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# IN MEMORIAM

The Postgraduate Medical Journal of Ghana announces with great sadness the passing of its Editor-in-Chief, Professor Joseph Darkwah Seffah. The sad event happened on the 22nd January 2024.

The College, as well as staff of the Editorial Office of the College mourn the passing of their beloved Editor who has served the College with such hard work and quiet efficiency and express their condolences to his dear wife and children, as well as the entire extended family.

A fitting Tribute contributed by one of his close friends, is published in this issue of the Journal and gives a brief account of the stature of the departed Editor-in-Chief of the Journal.

***May the soul of Joseph Darkwah Seffah rest in perfect peace!***



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# PROFESSOR JOSEPH DARKWA SEFFAH

***Isaiah 55:8,9. For my thoughts are not your thoughts, neither are your ways my ways, saith the Lord. For as the heavens are higher than the earth, so are my ways higher than your ways, and my thoughts than your thoughts. Amen.***

## Preamble

It is with heavy heart that I write this tribute to my bosom friend with whom I have been associated since we first met in the Premed Class of the University of Ghana in October 1976 i.e. nearly 48 years. We became friends the first time we met but the friendship grew stronger when we joined the postgraduate training programme at the Korle-Bu Teaching Hospital in October / November 1988.

## Early Life

Professor Darkwah Seffah, popularly known as JD, was born on the first day of September 1956. He started his Primary and Middle School education in Kumasi. He was very brilliant and he sat for the Common Entrance Examination in 1969 whereupon he gained admission to the popular Prempeh College in Kumasi. He passed his GCE Ordinary Level examination with Distinction in 1974. He had the 2-year Sixth form Education in science at the same school and in 1976 passed the GCE Advanced Level Examination with flying colours.

## Medical School Life

He gained admission to the University of Ghana Medical School [UGMS] in October 1976. He concentrated on his studies and sailed through medical school with relative ease. He passed his examinations at the first attempt. In May 1982 he passed the final conjoint examinations of Bachelor of Medicine and Bachelor of surgery [MB CHB] to become a practising physician.

## Early Working Life

After the swearing – in ceremony on 12th June 1982, JD started the Housemanship in General surgery and Child Health. Soon after the Housemanship in 1983, he had the opportunity to travel to Nigeria where he lived with his wife, Leticia. He returned after 2 years and was posted to Tetteh Quarshie Memorial Hospital at Akwapim Mampong where he worked till 1988. He worked under Dr. Neequaye, an Obstetrician Gynaecologist, who ignited the passion for Obstetrics & Gynaecology in him. JD proceeded to the Korle-Bu Teaching Hospital for postgraduate Training in Obstetrics and Gynaecology in 1988. In those days the postgraduate students stayed in Korle-Bu and passed the Part 1 Examination of the West African College of Surgeons then proceeded to the United Kingdom for the Membership of the Royal College of Obstetricians and Gynaecologists. Rather, unfortunately, this trend was truncated and the training was completely localised under the Canergie – Ghana Postgraduate Training Program. JD and I did not want to be called Residents forever so we had to study hard to pass all the Examinations on time. We spent a lot of time in the departmental library from 7 – 10 pm whenever we were both free. Those were the days when there were very few residents but with a rather very high work-load. When we were getting ready for our Part 1 Examination, I had the misfortune of having to do my usual Team A duty followed by Team C duty after 48 hours. This was very exhausting but JD was always there to relieve me of some of the extra burden. ***He was such a loyal friend.***

The "struggle continued unabated" till we passed the Final Part II Fellowship Examination in 1994. The Fellowship of the West African College of Surgeons (Faculty of Obstetrics and Gynaecology) was conferred on us at a colourful ceremony in Abidjan in 1995.

## Late working Life

We were appointed Specialists in Obstetrics and Gynaecology in 1994. Both of us applied to join the University of Ghana Medical School in 1994 but we didn't receive any reply to our applications till late 1996 when I was on a long holiday in the Republic of South Africa. When he received his invitation letter to the interview, he immediately asked for mine. He went to inform the Dean of UGMS that I was out of the country so he suggested a video or conference call for my interview but that did not materialise. There were only 2 places so they were given to the late Prof. S. A. Obed and JD. Our postgraduate students [Residents] thought they were not getting enough tuition from their teachers at the time. I, therefore, discussed the issue with JD that I would like us to start preparing them for the West African College of Surgeons Examinations; he immediately agreed and we started taking them on Saturday mornings. This continued till the Covid-19 pandemic struck.

By dint of hard work, JD rose gradually to become a Full Professor of Obstetrics and Gynaecology in 2016 before his official retiring age. He was a researcher and a writer with many publications to his credit. Apart from the journal articles he also wrote book chapters for local and foreign books. He was my co-author to the popular "HANDBOOK OF GYNAECOLOGY: A Practical Guide to Student and Practitioner" popularly known as TWO TEACHERS. His contribution to the preparation of my initial book "HANBOOK OF OBSTETRICS: A Practical Guide to the Management of High-Risk Obstetric Patients" was immense**.** ***I am forever grateful to this wonderful friend.***

He taught and mentored many Medical Students, Residents, Senior Residents, Specialists, Senior



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Specialists and Consultants. He also mentored some of the Lecturers in the Department. JD together with me, Dr. Lucie Moravia and Prof. Timothy Johnson were instrumental in starting the Maternal Fetal Medicine (MFM) Programme of the Ghana College of Physicians and Surgeons. Indeed, JD and the late Dr. J. O. Armah set up the MFM Unit of the Department of Obstetrics and Gynaecology of the UGMS and KBTH to offer high level care for pregnant women and their unborn children. The 2 names mentioned here were involved in performing advanced Ultrasound Examinations on the pregnant women. The centre has collaboration with many institutions around the globe. He held various positions in the University of Ghana including Vice Dean of Postgraduate Studies and Deputy Provost of the College of Health Sciences. At the University he served on many Committees and Boards; he chaired some of them with distinction. He retired officially in 2016 and has been on contract since then.

## Postgraduate Medical College Activities

### West African College of Surgeons

He served as Secretary for the Faculty of Obstetrics and Gynaecology of the West African College of Surgeons for 4 years and later the Faculty Chairman and Chief Examiner for another 4 years. During his tenure as Faculty Chairman, Chief Examiner and Faculty Board Chairman, he brought significant changes to the Fellowship Examinations. He introduced the use of Objectively Structured Clinical Examination (OSCE) at the Membership [Part 1] Examination. Since then, many Faculties of the College have also adopted same. He also started some of the Subspecialty Training Programmes in the WACS. JD was such a wise and witty administrator that before he started the OSCE he constituted a Planning Committee and put the renowned Nigerian Professor and a former Internal Assessor [Prof Fakeye] in the Chair while he sat in as a member. He made sure that he placed on the committee the three leading Ghanaians who had developed OSCE for UGMS namely Prof. K. Nkyekyer, Dr Ali Samba and me. It was very difficult working with our colleagues from Nigeria but JD kept his calm and we succeeded. We initially started with the Gynae OSCE and then later Obstetrics. Because of the harmonisation of the various colleges in West Africa we also had to start same in the Ghana College of Physicians and Surgeons at the Membership Level. This was easily done because of our past experience.

### Ghana College of Physicians and Surgeons

At the Ghana College of Physicians and Surgeons (GCPS) he became a Foundation Fellow in 2003 and an Examiner for the College from 2005 until his untimely demise. He was appointed the Editor – In – Chief for the GCPS Journal, "Postgraduate Medical Journal of Ghana" in 2015; he was active on the job until his untimely demise. He was very hard working sometimes spending sleepless nights just to make sure the journal came out on schedule to the admiration of authors. It must be mentioned here also that JD was a reviewer for other journals such as the International Journal of Gynecology and Obstetrics, Ghana Medical Journal.

### Examinership

JD has been an excellent Examiner for many examination bodies including, the Medical and Dental Council of Ghana; Nurses and Midwives Council, West African **C**ollege of Surgeons; Ghana College of Physicians and Surgeons; Kwame Nkrumah University of Science and Technology, University For Development Studies, Cape Coast University etc.

### Other activities

He once held the position of Secretary for the Ghana Research Society. He continued to become the President of the society, a position he held for 2 years. He organised the activities of the Society with zeal and improved on the membership. We attended many conferences together and JD always made sure he made a presentation at each conference be it local or international. He was a Friend of FIGO. He had an award for one of his earlier articles in the "International Journal of Gynecology and Obstetrics".

### Family life

JD married early and they had 3 lovely children [2 sons and a daughter] who are grown now. The senior son is an accountant and the remaining 2 are Specialist Doctors. These children are also like siblings to my children. The family ties have been very strong. JD and his wife were very serious with the care of their children. They supplied the needs of the children with adequate entertainment so that they never lacked anything even when it was very tough for us to make the ends meet. I must confess here that at a point in time we nearly stopped the postgraduate training as life became very tough and unbearable but by the grace of God we managed to persevere to the end.

### Christian life

JD was a devout Christian of the Presbyterian Faith. Upon his return to KBTH in 1988, he joined the Ebenezer Congregation at Mamprobi with his family. He held various positions in the Congregation before his demise. He was very punctual at church service and he always sat at a particular area that even the Senior Minister remembers very well.

### Social life

Even though he was busy with his patient care and research he still managed to keep serious ties with his family and friends. He attended the Prempeh Old Students Association meetings. He also made many professional friends.

### End of life

Within 2 months of my friend complaining of what looked like a benign problem we were surprised to hear



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of his admission at the UGMC and within a few days he had been called to his maker. It has to be pointed out that JD was at the sod-cutting ceremony for the UGMC as the Deputy Provost of the College of Health Sciences. JD left us when the applause was loudest. We thought we needed him but the Lord knows best.

**Summary**

In summary JD has been a very good friend not only to me but to many others. He has been a mentor to many medical students, Residents, Specialists and Consultants. He has also been a wonderful researcher and academic. At the clinical level he has been a very good and hard-working Consultant Obstetrician / Gynaecologist with vast experience in teaching clinical and surgical skills to the up-and-coming Obstetrician Gynaecologists. Indeed, he has been a leader in training the next generation of Obstetrician Gynaecologists.

***A Medical Giant has fallen and the void created will be felt in Ghana, West Africa and indeed other parts of the world.***

**Gratitude**

As we part company I would like to extend my sincere gratitude to JD for his sincere companionship. I thank God for giving us such a gem whom we have cherished to this day. He will be forever remembered in our hearts.

**FAREWELL**

Fare thee well my good friend, Professor J. D. Seffah, Professeur Extraordinaire, and may you find eternal rest in the bosom of the Lord. DAMIRIFA DUE!!!

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# EDITORIAL

## A NOVELTY IN SUBSPECIALTY TRAINING IN GYNAECOLOGY: THE CASE OF REPRODUCTIVE ENDOCRINOLOGY AND INFERTILITY FELLOWSHIP PROGRAMME

The Ghana College of Physicians and Surgeons was started 20 years ago with the aim of training highly skilled human resource for advancing medical expertise and research in the country. Indeed, over the years, the college has performed excellently in this task. With well-structured curriculum that placed emphasis on clinical excellence, competence in research and ethical practice, Its graduates can be seen all over the country providing specialized healthcare services to Ghanaians. A lot of district hospitals now have specialist doctors, where in the past, even regional hospitals were not that endowed. The establishment of the college, and its structured approach to training and the high quality of its products has arguably slowed down the exodus of young Ghanaian doctors to foreign countries for postgraduate training [1].

The college has gone a notch higher by embarking on sub-specialty training. In the faculty of Obstetrics and Gynaecology, for example, sub-specialty training exists in Reproductive Health and Family Planning, Gynaecological Oncology, Maternal Fetal Medicine, Urogynaecology, Advanced General Obstetrics and Gynaecology, and recently reproductive endocrinology and infertility. The college recognized the high prevalence of infertility in our country and the negative sociocultural and psychological impact it has on infertile couples and society at large[2]. Hence its drive to start the fellowship programme to help improve the management of the condition in the country.

The challenge, however, is that none of the training institutions has the necessary infrastructure to embark on this highly skilled training programme, even though a good number of the faculty in these training institutions have the skill and know-how in advanced treatment of infertility, including assisted reproductive technology (ART). Faced with this challenge, the college with all stakeholders came up with a very innovative way to achieve its aim. A private-public partnership arrangement to train fellows in reproductive endocrinology and infertility (REI). A detailed curriculum was drawn by a team of academics, both local and international, consultants from International Federation of Fertility Societies (IFFS) and industry operators within the training institutions and from the private sector. Some of these academics and industry operators are working in institutions outside the country and are directly involved in fellowship training in REI in their countries of residence. This engagement of practitioners in the private sector right from the formative stages of the programme ensured their commitment to making their facilities available for the accreditation and practical training of the fellows.

Indeed, the first batch of fellows have acquired valuable practical experience in ART from their rotations in these accredited private fertility hospitals. Most of them are collecting data for their dissertation from these institutions. In the next few months, we will have our first locally trained fellows in Reproductive Endocrinology and Infertility (REI). These fellows hopefully will serve as focal points around which advanced treatment of infertility and training of doctors in REI in the regions will revolve.

While this unique and innovative arrangement has allowed for the smooth start of the fellowship training in REI by the college, the need to equip the training institutions with the necessary equipment that allows for in-house training and research cannot be overemphasized. It is our hope that a successful implementation of the REI fellowship programme will ultimately result in improvement in the management of infertility and reproductive endocrinopathies in the country and sub-region.

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# ORIGINAL ARTICLES

## IMAGING OF PATIENTS SUSPECTED OF HAVING PULMONARY THROMBO-EMBOLIC DISEASE; THE VALUE OF CHEST X-RAY COMBINED WITH PERFUSION SCAN

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## Abstract

***Objective:*** To determine the value of a recent chest x-ray (done within 24 hours of the perfusion scan) combined with perfusion in diagnosing acute pulmonary thromboembolism in clinical settings.

***Methodology:*** Retrospective analysis of 155 consecutive patients clinically suspected with pulmonary thromboembolism between January 2017 and January 2019, who underwent a lung scintigraphy.

***Results:*** Most of the study participants (75.5%) were black Africans. The overall population studied had a mean age of 50.09 years (SD 16.78). A recent chest x-ray was found in 40.1% of the projected sample size of 386 patients. The sensitivity and specificity of the PISAPED 1 reader were 96% and 97%, respectively, with a NPV and PPV of 99% and 89%. The sensitivity and specificity of the PISAPED 2 reader were both 96%, with a NPV and PPV of 86%and 99%, respectively. The PIOPED II and the PISAPED 1 had an agreement of 88.39% (Kappa value of 0.7348) while the PIOPED II and the PISAPED 2 had an agreement of 88.39% (Kappa value of 0.7444).

***Conclusion:*** Chest x-ray in conjunction with perfusion scintigraphy is accurate and can be used where ventilation/perfusion scintigraphy cannot be done in the diagnosis of pulmonary embolism.

**Key words:** *Pulmonary thromboembolism, chest x-ray, ventilation perfusion scintigraphy, PISAPED criteria.*

## Introduction

Pulmonary thromboembolism (PE) is the partial or complete occlusion of the lungs' central or peripheral artery by an embolus[1] . Acute PE is the 3rd most common cause of death after cardiovascular diseases and malignancies and the 3rd most common cause of cardiovascular death after myocardial infarction and stroke[1,2].

