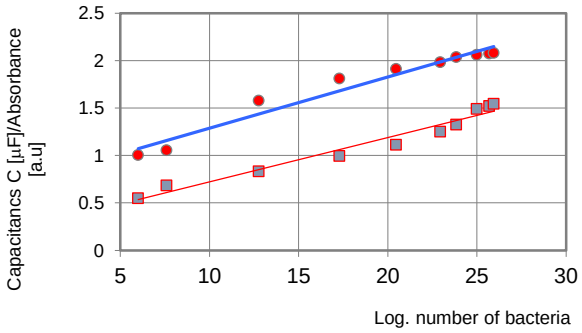


**Figure 5. Relation between capacitance of and number of E. coli has linear correlation.**

## C. The relation of Absorbance, Capacitances, and Number of Bacteria

Absorbance measurements on the growth of *E. coli* bacteria was carried out up to 24 hours. Together prior to the measurement of absorbance (at wavelength 365 nm) was measured capacitance of each clip (see also figure 4). Capacitance and absorbance curves shows the consistent evidence, that both curves, respectively proportional to the number of bacteria in solution.

As shown in figure 5, figure 6 ilustrates unnormalized and normalized curves of capacitance and absorbance. The capacitance curve is always higher than the absorbance. This fact indicates that the capacitance is more transparent or sensitive to the number of bacteria in solution compared to the absorbance. It is clear that as the basic parameter of capacitance is charge, while relying on the light absorbance, the more concentrated solution, the ability of equipment to record the light absorption is limited.

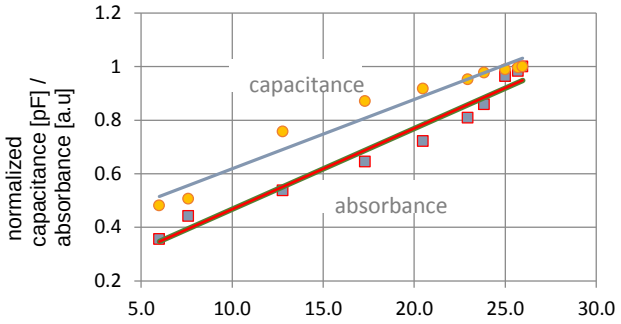


**Figure 6. Comparition of normalized absorbances and Capacitances of E. coli cells. The differences between two curves shows the sensitivity of the metods.**

This fact shows that the values of the capacitance is proportional to the values of absorbance and also proportional to the bacterial populations:

$$C \text{ (Capacitance)} \propto N \text{ (number of cells)} \propto A \text{ (Absorbance)}$$

For proving quantitatively, the variation of capa-citance and the absorbance curves of E. coli in variation logarithmic number of cells were illustrated in figure 6. Both curves show the consistency of the increasing number of cells and also are proportional to the number of bacteria.

The interesting thing to note is, there are significant difference sensitivity respons of the number of cells/ bacteria through absorbance and capacitance measurements. The number of bacteria more sensitive by using a capacitor than by spectrophotometer (absorbance). If the relative sensitivity between capacitance and absorbance methods is defined as $\Delta S = (C\text{-}A) / C \times 100\%$, $\Delta S$ is about 45% (relative to the capacitance values) if the number of bacteria present in the solution ranging from $10^6$ to $10^{17}$. If the number of bacteria more than $10^{17}$ such differences (sensitivity) begin to decrease. This is understandable due to reabsorption of light when the number of bacteria present in the solution is greater than $10^{17}$. The greater the number of bacteria up to $10^{17}$ to $10^{25}$, the sensitivity was decreased, namely from 37% to 25%. This methods have been proved for different bacteria, such as *Saccaromyces cerevisae*, *Streptococcus agalactiae*, and *Aspergillus niger* [1,2,3].

As we known, that the principle of capacitance measurement refers to the amount of induced charge contained in the solution and the cell's surface, through the existence of electric field on both of capacitor plate. While the absorption relying of light which is absorbed by solution containing the bacteria. The more viscous or more number of cells present in the solution, the absorption of incident light

by the bacteria is inhibited due to reabsorption of light by the surface of the bacteria in question, so that the light detected at the detector isn't contains the real information of the samples.