Globally, over 650,000 cases of PE are diagnosed annually, with more than 100,000 deaths yearly[3]. The mortality rate is approximately 30% but could be reduced to 3-10% if anticoagulation is commenced timeously or inferior vena cava filters, when indicated, are placed in time. In South Africa, however, there is a lack of data on the disease prevalence. Both PE and anticoagulation therapy for PE may be detrimental to the health of the patient. There is, therefore, a need for prompt and accurate diagnosis.

Even with recent advances in technologies aimed at enhancing medical diagnostics, diagnosing individuals suspected of having PE remains a challenge in medicine. To arrive at a diagnosis, a thorough clinical examination and risk assessment are required[4–6]. The imaging modalities employed in the workup of patients with suspected with PE include chest radiograph, lung ventilation/perfusion scintigraphy (V/Q), computed tomography pulmonary angiography (CTPA) and magnetic resonance angiography (MRA) [7,8].

A chest x-ray (X) is required as part of the initial evaluation, and lung scintigraphy is frequently performed after that. The V/Q scintigraphy was first introduced in 1964 to assess pulmonary blood flow[9]. Over the past five decades, it has become an essential modality for assessing PE[9].V/Q scintigraphy is a diagnostic nuclear medicine imaging procedure that compares the pattern of distribution in the lungs of intravenously injected radiopharmaceuticals labelled with metastable technetium 99 with inhalation of inert gases or aerosols. A gamma camera is then employed to acquire two-dimensional (2D) or three-dimensional image (3-D) images (10). A conventional V/Q study is performed with planar imaging (2-D).

V/Q scintigraphy, is the imaging of choice in the setting of suspected PE with a normal chest radiograph. Also, it has an advantage over other PE assessment techniques like CTPA in that it does not require the use of contrast agents. Patients having a history of iodinated contrast allergy and renal impairment will benefit from this property[9]. Furthermore, obese patients who cannot fit in the CT gantry or exceed the table's weight limit will also benefit from V/Q scintigraphy[4]. Finally, in pregnancy, where reduced radiation exposure to the

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breast and developing fetus is desired, V/Q scintigraphy is also the imaging modality of choice.

The lung scintigraphy makes use of ionizing radiation, just as the chest x-ray. The lung scintigraphy is made up of two aspects, a ventilation study (V) and a perfusion study (Q) component. In nearly a third of all patients suspected of having a PE, normal perfusion scintigraphy usually rules out PE[4,11]. However, when there are perfusion abnormalities, ventilation scintigraphy is required to determine whether these defects seen on the perfusion study are matched or unmatched on the ventilation scintigraphy. If these defects are unmatched, the diagnosis of PE is confirmed. However, if these defects are matched, this disproves the diagnosis of PE[5,7].

Although ventilation scintigraphy is an essential tool in this diagnostic strategy, there have been concerns about increased radiation exposure to patients, especially the developing foetus in pregnant women and the lactating breasts[8,12]. The study's high cost, non-availability of the tracer, time commitment, and low compliance in patients with respiratory distress are significant limitations in performing ventilation/perfusion (V/Q) studies[7,12]. Several guidelines propose a chest x-ray prior to lung scintigraphy as part of the diagnostic process [7,8,13]. We investigated if a chest x-ray could substitute the ventilation scintigraphy in defining these segmental perfusion defects because the chest x-ray has a similar role in increasing the specificity.

In Nuclear Medicine, there are several diagnostic criteria used in the assessment of PE. Available criteria include the Prospective investigation of pulmonary embolism diagnosis II (PIOPED II), Modified PIOPED II and the prospective investigative study of acute pulmonary embolism diagnosis (PISAPED) and the ventilation/perfusion single-photon emission computer tomography (V/Q SPECT) criteria. The modified PIOPED II and the PISAPED criteria are the two most widely used protocols in diagnosing acute PE. In the modified PIOPED II, a perfusion scan is read against a ventilation scan to make a diagnosis. Perfusion lung scanning was enhanced with ventilation imaging to increase accuracy, hoping to distinguish pulmonary vascular occlusion due to embolism from perfusion anomalies caused by respiratory disorders. In diagnosing PE using the PISAPED criteria, the ventilation study is omitted. The perfusion scan is read against a recent chest x-ray for interpretation[14]. The diagnosis made using these criteria could be a positive, negative and indeterminate study.

In a couple of studies to compare the modified PIOPED II and the PISAPED parameters, statistics showed that the sensitivity and specificity were not significantly different (84.9% and 92.7%, respectively, for modified PIOPED II and 80.5% and 96.6%, respectively, for PISAPED) [15,16]. Furthermore, Miniati et al. (1996), in their study, suggested that using the PISAPED criteria reduces the percentage of patients with indeterminate findings that will require an additional test to arrive at a diagnosis of positive or negative study for PE[16]. Pre-test probability tools such as the Wells score and the Geneva score when used in conjunction with the PISAPED criteria further increases its diagnostic accuracy. The Wells score objectively assign points based on patient history, symptoms, and physical findings[17–19].

In South Africa, patients referred for assessment for acute PE usually have undergone a radiological chest x-ray examination to assist in identifying the cause of the patients' chest symptoms. This study compares the ventilation and perfusion scan findings using the modified PIOPED II criteria and the perfusion chest x-ray combination using the PISAPED criteria. If the results are similar, then, if already performed, the chest x-ray can replace the ventilation scintigraphy in selected investigations. The direct consequences of this study will be reduced radiation dose to the patient, the developing fetus and breasts of pregnant women and lactating mothers, respectively. It may also assist in cost reduction and save time, thus assisting in service delivery. Finally, although not proven, the ventilation component of the study might be associated with an increased risk of spread of COVID-19 and many centers have eliminated this technique in patients with COVID-19 infection[36].

## Materials and Methods

### *Study design and participants*

This retrospective cross-sectional analysis focused on secondary data obtained at the Charlotte Maxeke Academic Hospital's Nuclear Medicine Department, Johannesburg, South Africa from January 2017 to January 2019.-Patients above 18 years who had a chest x-ray done within 24 hours prior to lung scintigraphy were recruited. Patients with uninterpretable chest x-ray were excluded.

One hundred and fifty-five (155) consecutive patients of the 389 participants were examined to reflect the appropriate referral pattern of patients who required a chest x-ray in less than 24 hours. Data extracted from patients' laboratory results such as D-dimer and kidney function were retrieved from the National Health Laboratory System (NHLS). Patients' chest radiograph and images from ventilation/perfusion and their reports were retrieved from the hospital database. Data analysis was limited to patients with chest x-ray done within 24 hours before lung scintigraphy. All patients' clinical characteristics and risk factors for pulmonary embolism were recorded from the request forms/report. This study utilised two experienced nuclear medicine physicians who were unaware of the results of the V/Q scan. They read only the perfusion images against the chest x-ray. These nuclear medicine physicians were coded as P1SAPED 1 and PISAPED 2, respectively. An experienced radiologist also reviewed the same chest x-rays to determine the accuracy of the two nuclear medicine physicians' interpretations and to measure

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interobserver agreement. Any abnormalities on the chest x-ray, such as pleural effusion, atelectasis, tumor or consolidation was labelled as abnormal. The perfusion scan was subsequently compared with the chest x-ray, and the findings were classified based on interpretation using the PISAPED criteria. The readers interpreted the X/Q scans according to the PISAPED criteria. A descriptive statistic reporting on frequencies and proportions was computed to describe study participants' demographic characteristics. Cohen Kappa statistics was utilized to assess percentage agreement between PIOPED II (the gold standard) and PISAPED 1 and PISAPED 2 readers.

### *Ethical Considerations*

Ethical approval was obtained from the University of the Witwatersrand Human Research Ethics Committee (HREC), with ethics clearance number MP191138.

## Results

As shown in table 1, about half of the participants (78/155) were hospitalized patients. Also, 95% (147/155) of the patients did not have their Wells score calculated before being referred to the Nuclear Medicine department. Only 6 (constituting 4%) of the referred patients had a high Wells score (Wells score >2), while only 2 (1%) had a low Wells score. Also, about 60% (92/155) of the patients had a D-dimer done prior to lung scintigraphy. However, out of the 92 patients referred for a D-dimer examination, 41% (75/92) had high D-dimer levels (>0.5mcg/ml), while just 12% (17/92) had normal D-dimer levels (<0.5mcg/ml).

**Table 1 Demographics**

| Indicators | All respondents N=155 | Frequencies | Percentage (%) |
|---|---|---|---|
| **Race of participants** | | | |
| Black Africans | | 117 | 75.5 |
| Mixed-race | | 9 | 5.8 |
| Indian | | 2 | 1.3 |
| Caucasians | | 27 | 17.4 |
| **Gender of participants** | | | |
| Male | | 51 | 33 |
| Female | | 104 | 67 |
| **Age group (years)** | | **Mean= 50.09** | **Std= 16.78** |
| 18-29 | | 24 | 15 |
| 30-39 | | 27 | 17 |
| 40-49 | | 16 | 10 |
| 50-59 | | 35 | 23 |
| 60-69 | | 34 | 22 |
| Above 70 years | | 19 | 13 |

### *Assessing sensitivity and specificity of the diagnosis*

As illustrated in table 2, PISAPED 1 successfully identified 97% of the 132 outcomes utilized in this analysis. PISAPED 1 found 24 of the 25 positive results, giving it a sensitivity of 96%. Similarly, PISAPED 1 correctly recognized 104 of the 107 results categorized as negative by modified PIOPED II, yielding a 97% specificity. PISAPED 1 identified 24 of the 27 records as positive, with a PPV of 89%. The NPV was 100%. The sensitivity and specificity results for PIOPED II and PISAPED 2 may be seen in table 2. PISAPED 2 correctly identified 126 out of 131 samples, resulting in a 96% accuracy rate. Furthermore, the sensitivity rate was 96% for 24 of the 25 positives. In comparison, modified PIOPED II recognized 102 of the 106 instances as negative, while PISAPED 2 identified 102 of the 106 cases as negative, yielding a 96% specificity rate. PIOPED II and PISAPED 2 also projected PPV and NPV of 86% and 99%, respectively. This is the percentage of PISAPED 2 positive records that were also true positive by modified PIOPED II (24/28).

**Table 2: Sensitivity, specificity positive and negative predictive values of modified PIOPED II versus PISAPED 1 and PISAPED 2 readers.**

| Method | Diagnostic Reading | Sensitivity | Specificity | PPV | NPV |
|---|---|---|---|---|---|
| Modified PIOPED II vs PISAPED 1 | 97% (128/132) | 96% (24/25) | 97% (104/107) | 89% (24/27) | 99% (104/105) |
| Modified PIOPED II vs PISAPED 2 | 96% (126/131) | 96% (24/25) | 96% (102/106) | 86% (24/28) | 99% (102/103) |

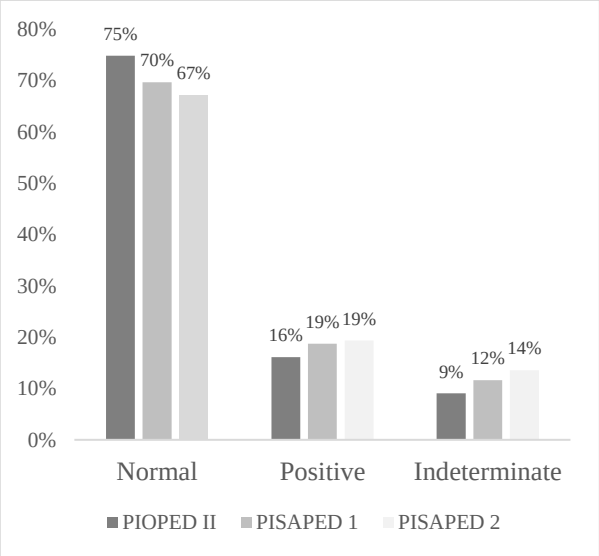


***Figure 1: Percentage score for diagnostic accuracy comparing PIOPED II with PISAPED 1 and PISAPED 2 readers.***

Figure 1 shows that out of the 155 instances, 137 agreements between modified PIOPED II and PISAPED 1 were established. One hundred and four (104) instances were classified as normal, 24 as positive, and 14 as indeterminate using modified PIOPED II and PISAPED 1. Between modified PIOPED II and PISAPED 1, the observed agreement rate is 88.39%. The Kappa value of 0.7348 suggests that modified PIOPED II and PISAPED 1 are strongly correlated and that the observed agreement is not due to chance. On the other hand, 102 instances were classified as normal, 24 as positive, and 11 as indeterminate using the modified POIPED II and PISAPED 2. For both modified PIOPED II and PISAPED 2, 137 (or 57%) of the cases were classified as normal, positive, or indeterminate. The observed agreement cannot be attributed to chance, given the Kappa value of 0.7444, the observed proportion of agreement between modified PIOPED II and PISAPED 2 (88.39%), and the proportion of agreement that would be projected merely by chance expected agreement (54.56%). The results of the study show that the radiologist identified 98% (152/155) abnormal chest x-rays. At the same time, reader 1 and reader 2 found 48% (75/155) and 54% (85/155) abnormal chest x-rays respectively. Cardiomegaly was the most common abnormal finding on chest x-rays in this investigation. The radiologist recognized cardiomegaly in around 36% of all chest x-rays, while the PISAPED 1 and PISAPED 2 readers both found 21% cardiomegaly in their findings. Also, small pleural effusions accounted for 94% (34 out of 36) of the 36 pleural effusions identified on chest x-rays, while massive pleural effusions accounted for 6% (2 out of 36).

PISAPED 1 reader misclassified 77 of the 152 instances designated as abnormal by the radiologist. Both the radiologist and reader 1 classified a total of 78 cases as either normal or abnormal. Given the extremely low Kappa value of 0.0363, the observed proportion of agreement between the radiologist and PISAPED 1 reader 1 (50.32%) and the proportion of agreement that would be expected simply by chance expected agreement (48.45%), there is poor or weak agreement between the radiologist and PISAPED 1 reader. The PISAPED 2 reader, on the other hand, identified 71 instances as normal. Both the radiologist and the PISAPED 2 reader correctly diagnosed 87 instances as either normal or abnormal. Given the extremely low Kappa value of 0.0363, there is only a slight agreement between the radiologist and the PISAPED 2 reader.

## Discussion

### *Demographics of eligible patients*

The majority (75%) of the patients who participated in this study as shown in table 1 were black Africans; this is similar to Dentan et al. (2014), Bulajic et al. (2019) and Danwang et al. (2017), who found a higher prevalence of PE in blacks and associated this to the presence of communicable diseases such as tuberculosis (TB) which are themselves a hypercoagulable state (2,32,33). Interestingly, there were 27 people in the 30–39-year-old age bracket (representing 17%) of the total eligible candidates compared to the 19 people in the 70+ age group representing only 13% of the total population investigated. Increased risk factors such as obesity and the use of hormonal contraceptives could account for the major cause of high PE suspicion among young people. Additionally, patient lifestyle and socioeconomic status could add value to the study if the association and findings in the research group could be linked.

Almost half of the patients in our study were hospitalized patients. This is particularly important in the chest x-ray findings because in-patients are most likely to have cardiopulmonary problems, abnormal x-ray findings and increased indeterminate interpretation. This was the main flaw of the PIOPED study, where 68% of in-patients were utilized, resulting in a 44% of indeterminate diagnosis of PE[15]. In the modified PIOPED study, the number of in-patients was reduced to 11%, thus reducing the indeterminate results. Giving the high PPV of a normal chest x-ray by Stein et al. (2007) of 86%, the present study had indeterminate results of between 18-21%[34]. This was slightly higher than their findings in the PIOPED II study, where the indeterminate findings were 14%. Our higher indeterminate rate could also be due to the significant number of suboptimal quality x-ray images as described by the radiologist.

### *Value of chest x-ray and diagnostic accuracy of chest x-ray/perfusion scan*

Out of our estimated sample size of 386, only 40.1% of patients had a recent chest x-ray. Although there is limited data on the physician's chest x-ray referral pattern within 24 hours prior to V/Q studies, de Groot et al. (2000) reported that about 83% of patients had a chest x-ray done 48 hours before V/Q studies[4]. However, a more recent chest x-ray is preferred for symptomatic patients. Further studies could be done to compare the value of chest x-ray done within 24 hours and 48 hours in PE assessment.

The study showed almost double the percentages of radiologists' abnormal chest x-rays compared to the PISAPED 1 and PISAPED 2 readers. According to our findings, PIASPED reader 1 and PISAPED reader 2 both recorded close identical proportions of chest x-rays classified as normal or abnormal. This contradicts the radiologist's results, which revealed that 98% of the chest x-rays were abnormal. As a result, the interobserver variabilities between the radiologist's findings (designated as the goal standard) and PISAPED 1 and PISAPED 2 readers were exceptionally low (Kappa 0.0363). Various studies, including that of Al aseri et al. (2009), Gatt (2003) and Espinosa (2000), also confirm that chest x-ray evaluation interpretation is very varied among physicians and even more so among experienced radiologists[20–22]. However, this was contrary to the studies by Tranovich et al. (2019), who

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found a good inter-reader agreement between emergency medicine physicians and radiologists[23]. These discrepancies may require further investigations on the criteria of reporting between the two specialties. To increase the interobserver variabilities, a standard template for the diagnosis will be beneficial. Out of possible abnormalities that could be visualized on chest x-ray in patients suspected of having PE, our study was similar to many others, including the ICOPER study by Goldhaber et al(1999), which found cardiomegaly to be the most common abnormalities[24,25]. Since the majority of our participants are of the child-bearing age, further studies should be conducted to understand the high frequency in this study population.

This study showed that the majority (95%) of patients referred for assessment for PE in the Nuclear medicine department did not have a Well's score calculated (table 1). An indication that the majority of participants did not have an objective patient assessment to rule out PE before referral. This finding is higher than that of Smith et al. (2008), who found that there was no documentation of pre-test probability assessment in 64% of known VTE suspicious cases[26]. The results of Runyon et al. (2007) may explain the low utilization of the Well's ratings[17]. In their study, 68% of respondents said they were familiar with at least one of two pre-test likelihood tools for PE. However, due to medico-legal considerations, difficulty memorizing and applying the guidelines, the assumption that clinical configuration is easier, and the belief that none of the rules has been tested to their satisfaction, the physicians did not use the pre-test likelihood methods. The low use of pre-test probability in our study is evident and close to that of Adams et al. (2013) in South Africa, who found that the recommendation to risk-stratify patients prior to CTPA using a pre-test algorithm (Well's score or updated Geneva score) was ignored, with less than half of CTPA referrals adopting these recommendations[27]. The cause for exclusion of pre-test probability may need to be investigated further.

Approximately half of the patients in our sample did not have their D-dimers tested prior to referral. In a country with limited resources, such as South Africa, a less expensive D-dimer test would be a cost-effective method of patient risk stratification. In our study, 12 patients had a normal D-dimer. These patients could have avoided additional diagnostic test for PE had their Well's score been calculated as recommended by Goodacre et al. (2005), Quiroz and Shoepf (2005), and Ravel et al. (2005) given the high NPV of D-dimer [28–30]. This was also similar to Lee and Zierler's (2010) retrospective review of 1,161 patients, which found that the diagnostic technique of pre-test probability and D-dimer as an initial screening for suspected VTE was underutilized[31].

***Diagnostic accuracy and interobserver agreement***

When PIOPED II and the two PISAPED readers are compared, the readings are remarkably close. In PIOPED II, 75% of the patients had a normal study, 16% had scans positive for PE, and 9% had inconclusive studies. The PISAPED 1 group had 70% normal studies, 19% positive studies, and 12% indeterminate studies, whereas the PISAPED 2 reader saw 67% normal studies, 19% positive scans, and 14% indeterminate studies. The PISAPED 1 reader had a sensitivity and specificity of 96% and 97%, respectively, and an NPV and PPV of 99% and 89%. The PISAPED 2 reader had a sensitivity and specificity of 96% and an NPV and PPV of 86% and 99%, respectively. The agreement between the PIOPED II and the PISAPED 1 and PISAPED 2 was 88.39% (Kappa value of 0.7348) and 88.39% (Kappa value of 0.7444), respectively. Given their Kappa values, this remarkable agreement in interpretation is unlikely to be attributable to coincidence. These findings were similar to those of da Silva et al. (2014) and Miniati et al. (1996), who found that the modified PIOPED II and PISAPED parameters had comparable sensitivities and specificities (84.9% and 92.7% for modified PIOPED II and 80.5% and 96.6% for PISAPED) as well as similar NPV and PPV (96% and 90% for the PIOPED II criteria and 95% and 96% for the PISAPED criteria respectively) (15,16). Our results, however, had higher sensitivity, specificity, NPV and PPV than the study by J vans et al. (2015), which found a sensitivity of 60%, specificity of 86%, NPV of 83 and PPV of 71.4% in their research. However, with a Kappa value of 89%, both investigations demonstrated very strong interobserver agreement. This demonstrates that the diagnostic accuracy of the PISAPED criteria is highly dependent on the reader's level of experience and ability to include other parameters, such as pre-test probability tools, to improve diagnostic accuracy. However, in this analysis, the number of indeterminate studies was substantially larger than in other studies, such as that of Sostman et al. (2008), who had no patients in their indeterminate category[35]. This is most likely due to the high number of suboptimal x-ray quality found in this investigation.

## Conclusion

This study demonstrates that using a chest x-ray in conjunction with perfusion scintigraphy (PISAPED) is accurate and can be used where ventilation/perfusion scintigraphy (Modified PIOPED II) cannot be done in the diagnosis of PE. Although in our environment, majority of the chest x-rays are of sub-optimal quality, the PISAPED criteria had a comparably good accuracy and very good interobserver agreement. Even while the PISAPED readings yielded more uncertain results than the PIOPED II criteria, they seem to be more beneficial in the hands of an experienced reader who uses pre-test probability tools to improve diagnostic accuracy. The PISAPED criteria are also more helpful in younger patients, pregnant and breastfeeding mothers, and other settings where reduced exposure to ionizing radiation is desired. Also, in a resource limited country like South Africa, the ventilation portion of lung scintigraphy could



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be omitted to reduce cost and save time, thus assisting in service delivery.

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# KNOWLEDGE, PRACTICE AND PERCEPTION OF TRIAGE BY STAFF OF THE EMERGENCY DEPARTMENT OF HO TEACHING HOSPITAL

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## Abstract

***Objective:*** This study sought to assess the knowledge, practice, and perception of triage by Emergency Department (ED) doctors and nurses of a new teaching hospital in Ghana.

***Methodology:*** This was a cross-sectional study. Data was collected using a structured self-filled questionnaire which had sections on socio-demographic information of participants, knowledge, practice, and perception of triage. Descriptive statistics and bivariate analysis of the results was done using Microsoft Excel and Statistical Package for Social Sciences version 25, respectively.

***Results:*** Eighty-three ED staff participated in this study; 56 nurses and 27 doctors. Sixty-four participants had at least moderate level of knowledge of South African Triage Scale (SATS). Their level of knowledge had statistically significant associations with their work experience ($p = 0.032$) and frequency of triaging ($p = 0.000$). Forty-nine participants had at least moderate level of triage practice skill. Their scores had statistically significant associations with their level of triage knowledge ($p = 0.011$) and frequency of triaging ($p = 0.001$). Majority of participants agreed that triaging is important in reducing waiting times (89%) and improving communication (92%).

***Conclusion:*** The positive correlation between frequency of triaging and both knowledge and practice of triaging attests to the common notion that practice makes perfect. Regular on-the-job training may result in improvement in this skill. Participation by ED doctors should be encouraged.

**Key words:** *triaging, South African Triage Scale, knowledge, practice, perception*

## Introduction

Triage is the cornerstone of organisation of care in EDs. It is a term used to describe the sorting of patients for treatment priority in EDs.[1] Through this process, the healthcare provider is able to distinguish between patients that are critically ill and need immediate interventions and those seeking care but do not require prompt attention.[2] This affects the rest of the patient's evaluation at the ED, since subsequent management steps depend on initial triage assessment.

There are several ED triage tools available for use.[3] The South African Triage Scale (SATS), however, has been shown to improve the efficiency of resource limited EDs,[4–6] and is an extensively studied triage scale in low-and middle-income countries (LMICs) across Africa and Asia.[6] The suitability of the South African Triage Scale SATS for LMICs has made it recommended for use in all EDs in Ghana.[7] There is also published literature describing its efficient use in health facilities in the country.[8,9]

Evaluation of triage capabilities is important for several reasons. Limited triage training can result in inconsistent triage assignments which can endanger patients with emergencies.[6] Earlier studies on triage in LMICs demonstrated low level of knowledge among nurses and this was attributed to inadequate nursing curriculum content on triaging.[10,11] A general deficiency of knowledge on triage has also been reported among doctors. This was also attributed to lack of training exercise at the undergraduate level.[12]

A typical triage room in a Ghanaian health facility is manned by nurses. Since they are the first health worker that a patient encounters when presenting to the ED, they must have the ability to make accurate clinical decisions about patient prioritisation and their need for intervention.[13] Similarly, because doctors in the ED will be acting on information from the triage nurses, they must also have a good understanding of triage to better manage patients. From our literature search, the few studies on triaging done in Ghana were generally set in the middle and northern part of the country. Also, many of the published literature on triaging commonly focus on the nursing staff, leaving out the doctors. The objective of this study is to assess the present condition of nurses in terms of their knowledge, practice, and perception of triaging, while also evaluating the effective use of triage by doctors.

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## Materials and Methods

### *Study design, setting and population*

This was a cross-sectional study conducted at the ED of Ho Teaching Hospital (HTH) from 5th to 30th July 2021**.** The ED has an annual attendance of over 7000 and consists of a triage unit, a resuscitation area, an area for minor procedures, a plaster room, and a 'transient' ward. It operates on a 24-hour basis and has



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a bed capacity of 22. The staff of the ED comprise 6 doctors (including an emergency physician specialist) that are permanently in the ED. In addition to these, various team doctors run their duty schedules daily. Residents, medical officers, and house officers are also assigned to the ED on a rotational basis. The ED also has a total of 81 nurses (including 2 emergency nurse specialists) that run shifts in the department. It attends to both walk-in patients and referrals from peripheral facilities. Patients that present to the ED are triaged using the SATS. Participants in the study included nurses and doctors that worked in the ED during the study period and had given their informed consent to participate in this study. ED staff that were on leave (study, maternity, and annual leave) during the data collection period were exempted from this study.All the ED nurses, as described above, were enrolled in the study due to the small population size. For the doctors, convenient sampling was employed because a considerable number work on rotational basis at the ED.

### *Data collection and analysis*

A printed-out, self-administered questionnaire developed by the authors served as the data collection tool for this study. It was based on existing literature on the research topic and was structured into 4 sections. The first section included socio-demographic characteristics of participants such as work experience and level of education. The second section assessed their knowledge of the SATS colour codes and corresponding waiting times. The third section assessed their practice of triage using 3 case-based scenarios, along with the use of a SATS chart to assist in categorising patients. The final section evaluated the perception of triage by the participants by assessing their response to statements about triage and the SATS. Data was collected from each participant using the designed questionnaire after obtaining informed consent. Clarification needed on any question was duly given. Discussion among participants was discouraged to determine each respondent's own level of knowledge. Completed questionnaires were collected and entered into a Microsoft Excel spreadsheet for analysis**.** The data collected was cleaned, coded, and analysed using the Statistical Package for Social Sciences (SPSS) version 25. Microsoft Excel was also used to draw graphs, tables, and pie charts for data presentation. The Spearman rank-order correlation coefficient was used to determine the association between the independent and dependent variables.

### *Ethical Consideration*

Ethical clearance was obtained from the University of Health and Allied Sciences Research Ethical Committee (UHAS-REC A.12[167]20-21) prior to execution of the study.

## Results

### *Socio-demographic characteristics of ED staff*

A total of 83 ED staff (consisting of 56 nurses and 27 doctors) participated in the study. Response rates among doctors and nurses were 90% and 69.1% respectively, with an overall response rate of 73.5%. More than half of participants were male (Table 1).

**Table 1. Sociodemographic characteristics of ED staff**

| Variable | n (%) | Mean ± SD |
|---|---|---|
| **Sex** | | |
| Male | 54 (65.1) | - |
| Female | 29 (34.9) | - |
| **Age** (years) | | 28 ± 3.19 |
| **General work Experience** (years) | | |
| <1 | 34 (41.0) | - |
| 1 – 5 | 44 (53.0) | - |
| 6 – 10 | 5 (6.0) | - |
| **ED Work Experience** (years) | | |
| <1 | 48 (57.8) | - |
| 1 – 5 | 32 (38.6) | - |
| 6 – 10 | 3 (3.6) | - |
| **Highest educational Level** | | |
| Certificate | 6 (7.2) | - |
| Diploma | 36 (43.4) | - |
| BSc | 12 (14.5) | - |
| MSc | 2 (2.4) | - |
| MBChB | 27 (32.5) | - |
| **Rank** | | |
| Rotation Nurse | 8 (9.6) | - |
| Enrolled Nurse | 6 (7.2) | - |
| Staff Nurse | 27 (32.5) | - |
| Senior Staff Nurse | 4 (4.8) | - |
| Nurse Officer | 9 (10.8) | - |
| Nurse Specialist | 2 (2.4) | - |
| House Officer | 21 (25.3) | - |
| Medical Officer | 4 (4.8) | - |
| Resident | 2 (2.4) | - |
| ***n = frequency, SD = standard deviation*** | | |

The mean age was 28 years (standard deviation [SD] ± 3.19). The highest age recorded was 37 years and the lowest was 22 years. ED staff with less than 1 year of general work experience alone made up about 41% of all the participants. Furthermore, only 6% of participants had work experience of more than 5 years. Regarding ED work experience, more than half of participants (57.8%) had worked in the ED for less than 1 year, while only 3.6% of participants had more than 5 years working experience. Majority of ED nurses who took part in the study were diploma holders, making up 43.4% of participants. Fourteen nurses (16.9%) were degree holders, with 2 of these having master's degrees. The doctors all had the same level of education, which was the MBChB degree or its equivalent. Most of the nurses who participated in the study were staff nurses (27 out of the 56 nurses). On the other hand, House officers formed the majority of the doctors who participated in



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the study (21 of the 27 doctors). The rest were medical officers and residents. Fifty-four participants (65.1%) had never attended a triage workshop or in-service training. For the participants who attended triage workshops, 16 (19.3%), 10 (12.0%), 2 (2.4%) and 1 (1.2%) had attended one, two, three and four triage workshops, respectively.

### *Knowledge Of Triage Among ED Staff*

This was described in three ways: their knowledge of the SATS colour categories, their knowledge of waiting times associated with each triage category, and their overall level of triage knowledge.