## IV. CONCLUSION

From this experiment can be concluded as follows:

- The absorbance's values, proportional to the capacitance and is proportional to the number of cells containing in solutions:

$$A \sim C \sim N$$

- Capacitors are more sensitive than absorbance in the measurements of bacteria.
- These experiments showed that the Lambert-Beer's law no longer transparent or sensitive if the number of bacteria is greater than 1017.
- Capacitors can be used to measure the amount of bacteria for more than 1025 of bacteria.

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# HOW TO PUBLISH IN JOURNAL OF MEDICAL PHYSICS AND BIOPHYSICS: AN AUTHOR'S WRITING GUIDELINE

Authorname Authorsurname[1], Coauthorname Coauthorsurname[2], Coauthorname Coauthorsurname[2,3], and Coauthorname Coauthorsurname[1,2]

[1.] *Institution name, address*
[2.] *Institution name, address*
[3.] *Institution name, address*

E-mail: editor@jmpb.org

**Abstract:** The abstract should be clear, descriptive and no longer than 250 words. It should provide a brief introduction to the problem. A statement regarding the methodology should generally follow a brief summary of results. The abstract should end with a comment on the significance of the results or a brief conclusion. Abstract is written in Times New Roman font, 10 pt sized.

***Keywords:*** *Minimum 3 and maximum 5 words which are not contained in the title*

Received
Revised
Accepted
Published

## I. INTRODUCTION

This author kit is designed to assist authors in preparing their submission to Journal of Medical Physics and Biophysics. It is an exact representation of the format expected by the board of editor for the final version of papers. Final submissions not following the required format will be returned to the authors for modification and compliance.

One can simply edit the document you are now viewing. Formats of paper components are available as styles along with this file. All scientific papers to be submitted should be written in English.

## II. MATERIALS AND METHODS

This section provides information on how submitted papers should be arranged technically. It also serves as an exact example for writing.

### *A. Submission method*

Colleagues who wish to publish their works should submit the full manuscripts (maximum 10 pages). Journal of Medical Physics and Biophysics is issued on February and August annually.

Authors must submit their work electronically, by electronic mail after completing online submission procedure. The acceptable formats are Microsoft Word for Windows (any version) or RTF (Rich Text Format). No PDF format is to be accepted for submitting.

### *B. Submission steps*

- Download the file "Writing Guideline for Authors.docx" from the web site http://jmpb.org. Open the file with MS word 2007 or later version.
- Modify the file. Replace the existing text (e.g. title, authors, text, figure, table, references etc.) with your text. Papers should be maximum ten pages.
- Rename the final paper file using a new name. The final paper filename should have the following name: Author.doc where Author is the corresponding author's name and doc denotes that the document is in MS Word.
- Complete the online submission procedure found at http://jmpb.org after registering yourself as author.
- Any inquiry should be addressed by e-mail to editor@jmpb.org.

The remaining of this document describes the format requirements to which final accepted contributions should adhere.

### *C. General organization of the paper*

It is recommended that Scientific Papers have explicit sections for Introduction, Material and Methods, Results and Discussion, Conclusion, and Acknowledgements (when applicable).

### *D. Document format*

A number of paragraph styles have been created to facilitate the formatting of the document. If using Microsoft Word, this template will help in matching the requirements for the submissions.

The paper size is A4 (210 x 297 mm), double-column format with a 0,5" margin at all sides. Spacing between columns is 0,3". Lines are single spaced, justified. Do not number the pages and do not include references to page numbers in the text.

#### 1. Headings

Use only a maximum of three levels of heading as follows:

- Level 1 – 13 pt, Arial bold, left-aligned, sentence case, roman numerical-numbered
- Level 2 – 12 pt, Arial italics and bold, left-aligned, sentence case, capital latin-numbered
- Level 3 – 10 pt, Times New Roman, bold, left-aligned, sentence case, arabic-numbered.

Use bullets as in the next section. Ensure that page breaks do not come between any heading and the next level of sub-heading or first line of body text after the heading (in Word, use paragraph formatting of 'Keep with next' for Line and Page Breaks on heading lines). When MS. Word is used, authors are encouraged to follow the formatting (styles) for corresponding paragraph parts and components.