Knowledge of SATS colour categories and associated waiting times

More than half of the respondents were able to correctly identify the colour categories. Specifically, 58 (69.9%) respondents were able to correctly identify red as emergent, 55 (66.3%) correctly recognised orange as very urgent, 62 (74.4%) identified yellow as urgent, 76 (91.6%) identified green as routine and 48 (57.8%) identified blue as dead. With respect to the associated waiting times, 72 (86.7%) participants were able to correctly recognise that red cases should be seen immediately; 59 (71.1%) participants correctly identified that orange cases should be attended to within ten minutes of presentation; 66 (79.5%) participants correctly noted that yellow should be attended to within an hour; and 67 (80.7%) of them correctly identified that the waiting time for green cases is four hours. Thirty-six participants attained the maximum score for knowledge of SATS colour and associated level of acuity; while fifty-two participants attained the maximum score for knowledge of waiting times associated with SATS colour codes. (Table 2)

Overall Triage Knowledge of ED Staff

The overall triage knowledge was calculated by adding the scores for knowledge of triage colour code and SATS waiting times. The total was then graded according to the criteria used by an Indonesian study[14], where less than 60% was graded as low level of knowledge, 60-80 % was moderate level of knowledge and more than 80% was high level of knowledge. Forty-six (55%) of respondents were thus considered to have high triage knowledge (scored more than 80%), 18 (22%) had moderate knowledge (scored 60-80%) and 19 (23%) had poor knowledge (scored less than 60%).

### *Practice Of Triage By ED Staff*

This was done in two ways: the total score for the participants' practice of triage, and the percentage of cases which were either correctly triaged or not.

Triage Practice Score of ED Staff

The findings showed that 29 (35%) of the participants scored the maximum mark of 3 for practice of triage. Twenty participants scored 2, another 20 scored 1, and 14 (17%) scored 0 (Table 2). The method for assessing practice score was also adopted from the Indonesian study referenced above. In this case, a score of less than 60% was interpreted as having low level of triage skill, a score of 60%-80% was interpreted as moderate skill and 80% was considered high skill. Applying the above criteria, 29 (35%) participants demonstrated high triage skill (scored more than 80%), 20 (24%) demonstrated moderate skill (scored 60-80%), and 34 (41%) had low triage practice skill (scored less than 60%).

Correct triage, Over-triage, and Under-triage Performance by the ED staff

About 59% of respondents correctly triaged the cases given, while 8% under-triaged, and about 33% over-triaged (Table 3).

**Table 2. Distribution of scores on knowledge of SATS colour (based on level of acuity and waiting time) and practice of SATS**.

| Total score | Knowledge on SATS colour based on level of acuity | Knowledge of SATS colour based on waiting time | Triage practice score |
|---|---|---|---|
| | n (%) | n (%) | n (%) |
| 0 | 2 (2.41) | 2 (2.41) | 14 (16.87) |
| 1 | 11 (13.25) | 12 (14.46) | 20 (24.10) |
| 2 | 12 (14.46) | 7 (8.43) | 20 (24.10) |
| 3 | 4 (4.82) | 10 (12.05) | 29 (34.95) |
| 4 | 18 (21.69) | 52 (62.65) | N/A |
| 5 | 36 (43.37) | N/A | N/A |
| **Total** | **83 (100)** | **83 (100)** | **83 (100)** |

***n = frequency***

**Table 3. Under-triage and over-triage statistics for the ED staff**

| SATS Practice Scenario | Correctly triaged | |
|---|---|---|
| | n (%) | 95% CI |
| Scenario 1 | 52 (62.7) | 52-73 |
| Scenario 2 | 52 (62.7) | 52-73 |
| Scenario 3 | 43 (51.8) | 41-63 |
| Average | 49 (59.1) | 48-70 |
| | | |
| **Under-triaged** | | |
| Scenario 1 | 16 (19.3) | 11-28 |
| Scenario 2 | 4 (4.8) | 0-10 |
| Scenario 3 | 0 (0.0) | - |
| Average | 7 (8.0) | 2-15 |
| | | |
| **Over-triaged** | | |
| Scenario 1 | 15 (18.1) | 10-27 |
| Scenario 2 | 27 (32.5) | 22-43 |
| Scenario 3 | 40 (48.2) | 37-59 |
| Average | 27 (32.9) | 22-43 |

***n = frequency; CI = confidence interval***



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***Perception Of Triage By ED Staff***

This section was assessed using the participants' responses to 7 statements concerning triage and the SATS. Responses were graded using a Likert scale of 1 (strongly disagree) to 5 (strongly agree).

Statement 1: Triage reduces the waiting times of very sick patients

A combined 74 participants agreed and strongly agreed to this statement, while 5 participants disagreed and strongly disagreed. The rest remained neutral.

Statement 2: Necessary First Aid measures are part of the ED nurse's duty

Eighty-one (98%) participants strongly agreed and agreed that necessary first aid measures are part of the ED nurse's duty. Only 2 participants disagreed and strongly disagreed.

Statement 3: Documentation is highly essential in triage

Seventy-three (88%) respondents strongly agreed to this statement, while a combined 82 out of 83 participants agreed and strongly agreed.

Statement 4: The SATS improves communication between health workers

Seventy-six participants agreed and strongly agreed that the SATS improves communications between health workers. Six out of the 83 participants chose to remain neutral, and 1 participant disagreed.

Statement 5: The SATS is time-consuming

Forty-nine (59%) participants disagreed and strongly disagreed that the SATS is time consuming. About 24% of participants chose to remain neutral, while 14 (17%) respondents agreed and strongly agreed.

Statement 6: Triaging using the SATS is inconsistent and is greatly user dependent

Thirty-four (41%) participants chose to remain neutral on this statement, which was the most chosen single option for this item. A combined 35 (42%) respondents disagreed and strongly disagreed, while a combined 17% agreed and strongly agreed.

Statement 7: Staff at the ED should undergo training/workshops on triage

Seventy-six respondents strongly agreed that triage training should be organised for ED workers, and a combined 82 (99%) agreed and strongly agreed.

***Bivariate Analysis***

Factors associated with triage knowledge

Among all the factors analysed, there was a significant association between overall triage knowledge score and the general work experience, as well as with the frequency of triage by the respondents ($p < 0.05$) (Table 4).

Factors associated with triage practice score

There was also a significant association between the triage practice score and both frequency of triage, and triage knowledge score of respondents ($p < 0.05$) (Table 4).

**Table 4. Factors associated with overall triage knowledge and practice skills among participants.**

| Variables | Overall triage knowledge | | Triage practice skills | |
|---|---|---|---|---|
| | Spearman correlation coefficient | p (2-tailed) | Spearman correlation coefficient | p (2-tailed) |
| General Work Experience | 0.236 | 0.032 | 0.022 | 0.847 |
| ED Work Experience | 0.201 | 0.068 | 0.072 | 0.520 |
| Attendance of triage workshop | 0.117 | 0.291 | -0.014 | 0.902 |
| Highest educational level (for nurses only) | -0.014 | 0.916 | 0.104 | 0.447 |
| Frequency of Triaging | 0.407 | 0.000 | 0.362 | 0.001 |
| Overall triage knowledge | - | - | 0.279 | 0.011 |

## Discussion

This study aimed to improve on the current literature on the knowledge, practice, and perception of SATS. We noted that the ED staff generally had good level of knowledge and practice of triaging using the SATS even though they were relatively young and inexperienced. The mean age (± standard deviation) was 28 (± 3.19) years, and more than one-third had general work experience of less than a year. Furthermore, more than half of participants had less than one year work experience in the ED, a finding similar to a study conducted by Kerie et al. among nurses working in the ED.[15] Staff nurses made up the highest proportion of nurses that participated in this study. This was similar to findings from a study done among nurses in Indonesia[16]; however, that study had a lower proportion (5.6%) of bachelor's degree holders in nursing. Conversely, an Ethiopian study showed a higher proportion of about 74% of nurses having a bachelor's degree in nursing,[15] compared to 15% in our study. A reason for this disparity could be because that study involved multiple EDs in hospitals located in Adis Ababa, the capital city of Ethiopia, where a relatively high number of nursing degree holders would be expected. On the other hand, ours was conducted in a teaching hospital that was only recently upgraded from a regional hospital. Additionally, in Ghana, the establishment and accreditation of degree awarding institutions to grant nursing degrees by the Nurses and Midwives Council is a relatively recent development.[17,18] Only 2 out of the 56 nurses in our study had received specialty training in emergency medicine. This low level of specialist nurses

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may impact the quality of emergency care delivered by the ED staff, including triaging of patients.[19]

Among the doctors, more than 70% of the participants were house officers. This may suggest that junior doctors were more directly involved in the care of ED patients as compared to senior doctors. It is worth noting that, convenient sampling was used in this study and could account for the non-proportionate representation of senior doctors. Also, like in all teaching hospitals, junior doctors are in the majority, and work under the supervision of the senior doctors. Nonetheless, this finding highlights the need for junior doctors to have good triage capabilities.[20] The low attendance of triage workshop could be attributable to the short work experience of a significant proportion of the ED staff. In addition, some units of the ED practiced triage more frequently than others; thus, workers in such units were more likely to attend triage workshops. That notwithstanding, an understanding of triaging among all health workers involved in emergency care is essential for better care delivery and decision making.[21]

Using the criteria referenced earlier, 77% of participants had at least moderate overall knowledge about triage. This was in contrast with findings from studies in Pakistan and Tanzania where less than half of participants were knowledgeable about triage.[10,11] In terms of knowledge about waiting time associated with each colour code, about 75% of participants had at least moderate knowledge. These findings were in line with results from a study conducted in the Northern region of Ghana where more than half of participants were knowledgeable about the same parameters.[19] It is however, noteworthy that the proportion of participants with at least moderate overall triage knowledge in our study was significantly higher than that in the aforementioned study (77% versus 63%). The observed increase in triage knowledge could be attributed to better education on triaging concepts in the curriculum of health trainees.[17,18] Another possible explanation could be effective on-the-job training on triage.

Interestingly, we observed that there was no significant correlation between ED work experience, attendance of triage workshop and nurses' highest level of education versus either overall triage knowledge or triage practice skill. This finding was inconsistent with several studies.[15,22] We however, observed a weak positive correlation between general work experience and overall triage knowledge but not with triage skill practice. Even though we could not clearly explain the above incongruent findings, we noted that the frequency of triaging was associated with both overall triage knowledge and triage practice skill. This suggests that actual practice of triaging, not just working in the ED, improved triage knowledge and practice skill. This is consistent with an observational study involving 319 emergency nurses which noted a significant correlation between nurses perceived competency level and frequency in which they performed the clinical skills.[23]

About 59% of participants had at least moderate triage practice skill. This was comparable to findings from other studies[15,16] but was in contrast to a multi-hospital study conducted by Aloyce et al. in Tanzania.[11] This disparity could possibly be due to the fact that only the Tanzanian study employed the use of an observational checklist and triage equipment audit record in addition to the structured questionnaire. Therefore, triage skill was assessed differently in that study.

It was also important to assess the participants' skill at assigning the correct triage categories to cases since inappropriate triaging is associated with increased cost and unnecessary delays for patients who require prompt care.[24] In this study, about 33% over-triaged and 8% of participants under-triaged the clinical cases provided. While the value for over-triaged cases fell within the limit of 25-35% prescribed by the American College of Surgeons,[25] the under-triaged cases were slightly more than the 5% cut-off. In spite of this, these results were significantly better than the findings from a previous study in Ghana by Gyedu et al among senior house officers and final year medical students, where 49% of the senior house officers over-triaged and 53% under-triaged the scenarios provided.[26] A number of reasons could account for the seemingly better performance by participants in our study. First, there were significant differences in the composition of our study population. Unlike the Gyedu et al study which focused on senior house officers and senior medical students, our study population included both doctors and nurses with varied experiences. Secondly, only three case vignettes were given to participants in our study to triage, compared to 25 used in the aforementioned study.

Majority of participants agreed about the importance of triage in reducing waiting times, the need for documentation and first aid measures, and the improved communication that the SATS allows. Majority also disregarded the notion that the SATS is time-consuming. Furthermore, about 99% of participants agreed that more triage workshops should be organised. This generally aligned with the findings in previous studies.[19,27,28] However, only about 42% of participants believed that the SATS was consistent and not user dependent. This unfavourable sentiment was also highlighted in a Ugandan study among both doctors and nurses[28], and could be possibly due to poor training on the SATS, causing incorrect triaging which subsequently may lead to delayed care and poorer outcomes. It is therefore important for more effective training on triage to prevent this from happening.

## Limitations

This was a single-centre study with a small study population and so results may not be generalisable. Secondly, only three case vignettes were used in assessing triage capabilities of participants. Even though, the vignettes were not externally validated in this study, they were developed from validated questionnaires used in published studies on the topic.



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Thirdly, not all ED staff participated in the study. This could mean that there was disproportionate representation of participants, especially since the study did not use a probability sampling method. These notwithstanding, data from the study was put through standard analysis and therefore the findings are reliable.

## Conclusion

Despite the generally young and relatively inexperienced ED staff, majority had good knowledge of triaging and at least moderate triage skills. The positive relationship between frequency of triaging and the knowledge and practice of triaging attested to the common notion that practice indeed makes perfect. Emergency department doctors should be encouraged to participate in training sessions on triage. Regular in-service training and on-the-job practice may also result in further improvement in this skill. And finally, continued education on triaging concepts in medical and nursing school curricula will further promote the understanding by the doctors who are important stakeholders in patient care in the ED.

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# FACTORS INFLUENCING THE MEDICAL STUDENT'S INTEREST AND CAREER CHOICE IN NEUROSURGERY

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## Abstract

***Objective:*** To determine the factors influencing interest and a career choice in neurosurgery among final year medical students.

***Methodology:*** A mixed method study was conducted where primary data was collected from 120 final year medical students and three neurosurgery consultants in the University of Ghana Medical School, using quantitative cross-sectional study and qualitative Delphi panel study methods, respectively. The main study outcome was the choice of Neurosurgery as a specialty.

***Results:*** About 90% of the students expressed interest in neurosurgery. Interest in neurosurgery (70%) and the will to make an impact in the specialty (75%) were the top factors for the 13.8% of students who said they would apply for neurosurgical residency, while the long duration of training deterred 63% of respondents. The students had poor exposure to the clinical aspects of the specialty. Practicing neurosurgeons placed a high premium on student interest in the field.

***Conclusion:*** To build interest among medical students to enter neurosurgical residency programs, students should be given more contact hours during their neurosurgery rotations, and neurosurgical mentorship programmes should be established in medical schools to give medical students insight into the typical life of practicing neurosurgeons.

**Key words:** *Neurosurgery, career choice, medical students, Sub-Saharan Africa, residency.*

## Introduction

Sub-Saharan Africa suffers from a lack of qualified neurosurgeons and well-equipped neurosurgical facilities, despite a high demand. With a neurosurgeon-to-population ratio of 1:1,240,000 it is no surprise that only a minority of African neurosurgical patients have easy access to neurosurgeons available to serve them [1]. Though there has been an increasing number of neurosurgeons in Ghana, the numbers are still not enough to meet the demand of the country's increasing population[2,3]. These numbers emphasize the need to make the neurosurgical subspecialty more attractive to medical students to pursue by overcoming some of the barriers that deter them from considering a career in neurosurgery[4].