## 2. Body text

The font used throughout the paper is Times New Roman 10 pt. Standard paragraph has no space both before and after the paragraph. Do not include extra paragraphs between lines. Body text format applies under all headings. All spacing must be set at an increment of 12 pt.

## 3. Bullets

There are two levels of allowed bulleting:

- This is the first bullet level. Font is Times New Roman 10 pt, with no space before and after the paragraph. Paragraph is hanging by 0,48 cm and text starts at 0,67 cm from the margin.
  - This is a sub-bullet level. Font is Times New Roman 10 pt, with no space before after the paragraph. Paragraph is hanging by 0,4 cm and text starts at 1,19 cm from the margin.

For texts requiring additional bullets level to be created, a table showing the complete data is advisable rather than the use of multiple bullets.

## 4. Tables

Tables are sequentially numbered in numeric fashion with the table number and the title above the table. Caption font is Times New Roman 9 pt bold, with no space before and 12 pt space after the paragraph. Include a paragraph immediately after the table to separate it from the following text or heading.

Tables should be centred in the page. Font is Times New Roman 9 pt, with 6 pt space before and 6 pt space after the paragraph. Table column headings should still use the same style but be bold. Tables are referred to in the text by the table number as shown in Table 1. When necessary, tables can be made wide accross the two columns.

**Table 1. Summary of formatting rules**

| Object | Font | Align |
|---|---|---|
| Paper Title | 14 pt Arial, bold, upper Chase | Left |
| Abstract | Times New Roman font, 10 pt | Justified |
| Text body | 10 pt Times New Roman, sentence Chase | Justified |
| Heading 1 | 12 pt, Arial bold, left-aligned, sentence case, roman numerical-numbered | Left |
| Heading 2 | 11 pt, Arial italics and bold, left-aligned, sentence case, capital latin-numbered | Left |
| Heading 3 | 10 pt, Times New Roman, bold, left-aligned, sentence case | Left |
| Bullet | Times New Roman 10 pt | Justified |
| Sub-bullet | Times New Roman 10 pt | Justified |

## 5. Figures

Figures are sequentially numbered in numeric fashion with the table number and the title below the figures. Caption font is Times New Roman 9 pt bold, with no space before and 12 pt space after the paragraph.

Figures should be centered in the page. The size of the figure must be kept proportional (not stretched) and span at exactly the column's width (8,72 cm). Font is Times New Roman 8 pt, with adjustable (increment of 12) space before and fixed 12 pt space after the paragraph. Figures are referred to in the text by the figure number. Figure 1 shows an included object.

Detailed recommendations for figures are as follows:
Ensure that figures are clear and legible. Black & white only is allowed. Hard copy illustrations should be scanned and included in the electronic version of the submission in an appropriate manner.

Acceptable formats as follows:

- BMP - Microsoft bitmap file
- WMF - Windows Metafile Format
- JPG - JPEG File Interchange Format
- TIF - Tagged Image File Format
- GIF
- PNG

The following included files are also permissible:

- Microsoft Graph
- Microsoft Draw
- VISIO Draw

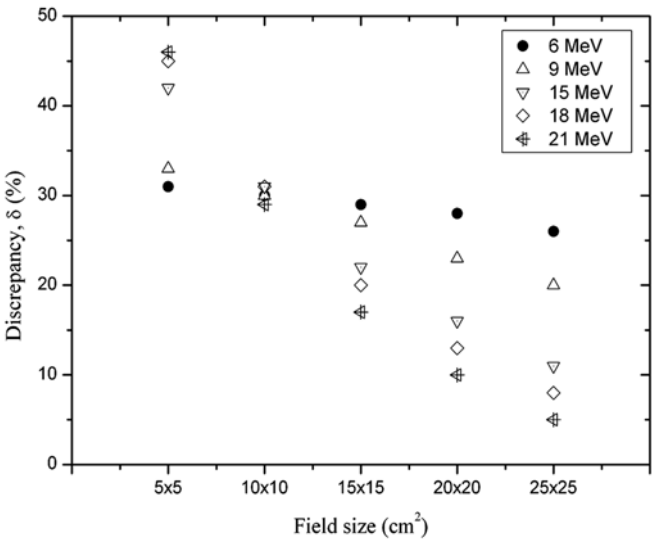


**Figure 1. An example of figure**

## 6. Equations

Equations are sequentially numbered in numeric fashion with the equation number and no title above or below the equation. Equations to be identified with bracketed decimal number right-justified after the equation. Should this is impossible (equation too long), bracketed denotation to be made in the same fashion right below the equation.

Font is Times New Roman 9pt bold, with 24pt space before and 24pt space after the paragraph. Should the equation spans longer that the spaces are cutting the

equation's top or bottom side, the spacing must be modified into any increment of 12 to maintain vertical alignment between inter-column lines.

$$\delta = \left| \frac{D_{calc} - D_{meas}}{D_{meas}} \right| \times 100\% \quad (1)$$

### 7. References

All publications cited in the text should be included in a list of references as the last section of the paper. Within the text, references must be denoted by placing number of appearance order between square brackets [1].

Two or more different references addressing the same ideas should be indicated by putting all references between a pair of square brackets, separated by comma [2,4,6,7]. Order of appearance should be made on the references section.

List of references should serve as an enclosure for the entire paper. The format accepted for publication is a modified APA format, where they are being numbered by the order of appearance rather than sorted alphabetically without number as the original APA style is.

## III. RESULTS AND DISCUSSION

Submissions for Full Paper will be reviewed by the board of reviewers. Reviewers will use a standardized form for review. Evaluation will stress the originality of the submission, the contribution to medical physics and biophysics field, the clarity of exposition and the adequacy of references to relevant work.

All accepted papers will appear on the website of the Journal of Medical Physics and Biophysics. Printed version can be requested by sending an inquiry to editor@jmpb.org mentioning the issue number or subscription request. Authors may wish to include a letter to the Editor with their final submission if the final Full Paper makes a major deviation from these expectations.

## IV. CONCLUSION

A detailed conclusive remarks should be included in this section. Further recommendation and statements may also be involved.

## V. ACKNOWLEDGMENTS

When necessary, this section serves as a media to thank those that have supported you and your work.

## REFERENCES

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# HOW TO SUBMIT IN JOURNAL OF MEDICAL PHYSICS AND BIOPHYSICS: AN AUTHOR'S TECHNICAL GUIDELINE

Prepared by Journal Manager

*Journal of Medical Physics and Biophysics*

E-mail: editor@jmpb.org

**Abstract:** This set is prepared to guide authors in going through the online procedure to submit their works in Journal of Medical Physics and Biophysics. Open Journal Systems are applied in JMPB procedures and the step-by-step procedures for submitting articles are described in this document. Authors may also see OJS's userguide for more illustrations.

Received
Revised
Accepted
Published

***Keywords:*** *Author, paper, submit*

## I. Overview

OJS exists to serve Authors as well as journals. Not only does OJS provide an easy-to-use submission process, it can collect and disseminate key information about Authors and their work across important research and citation databases, including Google Scholar, PubMed, the Directory of Open Access Journals, and others.

As an Author, your tasks include submission; submitting revised copy; copyediting; and proofreading. To make a submission, you must have a user account and be enrolled as an Author. User accounts can be created by registering yourself. Once you have an account, log in to the journal site and select the role of Author.


**Figure 1. Selecting the Author's role**

## II. The Author User Home Page

After clicking on the Author link on your User Home page, you will be directed to your Author's User Home page, which includes information on Active Submissions; a link to start a new submission; and information on any Refbacks you may have.

### *A. Active Submissions*

This page will list any of your submissions to the journal that are still in process (e.g., awaiting assignment to an editor, undergoing review, being edited) or incomplete (in which case you can return and finish the submission at any point).

Each completed submission will fall into one of the following categories:

- Awaiting Assignment: the submission has been completed by you; you cannot now delete the submission from the system yourself. The Editor can now see the submission, and must assign an Editor or Section Editor to it.
- Queued for Review: the submission has been vetted and is now in the review process. You should receive notice shortly on the review decision.
- Queued for Editing: the submission has completed the review process and has been accepted for publication; it will now make its way through the system's copyediting, layout editing and proofreading processes.

In the example below, the journal is charging a submission fee to authors, and you must pay this (using the Pay Submission Fee link) before the submission can be considered. If a journal does not charge submission fees, this link would not appear. Similarly, this example journal is also configured to require a publication fee. The author must use the Pay to Publish link to make the payment and allow for publication to proceed. JMPB does not charge any fee for any process, so authors will not see these steps.