Clinical knowledge and skills aside, medical students appear to have limited understanding of daily activities of neurosurgeons. This may result in negative attitudes and perceptions in the students concerning the field. A prospective study involving 60 medical students in their 3rd to 5th years of the Royal College of Surgeons in Ireland showed negative attitudes and perceptions towards neurosurgery, albeit well-founded [5]. Difficult work-life balance, long duration of residency, issues regarding adequate remuneration, likelihood of litigation and risk of burnout are other important factors accounting for this trend of decreased neurosurgical pursuit in medical students[6]. Interestingly, some neurosurgeons report the highest percentage of job satisfaction compared to other surgical specialties, suggesting that these factors may be largely individual-specific or at least modifiable[7]. Some universities have improved the exposure of medical students to the professional, academic and personal lives of neurosurgeons by means of neurosurgical electives entered into existing curricula and neurosurgical interest groups. These have increased their overall neurosurgical turnouts[8,9,10].

This study thus sought to highlight factors influencing the choice of a career in neurosurgery among medical students at the University of Ghana Medical School as a means to determine ways to increase neurosurgical capacity in Sub-Saharan Africa.

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Conflict of Interest: None Declared

## Materials and Methods

A mixed method study was used, where a quantitative cross-sectional study and a qualitative Delphi panel study was conducted among final year medical students and neurosurgery consultants in the University of Ghana Medical School, respectively. Final year students were used as they were more likely to have decided on their specialty careers. Neurosurgical consultants were key to the study, having good knowledge of neurosurgery in Ghana and the professional, clinical, and personal demands of the specialty. This study design was chosen to ensure the critical input of these neurosurgeons and contrast findings from the students. Using the prevalence of medical graduates who choose neurosurgery as their long-term career specialty of 0.8%



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in a UK national survey due to limited data on such statistics in West Africa,[12] a sample size of 113 medical students was calculated using the Cochran's formula $Z^2(pq)/e^2$ at a confidence level of 95% and margin of error 0.01. A sample size of 120 medical students was therefore used for the quantitative aspect of this study to offset anticipated non-response [13]. These were selected from the final year class list of 178 students by the Simple Random Sampling method using a Random Digit Table generated by Microsoft Excel® software. A self-administered questionnaire (Questionnaire 1) created using Google Forms online platform was distributed via WhatsApp® to the sampled students. With the aid of personal reminders, all participants completed the survey within 2 days.

Three neurosurgery consultants, out of 6 working with the University of Ghana Medical School and Korle-Bu Teaching Hospital, were included in the study as experts for the Delphi panel for the qualitative aspect of the study. These were selected by convenience. An entirely open-ended questionnaire (Questionnaire 2) was created using the Google Forms online platform and mailed to them via Google Mail. The Delphi panel was run for 1 round.

### *Data Analysis*

The main study outcome was the choice of neurosurgery as a specialty, explained by variables 'student interest in neurosurgery', 'student exposure to neurosurgery', and the 'push-or-pull factors' surrounding the specialty which influence the medical student. 'Student interest' was measured using a Likert scale with three statements (questionnaire 1: section B). The responses from the Questionnaire 1 were cleaned and the quantitative data analyzed using the Windows Excel software and the Statistical Package for the Social Sciences (SPSS) software. Percentages were used to summarize the categorical data. The Pearson Chi-square test was used to determine the strengths of associations (p-values < 0.05) between the choice of neurosurgery and other factors.

The data was presented using graphs and tables. Questionnaire 2 was aimed at qualitatively assessing the explanatory variables from the perspective of practicing neurosurgeons. The neurosurgeons were not limited in the length and style of the opinions and answers they provided. The qualitative data was analyzed by thematic analysis using the triangulation method to establish themes. Boxed displays were used to present the qualitative data.

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### *Ethical Considerations*

Ethical approval for the study was obtained from the Korle-Bu Teaching Hospital Institutional Review Board (protocol approval number: KBTH-STC/IRB/0038/2020). Participation was entirely voluntary.

## Results

### *Socio-Demographics*

Of the 120 medical students selected for the study a total of 116 medical students in final year completed Questionnaire 1 (response rate of 96.7%). The mean age of the participants was 23.8 years (range: 21-34 years, SD 1.5). The male-to-female ratio was 1.04:1. Five (4.3%) were married, engaged, or living together; and the rest were all single.

### *Interest in Neurosurgery*

About 90% of the medical students were interested in neurosurgery in the clinical years. There was a statistically significant association between interest in neurosurgery and the choice to apply for neurosurgical residency (Table 1). 84.5% had interests in other specialties before their neurosurgical rotations. (Fig 1).

**Table 1. Associations between Variables and the Choice to Apply for Neurosurgical Residency**

| Variable | Choice to apply for neurosurgical residency | |
|---|---|---|
| | Pearson Chi-square value | p-value |
| Interest in Neuroscience | 13.238 | 0.034 |
| Interest in Neurosurgery | 13.228 | 0.040 |
| Adequacy of neurosurgical teaching | 5.177 | 0.521 |
| Pure interest in Neurosurgery | 46.390 | 0.000 |
| Little time spent with Neurosurgery | 23.118 | 0.000 |

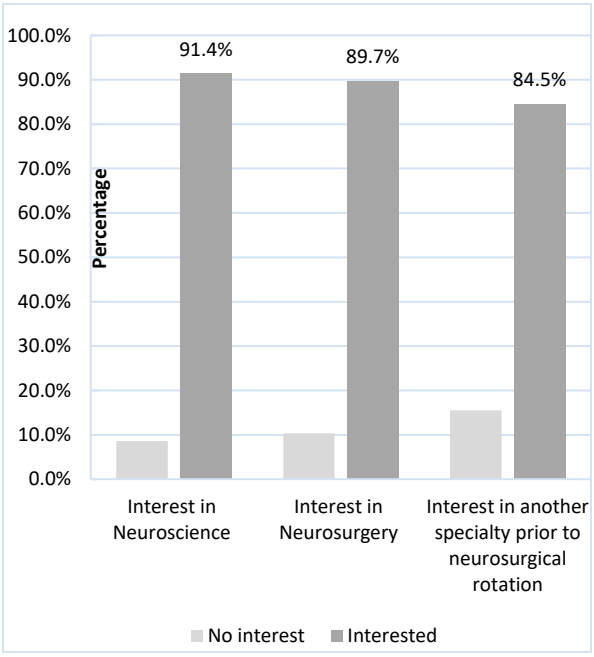


**Figure 1. Interest in Neuroscience lectures and Neurosurgical clinical rotations**

***Exposure to Neurosurgery***

Although 76.7% of the students believed their neurosurgery teaching was adequate, more than half of them agreed that they found it difficult obtaining neurosurgical histories and eliciting clinical signs from patients. Thirty-nine percent of the students had never spent time in the neurosurgical theatres. Nearly all of them (98.3 %) noted neurosurgery required a long training period and 91.4% felt that there were very few training facilities in Ghana. (Table 2).

**Table 2. Exposure of Medical Students to Neurosurgery**

| Items | Disagree (%) | Agree (%) |
|---|---|---|
| My neurosurgery teaching is adequate | 27(23.3) | 89(76.7) |
| It is difficult to obtain a neurosurgical history | 40(34.5) | 76(65.5) |
| It is difficult to elicit neurosurgical signs | 57(49.1) | 59(50.9) |
| Neurosurgical conditions are complicated | 19(16.4) | 97(83.6) |
| Most neurosurgical conditions have poor outcomes | 16(13.8) | 100(86.2) |
| I have spent time in the neurosurgical theatres | 70(60.3) | 46(39.7) |
| Neurosurgery requires a long training period | 2(1.7) | 114(98.3) |
| Neurosurgery is a physically and emotionally draining specialty | 9(7.8) | 107(92.2) |
| Neurosurgery faculty are friendly and collegiate | 5(4.3) | 111(95.7) |
| Huge prestige and income are attached to neurosurgery | 5(4.3) | 111(95.7) |
| Neurosurgeons have poor work-life balance | 33(28.4) | 83(71.6) |
| It is difficult to be a neurosurgeon and have a family | 51(44.0) | 65(56.0) |
| There are very few neurosurgery training facilities in Ghana | 10(8.6) | 106(91.4) |
| The Ghanaian neurosurgeon has limited job opportunities | 60(51.7) | 56(48.3) |

***The Choice of 'Neurosurgery' or 'Not Neurosurgery'***

In all 16 final year medical students (13.8%) said they will apply for neurosurgical residency after school. Of these three students (18.8%) planned on training in a foreign country. 14 of the students (12.1%) were not sure whether they would choose to do neurosurgery or not. All students married, engaged or living together chose not to apply for neurosurgical residency.

***Top Factors Influencing the Choice of Pursuing Neurosurgery***

Seventy-five percent of students who chose to apply for neurosurgical residency did so because they thought they could make an impact in the specialty. About 56% saw the specialty as a good source of income. (Figure 2).

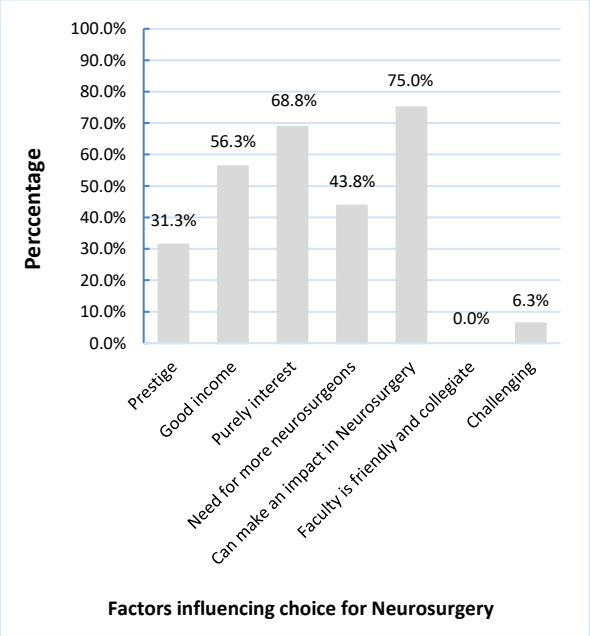


***Figure 2. Top Factors Influencing the Choice for Neurosurgery***

Of the respondents who chose not to apply for neurosurgical residency, 64.0% had already decided on another specialty, while 37.2% felt that too little time was spent during rotations in neurosurgery. About 63% said the period of training was too long, and 33.7% thought a neurosurgical career resulted in a poor work-life balance. (Figure 3).

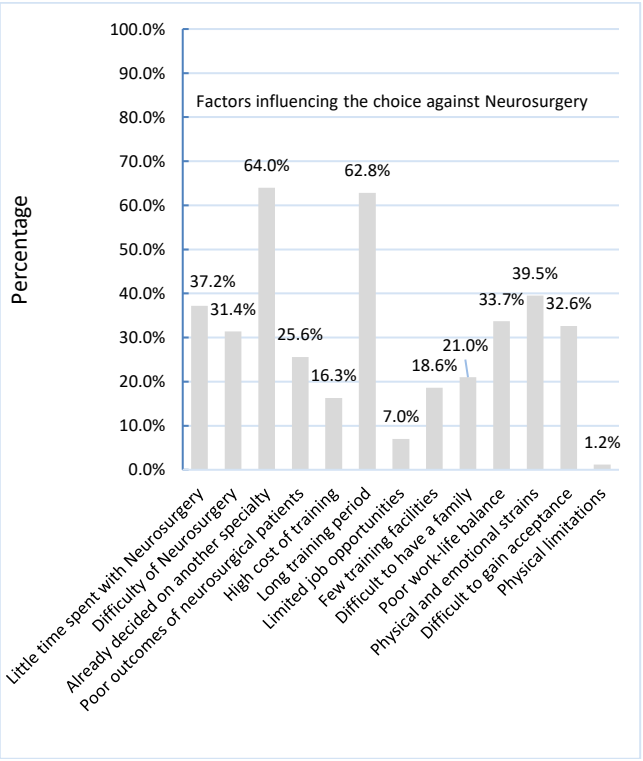


***Figure 3. Top Factors Influencing the Choice Against Neurosurgery***

***Improving Medical Student Interest and Recruitment in Neurosurgery.***

Each student suggested up to two ways they believed would best improve student interest and recruitment in neurosurgery. Nearly 40% of the responses focused on the need for more time to be allocated for neurosurgical rotations, including lectures, ward sessions, patient-clerking, and time to follow long-term clinical outcomes of patients. Only one response mentioned the need for earlier exposure to neurosurgery. (Table 3).

**Table 3. Ways to Improve Student Interest and Recruitment in Neurosurgery**

| Ways to improve student interest and recruitment in Neurosurgery | Frequency of response (%) |
|---|---|
| Allocate more time for neurosurgical rotations | 64 (38.8) |
| Organize Neurosurgery seminars for students | 18(10.9) |
| Adopt a more practical approach to teaching | 17 (10.3) |
| Improve residency factors | 14 (8.5) |
| Faculty should be more friendly | 12 (7.3) |
| Allow for more time spent in neurosurgical theatres | 9 (5.5) |
| Increase remuneration and incentives | 9 (5.5) |
| Increase training capacity | 8 (4.8) |
| Better teaching of Neurosurgery | 8 (4.8) |
| More emphasis and quality of Neuroscience lectures | 4 (2.4) |
| Earlier exposure to Neurosurgery | 1 (0.6) |
| Better integration with Neurology | 1 (0.6) |
| ***n (responses)=165(100)*** | |

***Male-Female Imbalances in Neurosurgery***

Of the 16 final year medical students who will apply for neurosurgical residency 6 (37.5%) were female. Most females (83.3%) chose not to apply because they believed it would be difficult to have a family as a neurosurgeon.

***Assessing These Influencing Factors from the Perspective of a Practicing Neurosurgeon.***

Two of the three neurosurgeon participants were able to answer the questionnaire 2 in this study.

These neurosurgeons were of view that the student's interest in neurosurgery is of sole and overriding importance over all other factors in making the choice to enter into the specialty.

> "…though many factors influence one's choice of a specialty including duration, remuneration etc., the overriding factor is one's personal interest and capabilities."
> Participant 1

> "Most students show a keen interest once they appreciate the importance of the rotation."
> Participant 2

They explained that medical students do not appreciate the challenge the specialty poses, viewing the specialty as too difficult and consequently barring themselves mentally from it.

> "A lot of students are also not interested in challenging stuff as you may find elsewhere."
> Participant 1

> "They see it as a difficult specialty as the basic science is not so attractive and the neurological exam/ neurological diseases are a bit far-fetched to identify with."
> Participant 2

They also expressed that being paid the same as colleagues in other specialty areas is a disincentive to some students.

> "…same remuneration as other specialties who do less…"
> Participant 1

> "Some may not be comfortable with … the fact that you get remunerated like everybody else."
> Participant 2

They expressed the need for Neuroscience in the pre-clinical years to be taught by practicing physicians and surgeons, and that mentorship sessions were key for any career choice in any specialty.