As the author, you can click on the hyperlinked title of any listed submission and review it. Clicking a submission title will bring you to your submission's Summary page. From here, you could revise the title or abstract (by clicking the Edit Metadata link). If the editor asks for revisions, you will upload the changes this way too (in the Review section of your submission).

### *B. RefBacks*

The RefBacks section displays any incoming links from external web sites such as blogs, news sites, or other articles that link directly to your articles. Each RefBack can be edited: it can be ignored, deleted, or published, in which case it appears publicly at the end of your published article on the web site.

### *C. Archive*

Your Archive page will list all declined submissions, as well as any published submissions along with information on which issue they appear in.

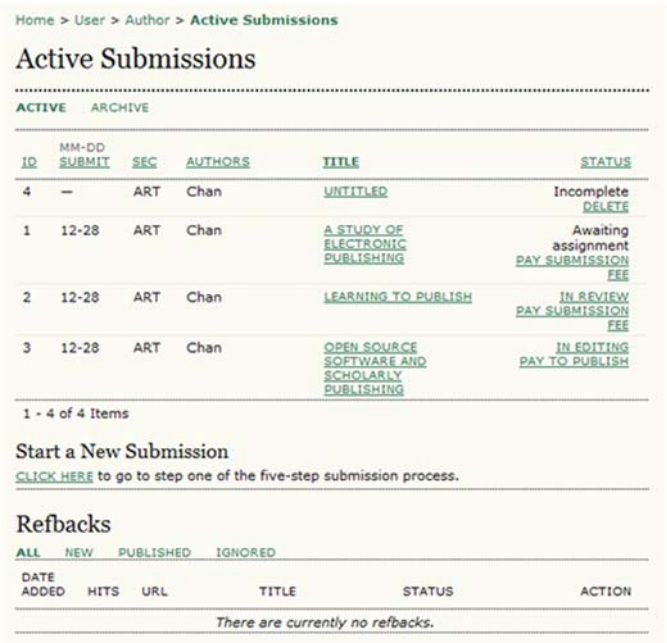


**Figure 2. Active Submissions**

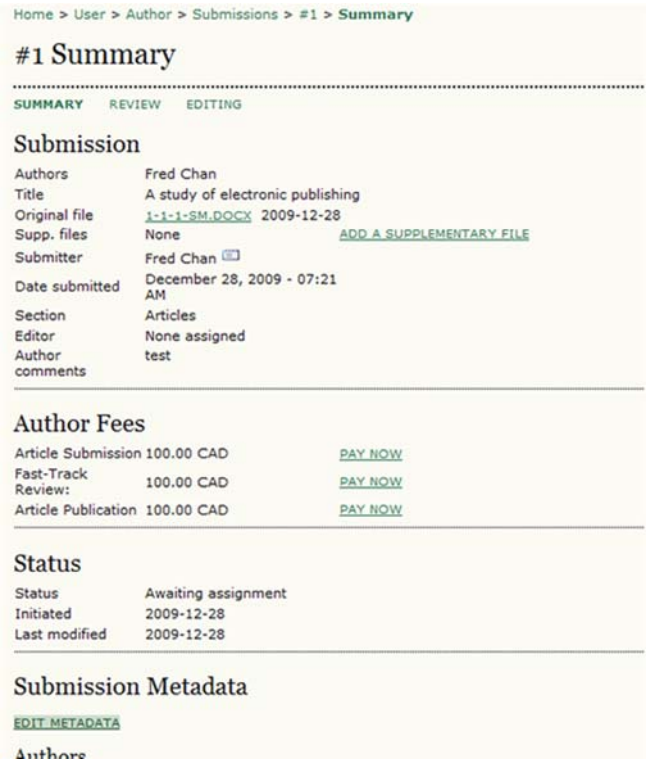


**Figure 3. Submission Summary**

## III. Submitting an Article

To make a submission, select the Click Here link (under Start a New Submission) to proceed to the first step of the submission process.


**Figure 4. Starting a Submission**

### A. Submission Step One: Starting the Submission

Step 1 ensures that the Author understands the journal's submission rules. The Author will have to pick the appropriate section to submit to, and will be provided with information on the journal's privacy statement, copyright notice, competing interest statement and/or author fees, if applicable. If you need any help the journal's technical support contact is provided at the top of this page.