> "There probably should be a neurosciences day where students can interact with clinical neuroscientists…"
> Participant 1

> "Mentorship is key. Medical school should help students about career choices by inviting relevant doctors to interact with students."
> Participant 2

> "Neuro-anatomy and some of the neurosciences should be taught by clinicians- neurosurgeons and neurologists."
> Participant 1

> "Practicing physicians should be enlisted to teach at the basic science level."
> Participant 2

## Discussion

This study demonstrates a high level of interest in neuroscience among medical students, with more than 90 percent having interest in their pre-clinical neuroscience lectures. Similar to the study by



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Kashkoush et al, it shows that this early interest fails to translate into neurosurgical residency applicants, revealing a sharp decline to the 14% who actually decide to apply for neurosurgical residency[10]. This sharp decline may be due to other competing specialties, with 64% of respondents choosing not to apply because they had already decided on another specialty. The association found between pure student interest and the choice to enter into neurosurgery (p=0.00) was reechoed by this quote from a neurosurgeon: "though many factors influence one's choice of a specialty including duration, remuneration etc., the overriding factor is one's personal interest and capabilities", expressing that student interest is a key factor driving the medical student to choose neurosurgery. This study revealed that most medical students have an unfavorable disposition towards Neurosurgery as a specialty with over 90% indicating that the specialty was physically and emotionally draining. A study by Zuckerman et al. in 2016 showed that after students were exposed to the professional and personal lives of neurosurgeons these attitudes towards the specialty changed for the better[8]. Unlike in the study by Akhigbe & Sattar, where most medical students reported that their neurosurgical teaching was inadequate and that neurosurgical histories and signs were difficult to elicit, almost 80% of our study participants said their teaching was in fact adequate[5]. Few neurosurgical sessions may explain why perceived adequate teaching still left the students with difficulties in history-taking and examination. This premise supports that lacking exposure to the non-academic aspects of the specialty such as the work-life balance of a neurosurgeon may explain this poor disposition towards the specialty.

In all, 16 final year medical students (13.8%) reported that they will apply for neurosurgical residency. An interest in neurosurgery, which overrides the negative dispositions in these students, and their perceived adequacy of the neurosurgical teaching they have received may be the reasons for such a high percentage of the students opting for neurosurgery seeing as 70% of them chose the specialty purely based on interest. This supports the claim by Haggerty et al reporting neurological interest as necessary in increasing neurosurgical recruitment of medical students[15].

About 45% of the students wanted to pursue neurosurgery as there is a need for more neurosurgeons in Ghana, and 75% did so because they believed they could make an impact in the specialty. These numbers represent students who similar to Dewan et al. have come to realize the acute need for more neurosurgeons in a middle-income country like Ghana and believe their contributions may change the face of neurosurgery in these countries. The increased neurosurgical demand, reflected by the West-African neurosurgeon-to-population ratio of 1:6,500,000, may serve to encourage more students to pursue the specialty[14]. The perceived benefits the specialty brings is another reason for some to apply into neurosurgical residency. Benefits include better income and prestige. Indeed, about 56% of students chose neurosurgery because they believed it would be a good source of income. Surprisingly, the admissions by the neurosurgeons suggest that, barring private practices and supplemental income streams, the Ministry of Health-structured income is the same as that for other specialties in Ghana and that this may be a disincentive for students. In Canada, Wilson & Pugh identified financial remuneration as an important factor for students to be aware of[8]. Admittedly, none of these students chose neurosurgery because faculty was friendly and collegiate despite the general consensus that faculty actually was friendly (95.7%).

If it is safe to assume that such high numbers of medical students who will apply for neurosurgical residency exist in all Ghanaian medical schools, why then does Ghana suffer only few well-trained neurosurgeons? Perhaps only few ultimately get admitted into these residency programmes, emphasizing the need to expand training colleges for neurosurgery in Ghana. Nearly 75% of the final year medical students chose not to apply to match into neurosurgical residency. 64% of these students had already decided on another specialty. According to the literature, 23% of medical students would have decided on their specialties of choice by their second year in medical school[15]. The little time spent for Neurosurgical clinical rotations may then prove too little too late to change their minds.

As expressed in the study by Agarwal et al., the long duration of residency accounts much for the trend of decreased neurosurgical pursuit in medical students[6]. About 63% of students decided against the specialty on this account. Students in the study by Akhigbe and Sattar, invariably agreed that neurosurgery had a long training period and impeded family life[5]. This may be the reason why all students married, engaged or living together chose not to apply for neurosurgical residency. About 40% chose not to venture into a specialty where this very prospect may leave them overwhelmed. Over 30% chose against the specialty because they thought it too difficult, despite nearly 80% of respondents agreeing that their neurosurgical teaching was adequate. The neurosurgeon's quote, "A lot of students are also not interested in challenging stuff as you may find elsewhere" may explain this. In truth, only one student decided to choose neurosurgery as a career because it was challenging.

The most frequent suggestion by the students as a way to improve their interests and choice of neurosurgery was to allocate more time for the neurosurgical rotations. They expressed that they needed more time to experience the specialty by way of lectures, ward sessions and patient-clerking, and explained that this would mean enough time to see the outcomes of neurosurgical patients on the wards. This may be achieved by the fairly recent concept of neurosurgical electives implemented in already existing curricula to expose medical students to the professional and personal lives of neurosurgeons[9]. About 11 percent of responses



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suggested Neurosurgery seminars and mentorship programmes as ways to humanize and publicize the specialty. This is supported by the neurosurgeon's submission, "Mentorship is key. Medical school should help students about career choices by inviting relevant doctors to interact with students." The University of Pittsburg increased their neurosurgical recruitment by establishing a neurosurgery interest group whose goals were to meet very similar demands, and to dismiss misconceptions regarding the work-life balance in a neurosurgical career[11].Interestingly, only one response pled for earlier exposure to neurosurgery. It would seem that the timing of exposure, though critical to foster early interests, is not a focal area needing improvement for these students.

The dominance of male neurosurgeons is observed all over Africa[1]. In this study, three female students indicated that they will apply for neurosurgical residency for every five males who apply. A reason for this disparity may lie in the gender inequalities which exist in acceptance at residency, promotion and gaining leadership roles in the specialty[8]. Many more females (83.3%) chose not to apply because they believed it would be difficult to have a family as a neurosurgeon. It follows then that issues regarding self-development and family life in neurosurgery may be of more concern to female medical students than their male counterparts, and that these may be the reasons for the male-domineering outlook of the specialty.

## Limitations

A larger study involving medical students at all levels and perhaps in different schools, and more practicing neurosurgeons, would have lended the study more generalizability. Although a high response rate of 96.7 percent was achieved for Questionnaire 1 with the help of reminders, the use of a mailed questionnaire to collect qualitative data from the neurosurgeons lacked the interactivity that comes with personal interviews. Future studies with comparable objectives and methods must ensure adequate study durations to accommodate the longer periods of data collection notable of web-based methods.

## Conclusion

This study to determine the factors influencing the choice of a professional career in neurosurgery among final year medical students showed that medical students have high early interest in neurosurgery. Although teaching in the specialty may lend good academic exposure, the same cannot be said for the non-clinical aspects concerned with life as a neurosurgeon. Pure interest in the specialty, a will to make an impact in neurosurgery, and the prospects of a good source of income were found to be the top factors influencing students who will apply for neurosurgical residency (13.8%). The leading factors deterring medical students from choosing the specialty were the choice for other specialties, the long period of neurosurgical training, physical and emotional strains of the job, short durations of their neurosurgical rotations, and difficulty gaining acceptance into neurosurgical residency programmes. Practicing neurosurgeons agree that student-interest in the field is chief amongst these factors, bearing an association with the choice to apply and match into neurosurgery (p=0.04).

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# REVIEW ARTICLE

## CLINICAL APPROACH TO ADRENAL INSUFFICIENCY

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## Summary

Adrenal insufficiency refers to inadequate production of glucocorticoids, mineralocorticoids, or both by the adrenal glands. This may result from dysfunction or complete destruction of the adrenal cortex (primary adrenal insufficiency), inadequate adrenocorticotropic hormone production by the pituitary (secondary adrenal insufficiency), or inadequate corticotropin-releasing hormone production by the hypothalamus (tertiary adrenal insufficiency). Diagnosis of adrenal insufficiency requires a high index of suspicion because of its nonspecific signs and symptoms. It is associated with a high morbidity and low quality of life even in patients on treatment. When it presents as adrenal crisis it has a high mortality. Glucocorticoid replacement is the mainstay of management, and this may be combined with mineralocorticoids in the case of primary adrenal insufficiency.

Health care personnel must be reminded of this condition, to improve rates of early diagnosis and improve outcomes in management. In this review, we also look at the management of adrenal insufficiency in special populations and the potential role of newer long-acting steroids in the management of adrenal insufficiency is briefly discussed.

## Introduction

Adrenal insufficiency, a disorder characterized by a reduction in adrenal hormone synthesis appears to be increasing in incidence in many parts of the world; in Europe there has been an increase from 117/million in Italy in the nineties[1] to 144/million in 2007 in Norway[2] to 221/million in 2016 in Iceland[3]. There are few studies done on the disease in Africans[4] and when reported the prevalence is low at 3/million in South Africa[5]. It has been suggested that the diagnosis of Addison's disease is relatively more difficult in black Africans as hyperpigmentation a predominant sign is more difficult to identify in the black skin in addition to confounding illness like HIV and Tuberculosis being more prevalent with similar presentation[6]. In Ghana, there is a paucity of data on adrenal insufficiency; in a study on the spectrum of endocrine disorders in central Ghana, adrenal disorders were among the lowest in prevalence with Cushing Syndrome, hyperaldosteronism, adrenal carcinoma and phaechromocytoma reported but no case of adrenal insufficiency being recorded over a 5-year period in the second largest hospital in Ghana[7]. Adrenal Insufficiency may be misdiagnosed or undiagnosed and often may present late in adrenal crisis which is associated with higher mortality[8].

## Anatomy and Physiology of the Adrenal Gland

The adrenal glands also known as the suprarenal glands, are paired structures located superior to the kidneys, weighing about 4-5grams each. The gland is divided into an outer cortex and an inner medulla covered by a thin membrane known as the capsule. The cortex is derived from mesodermal tissue near the gonads on the adrenogenital ridge[9], secreting steroids as early as the 6th week of life. The adrenal medulla on the other hand is derived from the neural crest, which is of ectodermal origin[9].

The adrenal gland gets its blood supply from the inferior phrenic artery, the aorta and the renal arteries. Venous drainage of the right adrenal gland is into the inferior vena cava, whereas the left gland drains into the left renal vein**.** The cortex constitutes 90% of the gland and is made up of 3 zones: the outermost zona glomerulosa, the middle zona fasciculata and the innermost the zona reticularis. Glucocorticoid (cortisol 10-20mg /day) is produced from the zona fasciculata and the adrenal androgens from the zona reticularis; these two hormones together are under the control of Adrenocorticotrophic Hormone (ACTH) from the pituitary gland. Mineralocorticoid, is produced in the zona glomerulosa under the influence of the Renin Aldosterone Angiotensin System (RAAS). The inner medulla however is responsible for the production of the "flight or fight hormone" adrenaline and noradrenaline. Adrenocortical insufficiency refers to the deficiency of adrenal hormones i.e. glucocorticoids, mineralocorticoids and sex hormones. It may occur when both adrenal glands are destroyed with resultant deficiency of all adrenal hormones; this is known as primary adrenal insufficiency. Secondary adrenal insufficiency occurs when there is a deficiency of adrenocorticotrophic hormone (ACTH) resulting in deficiency of cortisol and adrenal androgens with

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sparing of mineralocorticoids. This is because mineralocorticoids are not under the influence of ACTH but rather the renin-aldosterone-angiotensin System (RAAS). This accounts for the differences in presentation and management of primary adrenal insufficiency and secondary adrenal insufficiency.

## Causes Of Adrenal Insufficiency

The causes of adrenal Insufficiency are many and are summarized in table 1. In developed countries, autoimmune causes account for approximately 85% of cases.

**Table 1: Causes of Adrenal Insufficiency**

| **Primary**<br>**Dysfunction of the Adrenal gland disease** | **Secondary**<br>**Dysfunction of the Pituitary gland** | **Tertiary**<br>**Dysfunction of the hypothalamus** |
|---|---|---|
| • Autoimmune-commonest cause in developed countries (70%) which can occur in isolation or as part of:<br>  o Autoimmune Polyglandular deficiency<br>• Infiltration- Amyloid, sarcoid, histiocytosis, lymphoma hemochromatosis<br>• Infection- tuberculosis, fungal, HIV-AIDS, Cytomegalovirus infection<br>• Vascular hemorrhage- anticoagulants, Friedrichson-Waterhouse Syndrome, thrombocytopenia, anticoagulant treatment<br>• Infarction- antiphospholipid syndrome<br>• Malignancy – primary/secondary or lymphoma<br>• Adrenoleucodystrophy<br>• Congenital adrenal hyperplasia<br>• Congenital adrenal hypoplasia<br>• Iatrogenic- bilateral adrenalectomy, Drugs e.g., ketoconazole, phenytoin, rifampicin | **Lesions of pituitary gland**<br>• Tumours- pituitary tumours, metastasis, craniopharyngioma<br>• Infection- tuberculosis<br>• Inflammation- sarcoid, histiocytosis X, haemochromatosis<br>• Iatrogenic- surgery, radiotherapy of head and neck<br>• Other – isolated ACTH deficiency,<br>• Trauma<br><br>**Suppression of hypothalamo-pituitary- adrenal axis**<br>• Glucocorticoid administration commonest cause of adrenal insufficiency (5)<br>  Cushing's disease (after pituitary tumour removal) | **Lesions of hypothalamus**<br>• Infection- tuberculosis<br>• Inflammation- sarcoid, histiocytosis X, haemochromatosis<br>• Iatrogenic- surgery, radiotherapy of head and neck<br>• Withdrawal of chronic suppressive glucocorticoid therapy<br>• Hypothalamic tumors<br>• Metastases to the hypothalamus<br>• Cranial irradiation<br>• Infiltrative diseases affecting the hypothalamus<br>• Infections (e.g. tuberculosis)<br>• Trauma |

In developing countries, Tuberculosis (TB), cases[10], disseminated fungal infection and Human Immunodeficiency Virus (HIV) remain significant causes[11,12]. Autoimmune adrenalitis (Addison's disease) is the most common cause of primary adrenal insufficiency and is associated with increased levels of 21-hydroxylase antibodies. It may occur in isolation or as part of an autoimmune polyglandular syndrome. Withdrawal of glucocorticoids after long-term administration is the most common cause of central (secondary/tertiary) adrenal insufficiency.

## Clinical Presentation of Adrenal Insufficiency

Adrenal insufficiency has been described as the great mimicker, with nonspecific symptoms such as anorexia, abdominal pain, weakness, fatigue, lethargy, fever, nausea and vomiting. The clinical presentation of adrenal insufficiency will depend on the extent and rate of loss of adrenal function; whether it is associated with mineralocorticoid deficiency or otherwise[14].

### *Adrenal Crisis or Acute Adrenocortical Insufficiency*

Patients will usually present as an emergency often in shock and sometimes with other nonspecific symptoms described. It is important to note that both primary and secondary adrenal insufficiency can present acutely in crisis[15]. This acute presentation may occur or be precipitated by 1. Acute destruction of the adrenal glands e.g. bilateral adrenal hemorrhage or infarction 2. Patients with chronic primary adrenal insufficiency, with an acute illness or stress precipitating the crisis, 3. Sudden withdrawal of glucocorticoids in patients on long term glucocorticoid therapy for a chronic condition, 4. Inadequate treatment (e.g., underdosing, malabsorption) in patients known to have adrenal insufficiency.