- First, if the journal charges submission fees, these will be presented to the author. If the journal does not charge submission fees, this section will not appear. This is not the case for JMPB.
- Next, the author must check each of the items from the submission checklist.
- The journal's copyright policy will appear next, and, if configured as a requirement, the author will need to agree to this policy.
- Finally, the author can add any comments, which will be visible to the editor. Move to the next step by hitting the Save and Continue button.

### B. Submission Step Two: Uploading the Submission

Submission Step Two allows you to upload the submission file, typically a word-processing document.

- Click Browse to open a Choose File window for locating the file on the hard drive of your computer.
- Locate the file you wish to submit and highlight it.
- Click Open on the Choose File window, which places the name of the file on this page.
- Click Upload on this page, which uploads the file from the computer to the journal's web site and renames it following the journal's conventions.
- Once the submission is uploaded, click Save and continue.

### C. Submission Step Three: Entering the Submission's Metadata

The third step of the submission process serves to collect all relevant metadata from the author. The first section of metadata covers the authors. The submitting author will have their personal information automatically appear. Any additional information, such as Competing Interests should also be added at this time, if required.

If there are multiple authors for the submission, their information can be added using the Add Author button. You can also re-order the list of authors, make one of the authors the principal contact with the editor, and delete any authors added in error. Next, enter the submission title and abstract. You will then add indexing information. This will help others find your article. The final section allows you to enter the name of any organization that may have supported your research.

Hit the Save and Continue button to move on to Step 4.

## D. Submission Step Four: Uploading Supplementary Files

This step is optional. If you have any supplementary files, such as research instruments, data sets, etc., you may add them here. These files are also indexed by the author, identifying their relation to the submission, as well as their ownership. Supplementary Files can be uploaded in any file format and will be made available to readers in their original format.

- Locate the file you wish to submit and highlight it.
- Click Open on the Choose File window, which places the name of the file on this page.
- Click Upload on this page, which uploads the file from the computer to the journal's web site and renames it following the journal's conventions.
- Once the submission is uploaded, click Save and Continue.

## E. Submission Step Five: Confirming the Submission

This final step provides a summary of your submission. Click Finish Submission to submit your manuscript. You will receive an acknowledgement by email and will be able to view your submission's progress through the review and editorial process by returning to the Active Submissions section of your Author page.

## F. Authors and Submission Review and Editing Process

To track your submission's progress through the review and editorial process, you will need to log into the journal web site, and choose your role as Author. Click on the linked title to go to the submission record.


Home > User > Author > **Active Submissions**

Active Submissions

ACTIVE ARCHIVE

| ID | MM-DD SUBMIT | SEC | AUTHORS | TITLE | STATUS |
|---|---|---|---|---|---|
| 1 | 12-28 | ART | Chan | A STUDY OF ELECTRONIC PUBLISHING | Awaiting assignment PAY SUBMISSION FEE |
| 2 | 12-28 | ART | Chan | LEARNING TO PUBLISH | IN REVIEW PAY SUBMISSION FEE |
| 6 | 12-28 | ART | Chan, MacIntosh | LIBRARIES AND PUBLISHING: NEW OPTIONS FOR RESEARCH... | Awaiting assignment PAY SUBMISSION FEE |
| 3 | 12-28 | ART | Chan | OPEN SOURCE SOFTWARE AND SCHOLARLY PUBLISHING | IN EDITING PAY TO PUBLISH |

1 - 4 of 4 Items

**Figure 5. Active Submissions**

### 1. Summary

The Summary section contains several sections, including Submission, which displays the author names, submission title, original submission file, any supplementary files, the ability to add a supplementary file, the name of the submitter, the date submitted, the section the article is assigned to, the editor responsible for the submission, and the comments to editor you made as part of your submission (see above).

From the resulting 'Summary' page, you will see links to Summary, Review, and Editing pages. Each of these pages will provide details about your submission.

The Status section lets you know where your submission is in the publishing process (see above for status possibilities). It also lets you know when you made your submission and the date of the most recent status change.

The final section outlines the submission metadata, including author details, title, abstract, indexing, and supporting agency. You can modify any of this information by selecting Edit Metadata.

### 2. Review

If your submission is In Review, you can view its details in the Review section (linked from the top of your page). First, you will see the basic submission information again. Below that is the Peer Review section. You will see information about each round of review (there may be one or more) and any revised files (e.g., a version of your original submission file with changes marked in) uploaded by each reviewer (Reviewer A, Reviewer B, etc.).

Last on this page is the Editor Decision section. From this section you can notify the editor once you have submitted your revised submission file, view the reviewer comments (click on the cloud icon), and upload your revised submission file (if revisions were required).

Possible decisions include:

- Accept: Your submission has been accepted as is.
- Revisions Required: Your submission requires minor changes and will be accepted once those have been completed.
- Resubmit for Review: Your submission needs significant re-working. A new file must be submitted and another round of review will take place.
- Reject: Your submission was not accepted for publication with this journal, either because it was not seen to be of high enough quality, or its subject did not match the journal.

### 3. Editing

Your submission is considered "In Editing" once it has been approved for publication. It will then need to go through copyediting to correct any grammatical or stylistic errors, layout editing to create the published galleys (e.g., HTML or PDF), and proofreading to take one final look at the article before it is made publicly available.

If your submission is In Editing, you can view its details in the Editing section (linked from the top of your page). The first section again includes basic submission information.

In the next section, you can follow the copyediting process.

- Step 1: The journal's Copyeditor has made changes to the reviewed submission file. You can download a revised copy here (e.g., 6-11-1-ED.DOCX).

- Step 2: You will review the Copyeditor'ss changes, and make any final changes of your own. You then upload your revised submission file here. Be sure to use the email icon to notify the Copyeditor that you have submitted your file.
- Step 3: The Copyeditor takes a last look at your changes before passing the submission over to the Layout Editor. No action is required by the author.

The next stage in the editorial process is layout editing. The Layout Editor takes the final copyedited version of the submission and converts it into a format suitable for publishing on the journal web site (e.g., typically HTML or PDF). These are known as the "galleys".

The final editing stage is proofreading. It is also broken down into 3 steps;

- Once the galleys have been uploaded by the Layout Editor, you will receive an email from the editor asking that you review them and note any errors in the Proofreading Corrections comments. Proofing Instructions are also available. To view these, you will need to login to the journal and select the appropriate submission link. On the resulting screen, you can use the View Proof links to display the files. You can click the linked file names (e.g, 1-95-1-PB.HTML) to download a copy. Review the files and make any comments using the Layout Comments icon. Once you have completed your review and noted any necessary changes, hit the Complete button. This will generate an email informing the Proofreader and Section Editor that you are satisfied with the galleys.
- The journal's own Proofreader will also check for errors and make their own notes and inform the Layout Editor when all proofreading is complete. No action is required by the Author.
- The Layout Editor takes all of the notes and incorporates all of the changes into revised galleys. These are then ready to publish. No action is required by the Author.

You have now completed all of the steps involved in submitting to the journal and participating in the review and editing of your submission.

## IV. ACKNOWLEDGMENTS

JMPB refers this complete guide from OJS instructions. We are thankful for the systems provided by OJS.

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# HOW TO REVIEW ARTICLES IN JOURNAL OF MEDICAL PHYSICS AND BIOPHYSICS: A REVIEWER'S GUIDELINE

Prepared by Journal Manager

*Journal of Medical Physics and Biophysics*

E-mail: editor@jmpb.org

**Abstract:** This set is prepared to guide reviewers in going through the online procedure to review submitted works in Journal of Medical Physics and Biophysics. Open Journal Systems are applied in JMPB procedures and the step-by-step procedures for reviewing articles are described in this document. Reviewers may also see OJS's userguide for more illustrations.

Received
Revised
Accepted
Published

***Keywords:*** *Article, paper, review*

## I. Overview

The Reviewer is invited by email to review a submission, which includes its title and abstract, as well as the journal's URL and a username and password for the Reviewer to use to enter the journal. The journal has the option of using a reviewer option that sends the submission as an email attachment to the Reviewer along with an invitation to review.

In this case, the Reviewer then responds by email via a provided link. What is described here is the principal method for reviewing (and ensuring complete records of the process), which involves the Reviewer conducting the Review on the journal's web site.