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***Chronic Adrenal Insufficiency***

The presentation of chronic adrenal insufficiency is less dramatic, it is insidious and often with non-specific symptoms like anorexia, weight loss, fatigue, weakness, abdominal pain, nausea, vomiting, joint and/ muscle pain. Psychiatric disorders like depression, mania and psychosis have all been reported[16,17]. Additionally, women may present with decreased axillary and pubic hair associated with low libido as females derive androgens responsible for axillary hair and libido mainly from adrenal androgens. In addition to these non-specific signs, skin hyperpigmentation of the buccal mucosa, gums, palmar creases, nail beds, scars (forming after the onset of adrenal insufficiency), sun exposed and friction exposed areas present in chronic PAH due to increased levels of proopiomelanocortin (POMC) a prohormone that cleaves into biologically active ACTH and melanocyte stimulating Hormone (MSH) [18],[19]. High levels of MSH results in increased melanin synthesis, which results in hyperpigmentation. Additionally, postural hypotension and salt craving due to mineralocorticoid deficiency occurs. Laboratory investigations may show hyponatremia, hyperkalemia, elevated urea, anaemia (normocytic, normochromic), elevated ESR, eosinophilia, mild hypercalcaemia and hypoglycaemia.

## Diagnosis of Adrenal Insufficiency

Adrenal insufficiency can be diagnosed if it can be shown that the functional capacity of the adrenal cortex to synthesize cortisol is impaired. Screening is by serum cortisol levels; random morning cortisol concentrations lower than 80 nmol/L (3 μg/dL) are strongly predictive of adrenal insufficiency [20] however, ACTH stimulation test must always be done to confirm the diagnosis although tests should never delay treatment with lifesaving steroids in patients suspected to have adrenal crisis. In individuals on chronic glucocorticoid therapy, in order to avoid detecting exogenous cortisol in the test assay, it is important to withhold hydrocortisone and prednisolone for 12 hours and 24 hours respectively[21] before the test.

Confirmation is done using the adrenocorticotrophin stimulating hormone (ACTH) stimulating test also known as cosyntropin or Synacthen test[22]. It assesses cortisol levels at baseline, 30mins and 60mins after parenteral administration of 250micrograms of adrenocorticotropic hormone. Although time 60mins seems to have a better response than time 30mins, there has not been well documented advantages of one time over the other and the exact cut-offs have been set at 500-550nmol/L(18-20 μg/dL) after stimulation with Synacthen depending on the assay being used[23]. If a corticotropin stimulation test is not available, a morning cortisol <140 nmol/L (5 μg/dL) in combination with an elevated ACTH as an initial test is suggestive of adrenal insufficiency until confirmatory testing with corticotropin stimulation is available[30].

A plasma ACTH level must be done to differentiate primary from secondary adrenal insufficiency. Primary adrenal insufficiency will have high ACTH levels usually greater than 100 pg/mL (22 pmol/L) [22]in addition to high renin and low aldosterone. In secondary adrenal insufficiency, plasma ACTH will be low or inappropriately normal[22]. It must however be noted that sometimes, in early secondary adrenal insufficiency, when the adrenals are not yet atrophied from hypo stimulation, ACTH stimulation may yield a response from the adrenal and give the impression that the hypothalamic –pituitary-adrenal axis is normal.

## Management Of Adrenal Insufficiency

Whatever the cause of adrenal insufficiency, glucocorticoids must be replaced to preserve life.

***Glucocorticoid Replacement***

Patients with adrenal insufficiency may need glucocorticoid replacement for life[24] depending on the cause . However, the frequency, as well as total daily dose remain challenging due to the individual variability of daily cortisol levels, daily stress levels as well as daily activity of the patient. A known fact remains that irrespective of cause most patients on glucocorticoid replacement still show reduced Quality of life(QoL) irrespective of cause[25]. Mode of replacement is dependent on the clinical presentation i.e. whether acute, previously undiagnosed, previously diagnosed or chronic [26].

1. Acute

In acute primary adrenal insufficiency (Adrenal crisis) regardless of the cause, cortisol must be replaced along with mineralocorticoid. Within the first 12-24hours, Intravenous saline (0.9%) and dextrose are necessary to correct hypotension and hypoglycemia respectively if they exist.

a. Previously diagnosed

In patients who are previously known to have adrenal insufficiency, Intravenous (IV) hydrocortisone 100mg bolus should be given, followed by IV 50mg 8 hourly until vital signs are stable, and patient tolerates oral medications when oral steroids are initiated in stress or maintenance doses as needed. Prednisolone can be used if hydrocortisone is unavailable or dexamethasone if hydrocortisone or prednisolone are unavailable but should be the last resort. Acutely, mineralocorticoid replacement may not be needed even in primary adrenal insufficiency, as sodium is given by saline infusion. Additionally, the high dose of hydrocortisone given in the acute setting has adequate mineralocorticoid activity (Table 2).

a. Previously undiagnosed

In patients who present with classic symptoms of adrenal insufficiency but in whom diagnosis is not confirmed biochemically, dexamethasone is preferred

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(IV 4mg) until samples are taken for biochemical confirmation. Under no circumstance must glucocorticoid of any type be withheld awaiting confirmation in a patient suspected to have adrenal crisis. Dexamethasone is preferred because it does not interfere with cortisol assays[27].

2. Chronic

In chronic adrenal insufficiency, short acting hydrocortisone (15-25mg) or cortisone (20-35mg)(see table 2) is recommended in 2 or 3 divided doses with decreasing doses as the day progresses[28] to mimic what happens physiologically i.e. higher doses of glucocorticoids are secreted in the morning and with progressive reduction as the day progresses. Prednisolone 3-5mg/day may also be used but dexamethasone with a long half-life (table 2) should not be encouraged, as the risk of Cushing's syndrome may be greater. Table 2 describes the glucocorticoid equivalences and their pharmacokinetics and dynamics; understanding this is important for appropriate steroid replacement therapy which will be discussed shortly.

**Table 2: Glucocorticoid equivalencies**

| Glucocorticoids | Equivalent dose (mg) | Glucocorticoid potency | HPA Suppression | Mineralo-corticoid potency | Plasma half-life (min) | Biologic half-life (h) |
|---|---|---|---|---|---|---|
| ***Short-acting*** | | | | | | |
| Hydrocortisone | 20.0 | 1.0 | 1.0 | 1.0 | 90 | 8-12 |
| Cortisone | 25.0 | 0.8 | | 0.8 | 80-118 | 8-12 |
| ***Intermediate-acting*** | | | | | | |
| Prednisone | 5.0 | 4.0 | 4.0 | 0.3 | 60 | 18-36 |
| Prednisolone | 5.0 | 5.0 | | 0.3 | 115-200 | 18-36 |
| Triamcinolone | 4.0 | 5.0 | 4.0 | 0 | 30 | 18-36 |
| Methylprednisolone | 4.0 | 5.0 | 4.0 | 0 | 180 | 18-36 |
| ***Long acting*** | | | | | | |
| Dexamethasone | 0.75 | 30 | 17 | 0 | 200 | 36-54 |
| Betamethasone | 0.6 | 25-40 | | 0 | 300 | 36-54 |
| Mineralocorticoids | | | | | | |
| Fludrocortisone | 2.0 | 10 | 12.0 | 250 | 200 | 18-36 |

## Mineralocorticoids Replacement

Mineralocorticoid replacement is indicated only in Primary Adrenal insufficiency. Fludrocortisone at an initiation dose of 50-100 micrograms daily is recommended without salt restriction[26]. Patients with mineralocorticoid deficiency experience weakness, hypotension, salt craving and electrolyte imbalance such as hyponatremia and hyperkalemia. Mineralocorticoid deficiency is confirmed with significantly decreased aldosterone level and a highly elevated plasma rennin activity. Monitoring of mineralocorticoid replacement is carried out using clinical parameters such as the patient's well-being, physical examination, blood pressure and electrolyte measurements as well as plasma rennin activity (PRA). Plasma rennin activity is kept within the upper normal range for adequate control.

## Androgen Replacement

Dehydroepiandrosterone (DHEA) is not routinely replaced even in primary adrenal insufficiency. In men there is sufficient androgen supply from the testes. In women who get all their androgen from the adrenals however, androgen replacement may be required in primary adrenal insufficiency. Particularly if after optimum replacement of glucocorticoids and mineralocorticoids the patients still complains of low energy levels accompanied by low libido or depression [26,29]. DHEA is given for 6 months and if there is no improvement it is stopped[30].

## Monitoring

Monitoring is essential in patients being managed for adrenal insufficiency. Glucocorticoids can be monitored clinically using general well-being, weakness, body weight and Cushingoid features. Mineralocorticoids replacement is monitored using salt craving, oedema and blood pressure measurement where hypotension or hypertension may indicate inadequate or over replacement of mineralocorticoids respectively[26]. Additionally, electrolytes and rennin may be used to monitor with rennin levels expected to be in the normal upper range. Androgen levels are monitored with early morning DHEAS and the sample must be taken before the replacement dose is taken.

## Patient Education

As for most chronic disorders, education of the patient is important, the patient must understand the rational of



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treatment and the risks of non-adherence and noncompliance. One important aspect of education that is essential is what to do in the event of sickness or stress known as the sick day rules. Sick day rules are important in managing patients with adrenal insufficiency because patients with adrenal insufficiency have no physiological increase in cortisol during stress, therefore, the patient must increase dose of glucocorticoid during acute illness, stress, prolonged physical exercise and during surgery[31] noting that steroid dose is dependent on the type of surgery[32] as shown in table 3.

**Table 3: Steroid cover for patients with adrenal insufficiency requiring surgery**

| Preoperative preparation | Post operative preparation |
|---|---|
| IV/IM 100mg hydrocortisone just before induction of anaesthesia with IV infusion hydrocortisone 200mg in 24 hrs.<br>Or IV/IM hydrocortisone 100mg every 6 hours till out of ITU , then double dose for 48hours+ then taper to regular dose<br><br>1. major surgery with long recovery time e.g. open heart surgery, major bowel surgery<br>2. major surgery with rapid recovery e.g. Caesarean section, joint replacement | Continuous IV infusion 200mg hydrocortisone or IM/IV 100mg hydrocortisone every 6 hours until able to eat Double oral dose for 48hours for major surgery then<br><br>a. Taper dose to regular dose in major e.g. open heart surgery, bowel surgery<br>b. Return to normal dose in major surgery with rapid recovery. |
| Overnight admission, with IV fluids, Then IV/IM 50mg hydrocortisone during purgative stage. Then IV/IM 100mg hydrocortisone just before<br>Invasive procedures requiring laxatives e.g. colonoscopy before the procedure | Double dose oral medication for 24 hours then return to normal<br>1. Minor surgery e.g. cataract<br>2. Invasive bowel procedures with or without laxatives e.g. endoscopy, colonoscopy<br>3. Dental procedures |
| IM/IV 100mg hydrocortisone just before anesthesia or commencement of procedure if anesthesia is not required e.g. in major dental surgery or gastroscopy | Normal dose unless hypo adrenal symptoms occur when an extra dose should be given in minor procedures e.g. skin biopsy, removal of skin moles, minor dental procedures like dental filling |

**Note**

a. IV bolus hydrocortisone should be given over 10 mins
b. If there are post operative complications, return to normal may be delayed
c. IVI is preferred to bolus
d. If nil per os, IV Fluids must be given adequately
e. Post procedure monitoring of clinical signs and electrolytes may be necessary.

**Steroid Alert**

Patients must also be given a steroid alert card/bracelet informing health care personnel of their condition and their regular dose of glucocorticoids[31]. It is therefore important that doctors look out for these alert cards/bracelets in any patient brought in an unconscious state.

## Dosing Regimen

Irrespective of the type of steroid used, subjective health status is reduced when steroids are given to patients with adrenal insufficiency[25,33]. Higher doses of hydrocortisone (>30mg) have a more impaired QoL than those on a lower dose although a complaint of impaired QoL may lead to increment in dose with an obvious selection bias[33].

Conventionally, hydrocortisone is given thrice daily[30], hydrocortisone is short acting and although this frequent dosing attempts to give a full steroid cover; this regimen is far from physiological with gaps between doses where adrenal insufficiency may occur [28]. It may also be given twice usually given to non-compliant patients who find the thrice-daily regimen difficult to keep up. Surprisingly; thrice daily dosing was not superior to twice daily dosing[34] although periods of adrenal insufficiency may be longer[35].

## Adrenal Insufficiency In Special Populations

It has been suggested that in special populations, doses and timing of medications may need to be changed[36] as discussed below:

### *Shift workers*

In shift workers, it is recommended that steroid replacement should be such that the larger doses are taken on waking up which may be in the night and the second dose 6-8 hours after that[37].

### *Hypertension*

Although patients with adrenal insufficiency can develop essential hypertension, it is important to make sure that the developing hypertension is not from fludrocortisone which may need to be reduced. Addition of antihypertensives as required is necessary using calcium antagonists and alpha blockers. Angiotensin Converting Enzyme Inhibitors and Angiotensin 1Receptor Blockers may not be effective due to the disruption of rennin angiotensin aldosterone system.

### *Thyroid dysfunction*

Patients with hyperthyroidism have high cortisol metabolism and may require higher doses of steroids until they are euthyroid. Patients with adrenal insufficiency may develop new onset hyperthyroidism which can precipitate an adrenal crisis. Adrenal insufficiency may coexist with hypothyroidism; in these patients, levothyroxine should not be started until cortisol has been replaced to prevent precipitation of an adrenal crisis.



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***Pregnancy***

Patients with adrenal insufficiency may have problems associated with pregnancy including reduced fertility, increased risk of miscarriage, preterm births, low birth weight infants and increased Caesarean section rates[38,39]. Adrenal insufficiency may actually present for the first time in pregnancy and mimic hyperemesis gravidarum[40], as it may do with most of the symptoms of pregnancy like fatigue, nausea and vomiting. Low cortisol and high ACTH are the expected in Primary adrenal insufficiency in adrenal crisis however, in pregnancy, cortisol may be normal due to the contribution of placental fetal steroids [41], rise in corticosteroid-binding globulin concentrations and increased cortisol half-life due to decreases in hepatic clearance of the bound hormone [42, 41].

However, there may be lack of cortisol increase in response to ACTH stimulation[43] therefore, higher total cortisol cut-offs may be needed to confirm a diagnosis of adrenal insufficiency. The recommended diagnostic cut-offs are 700 nmol/L (25 μg/dL) for the first trimester, 800 nmol/L (29 μg/dL) for the second trimester, and 900 nmol/L (32 μg/dL) for the third trimester vrs 700 nmol/L [26 μg/dL] post-partum) [44]. Most patients can safely go through pregnancy on their pre pregnancy dose of glucocorticoids although a few will require higher doses in the third trimester[45]. Hydrocortisone is preferred over prednisolone and dexamethasone is not recommended [26].

During labour and delivery, the recommended dose of hydrocortisone is as for major surgery (see table 2) i.e. 100mg at the time of active labour (cervical dilation of 4cm or contraction every 5minutes or more for 1 hour or both) after which intravenous infusion of 200mg hydrocortisone is given over 24hours or 50 mg of intravenous hydrocortisone every 6 hours until delivery [26].

Assessing mineralocorticoid sufficiency clinically in pregnancy will be challenging because oedema and postural hypotension often used may be present in normal pregnancies. Blood and urine potassium and sodium can be monitored, but rennin levels may not be useful as concentrations increase in pregnancy. Increased progesterone levels with anti-mineralocorticoid effects may sometimes necessitate adjustment of fludrocortisone doses[46]. In pregnancy, dose adjustments are needed often to compensate for the anti-mineralocorticoid activity of progesterone [47].

***Surgery***

Glucocorticoid replacement for surgical procedures is summarized in Table 3.