## II. Review Home Page

### *A. Submissions*

On logging in to the journal, you will arrive at the User Home page.


**Figure 1. Reviewer Home**

To see the submissions you need to review, click the Reviewer link, or click the "x" Active link. Both will take you to your active Submissions page. This page lists the submissions which you have been invited to review or are currently in the process of reviewing.

The Submissions queue also notes what round the review is, as some reviews may have entered a second round of reviewing, following the Section Editor's decision that the submission must be "resubmitted for review." This page also provides access to past reviews which the Reviewer has completed for the journal.

Clicking on the linked title will take you to the review process.

### *B. Review*

You will first see a summary of the submission details.


**Figure 2. Review Assignment**

Next, you will see the review schedule, and the associated deadline. Next, the Review process is divided into seven steps.

- You have first to indicate to the Section Editor whether they will undertake the review. The decision should be made after reviewing the submission's Abstract and perhaps looking at the submission, by clicking on the file name in Step 3 (depending on the journal's policies, the file may not be available before agreeing to review it).
- If you are unable to do the review, click on Unable to do the review which leads to a standard email to the Section Editor.
- If able to do the review, click on Will do the review, which leads to a standard email to the Section Editor, and which will indicate to Section Editor and Author that the review is underway.
- Consult the Reviewer Guidelines, found at the bottom of the Review page. The Reviewer Guidelines have been prepared by the Editors of the journal to ensure that your review is as helpful as possible to them and the author.
- The Author has uploaded the submission as a file, which you can download from the journal's web site to your computer by clicking on the file name. The Supplementary Files refer to materials the Author may have uploaded in addition to the submission, such as data sets, research instruments, or source texts.

- (Optional): In some cases, the journal may require you to declare whether or not you have competing interests with the article being reviewed. If this is the case, this step becomes a form requesting a declaration of Competing Interests, and all following steps change their step number accordingly.
- Click on the Review icon and is presented with two Review text-boxes where the Review can be either entered by hand or pasted: one for the Editor and Author, and one visible to the Editor only. The Reviewer may enter or paste partial reviews into these boxes and click the Save button at the bottom of the form to return and make changes later. The Reviewer may return to make such changes until a recommendation on the main Review pages is chosen, at which time the Review process is complete.
- Please note: the Journal manager, in conjunction with the journal's Editor(s), may have created an extended custom review form to be filled out here. More information on the custom form should be found in the Reviewer's Guidelines. The form can be returned to and edited until a recommendation has been chosen.
- You also have the option, in addition to entering a review, of uploading files for the Section Editor and/or the Author to see. These files may be an annotated version of the submission or some relevant data or other materials that will assist Editor and/or Author. It will be at the Editor's discretion whether these files are shown to the Author, but you can certainly comment on this in the Review (Step 5).
- You must select a Recommendation for the submission from among the following options: Accept, Revisions Required, Resubmit for Review, Resubmit Elsewhere, Decline Submission, See Comments. When you click Submit Review to the Editor, it leads to a prepared email to the Section Editor, and makes your recommendation, saved Review (which is now locked) and any uploaded files available to the Editor.

## III. ACKNOWLEDGMENTS

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JOURNAL of MEDICAL PHYSICS AND BIOPHYSICS

# CALL FOR PAPERS

The Journal of Medical Physics and Biophysics cordially invites papers to be published on the second issue due published on August 2015. Online submission for publication consideration can be performed at any time before May 31st 2015.

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Email: editor@jmpb.org
Medical Physics and Biophysics Division, Department of Physics, Faculty of Mathematics and Natural Sciences, University of Indonesia, Depok, 16424, West Java, INDONESIA


Print ISSN: 2355-2727 | Online ISSN: 2355-2719 | http://jmpb.org

JOURNAL OF MEDICAL PHYSICS AND BIOPHYSICS

Secretariat and Publisher:

Medical Physics and Biophysics Division,
Department of Physics, Faculty of Mathematics and Natural Sciences,
University of Indonesia
Depok, 16424, INDONESIA

http://www.jmpb.org | editor@jmpb.org

JMPB is the official publication media of:
Indonesian Association of Medical Physics and Biophysics (HFMBI)

ISSN 2355-2727
9 772355 272005