## Delayed Preparations

Currently, most patients with adrenal insufficiency are treated with immediate release hydrocortisone, which is given as multiple doses (2 or 3 doses) in a day because of its short half-life and also in a bid to mimic the normal circadian pattern. This strategy however fails to achieve this goal[4] The normal circadian rhythm is crucial for infection control, stress management and normal metabolism [48]. Abdominal obesity, glucose intolerance, coronary artery disease and altered sleep patterns have been linked to high levels of cortisol in the evening [26]which may occur with the current cortisol replacement strategies.

Considering the inadequacies of multiple dosing with immediate release hydrocortisone, it must be mentioned that recent modified release once daily forms with an outer shell of rapid release and an inner core of slow release has been shown to mimic the circadian rhythm with improved quality of life and metabolic effects of adrenal insufficiency [49]. Indeed, in randomized controlled studies, the conventional multiple daily doses of hydrocortisone seemed to have more disadvantages, mainly by causing a pro inflammatory state associated with a weakened immune system. The more physiological once daily dosing reduced body weight, improved the immune system quality of life[50], but that has been questioned suggesting that the multiple doses used higher, immune suppressive doses compared to the lower once daily dosing[51].

The once daily modified-release prednisone originally licensed for rheumatoid arthritis has shown promise in patients with adrenal insufficiency ; it is taken at 10pm and commences effect around 3am mimicking the physiological early morning cortisol rise[52]. Importantly, delayed release glucocorticoids forms may improve adherence because of single dosing compared to multiple dosing[53] with possible improved cost implications [54]. It is unlikely that any preparation will completely mimic the physiological pattern especially, the increase in cortisol that occurs during stress, however the success of a pilot study with the use of hydrocortisone pumps, which were acceptable to patients, is most encouraging [55].

These pumps which resulted in normalization of ACTH and near normal circadian variation gives hope for the future[56]. In the future, multiple daily dosing is likely to give way to single daily-dosing or pump therapy with better outcomes and better Quality of life; perhaps even increase dose during stress. Importantly, delayed forms may improve adherence because of single dosing [53] with possible improved cost implications [54]. However, more studies are needed before this becomes routine. In conclusion, a functional adrenal gland is essential for life, adrenal insufficiency can be life threatening and all physicians in all specialties must be able to identify, investigate, educate, and manage patients appropriately to preserve life.

## Authors' Contributions

**Atiase Y-** involved in conceptualizing, drafting and finalizing the manuscript; **Ampong C-** involved in drafting and finalizing manuscript; **Donkor-Baah C-** involved in drafting and finalizing the manuscript; **Yorke E-** involved in drafting and finalizing the



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manuscript; **Akpalu J-** involved in drafting and finalizing the manuscript.

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# CASE REPORTS

## TRAUMATIC RUPTURE OF DERMOID CYST IN EARLY PREGNANCY: DIAGNOSIS AND MANAGEMENT IN PEKI GOVERNMENT HOSPITAL RESULTING IN A SUCCESSFUL DELIVERY AT TERM

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## Abstract

***Introduction:*** Dermoid cyst is the commonest germ cell tumour, constituting about 20% of adult ovarian tumours. They are mostly asymptomatic, but complications such as torsion, rupture, and malignant transformation have been reported. Only a few cases of ruptured mature cystic teratoma in early pregnancy have been described and even fewer are those in early pregnancy with the pregnancy successfully carried to term with successful delivery.

***Case Presentation:*** We present a case of a grand multiparous woman who presented to Peki Government Hospital at 11 weeks gestation with an acute abdomen following a fall. She had been diagnosed with a dermoid cyst a week with dimensions of 20cm x15 cm before the presentation. Ultrasound diagnosis of a possible rupture of the cyst was made on admission. Right oophorectomy was done at laparotomy. She had progesterone support for the succeeding 4 weeks and the pregnancy was successfully carried to term with good outcomes at delivery for both mother and baby. The APGAR score for the baby at 1minute and 5minute after birth were 7/10 and 8/10 respectively.

***Conclusion:*** Traumatic rupture of dermoid cyst should be considered as a differential diagnosis in women presenting with acute abdomen in early pregnancy. Laparotomy with abdominal lavage is a viable management option in a low-resource setting.

***Keywords:*** *Dermoid cystic, Traumatic Rupture, Gestation, Delivery, Progesterone, laparotomy*

## Introduction

Dermoid cyst, also referred to as mature cystic teratoma, is the commonest germ cell tumour[1]. It constitutes about 20 % of adult ovarian tumours[1] with no particular racial predilection[2]**.** Embryologically, dermoid cysts develop along the lines of fusion with trapped ectodermal elements hence the macroscopic presence of hair, nails, and teeth[2]. They are usually unilateral, but bilateral cysts have also been described [2]

Dermoid cysts are usually large at the time of diagnosis and often detected incidentally at routine pelvic examination[3]**.** They can be associated with various complications such as torsion (16% of ovarian teratomas), rupture (1%–4%), malignant transformation (1%-2%), infection (1%), and autoimmune haemolytic anaemia (<1%) [4]. The occurrence of rupture of dermoid cysts is between 0.2 to 2.5% [5]. The main cause of rupture is idiopathic[5]. Ruptured dermoid cysts may also be due to torsion in conjunction with pregnancy because of changes to the position of the ovaries and increased vascularity[5]. However, on very rare occasions, blunt abdominal trauma, like in this case, can be the cause of a ruptured mature cystic teratoma of the ovary[6]. In this case report, the occurrence of the rupture in early pregnancy further makes it very important because its management involves the preservation of the life of the mother and pregnancy. We, present this case of traumatic rupture of a dermoid cyst in the first trimester of pregnancy and successful management of the pregnancy to term delivery of a live baby in a resource-deprived setting.

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Conflict of Interest: None Declared

## Case Presentation

A 36-year-old G6P5AA, presented at Peki Government Hospital with a grossly enlarged abdomen, 3 months amenorrhoea, and a positive pregnancy test at a booking visit. A routine ultrasound scan diagnosed a dermoid cyst measuring 20cm x 13 cm coexisting with an 11-week gestation. Five days later she was rushed to the hospital complaining of severe abdominal pain after having tripped and fallen on her abdomen at her farm.
On further enquiry, she was not bleeding per vaginam and was not feeling dizzy. On general physical

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examination, she was in pain, not pale, she was afebrile and anicteric. Her pulse rate was 90 beats per minute and her blood pressure, 110/60mmHg. Her abdomen was full, generally tender with positive shifting dullness.

An urgent ultrasound scan reported findings that were suggestive of a ruptured right ovarian cyst with an intact intra-uterine gestation at 12 weeks. Fluid was noted in the Pouch of Douglas. These findings were explained to her and she was counselled and prepared for an emergency laparotomy. Intraoperative findings of the laparotomy through a midline incision were consistent with a ruptured right ovarian dermoid cyst. There was approximately 300mls of brownish fluid in the peritoneal cavity as well as hair strands and multiple whitish fatty material deposited on the bowel and peritoneum. The uterus was bulky and was about 12 weeks in size. A right oophorectomy was performed. There was minimal handling of the uterus during the surgery. The findings are described in Figure 1-4 below.

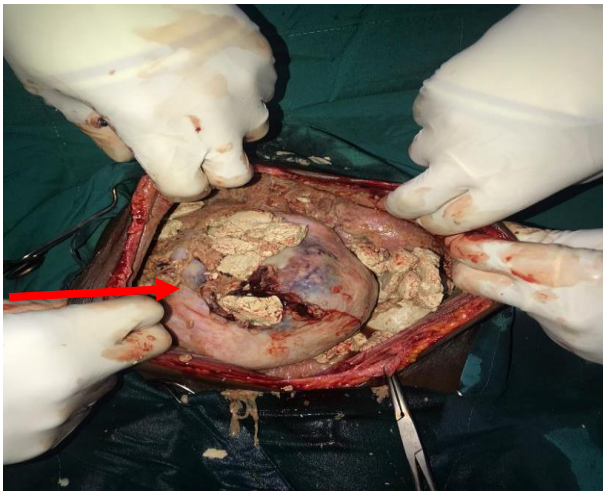

***Figure 1: Ruptured ovarian cyst with multiple whitish fatty deposits scattered all over the peritoneum. (ruptured dermoid cyst indicated with arrow)***

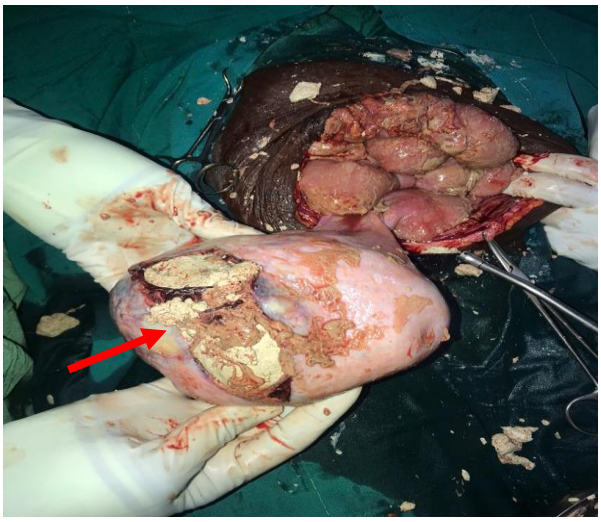

***Figure 2: ruptured dermoid cyst being removed. (ruptured dermoid cyst indicated with arrow)***

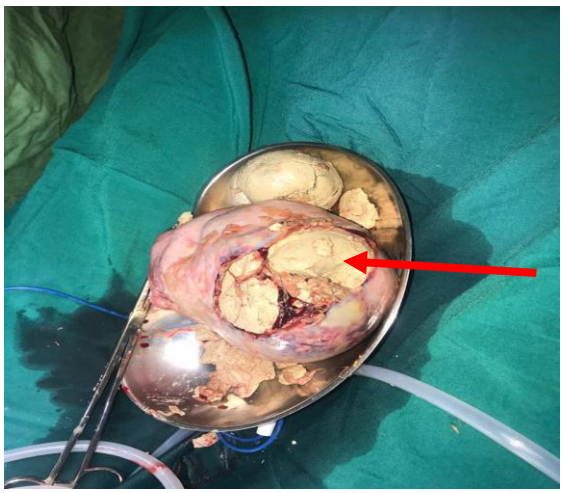

**Figure 3:** ***The dermoid cyst removed with the right ovary. (ruptured dermoid cyst indicated with arrow)***

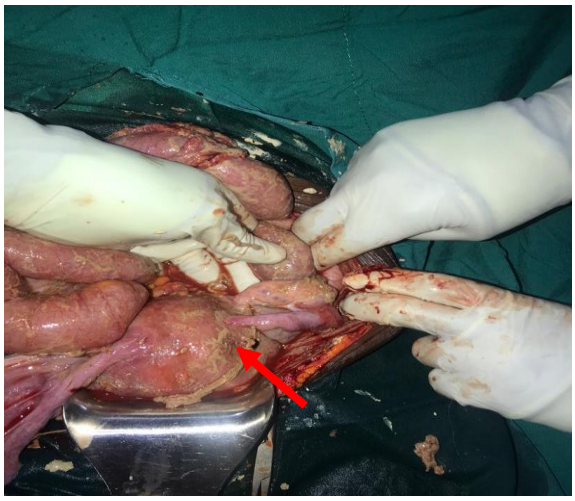

***Figure 4: Bulky uterus, about 12 weeks in size. (bulky uterus indicated with arrow)***

The abdomen was washed with about 3L of warm normal saline until it appeared clean. The specimen was sent for histology, findings of which revealed sections from the ovary showing multiloculated cystic ovary, lined by epidermal tissue and filled with keratin flakes, intestinal tissue, mature adipose tissue, smooth muscle, and bony tissue. No undifferentiated tissue was seen. The features were consistent with mature cystic teratoma. The patient was put on progesterone support (cyclogest® vaginal pessaries 400mg daily) for four weeks. Her subsequent care was uneventful through her regular antenatal visits until she went into labour at term. She later had an emergency Caesarean section on account of fetal distress. The outcome of this was the delivery of a live male baby weighing 2.9kg with good Apgar scores of 7/10 and 8/10 at 1 minute and 5 minutes after delivery respectively.

## Discussion

Mature cystic teratomas are characterized by adult ectodermal, mesodermal, and endodermal tissue and



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they may have skin, hair, teeth, fat and muscle, and in some cases thyroid and brain tissue[7]. The term dermoid cyst usually describes a mature cystic teratoma that contains primarily ectodermal tissue[7]. Although ovarian cysts have been known to undergo spontaneous rupture, external factors such as trauma, pelvic examination, coitus, and childbirth have also been documented as causes of rupture[8]. In our case, the suspicion of cyst rupture following the trauma was high due to the previous ultrasound diagnosis of a large dermoid cyst. The tenderness on palpation with the positive fluid thrill heightened our suspicion of a rupture. This acute presentation is one of two common presentations of ruptured dermoid cysts. The other is chronic presentation in which the patient may present with chronic granulomatous peritonitis with possible omental deposits which could be mistaken for ovarian carcinoma[4]. Collection of the sebaceous contents of a ruptured dermoid cyst could lead to peritonitis and fever[8]. Our patient did not develop a fever probably because she was managed early and had a thorough abdominal lavage. Blunt injury to other abdominal viscera could have been considered as a cause of her symptoms but the findings of the repeat ultrasound were suggestive of a ruptured ovarian cyst. More advanced radiological assessment could have been considered but they are not available in our facility. CT scans are thought of as being relatively unsafe in pregnancy due to exposure of the fetus to radiation. MRI although relatively safer to use in pregnancy, was not available in our facility.

It is advisable that any surgical intervention in the first trimester should be avoided, if possible, because of the high rate of spontaneous abortion[9]. The optimum time for surgical intervention is 16-18 weeks of gestation[9] but we had to perform the laparotomy at 12 weeks because of the acute presentation. Conservative management was not possible. Fortunately, despite the risk of spontaneous abortion, she was successfully managed on progesterone for 4 weeks. Her recovery and antenatal care were uneventful after the laparotomy. Although this patient reported early enough after the rupture of the ovarian cyst, laparoscopic management with its benefit of being minimally invasive was not an option because that service was not available. Oophorectomy should be the standard operation in postmenopausal women and perimenopausal women with multiple cysts in the same ovary or with large teratoma where there is not much ovarian tissue to conserve[10]. Oophorectomy was done because of the intraoperative finding of rupture of the dermoid cyst with content spillage all over the abdomen. Cystectomy would have been considered if not for the rupture. A thorough lavage with warm saline was performed to minimise the risk of chemical peritonitis as this practice is known to reduce this risk. The risk of chemical peritonitis after contents spillage is extremely rare and can certainly be overcome with thorough peritoneal lavage using warm fluid.

## Conclusions

Overall, we have highlighted the point that, although uncommon, in a pregnant woman diagnosed with a dermoid cyst who presents with acute abdomen following a fall, traumatic rupture of the dermoid cyst should be considered as a differential diagnosis. Prompt diagnosis, timely laparotomy, progesterone support, and continuous monitoring ensured that the pregnancy was successfully carried to term with a favourable outcome. Laparotomy remains an option for managing ruptured dermoid cysts with acute abdomen in a low-resource setting like ours.

## Authors' Contribution

**Azanu WK –** conceptualization, data curation, investigation, resources, validation, writing original draft, review and editing. **Appiah-Kubi A –** conceptualization, data curation, investigation, resources, validation, writing original draft, review and editing. **Maalman RS –** writing review and editing. **Konney TO –** writing - review and editing. **Amoh MY:** writing review and editing. **Sakyi AT –** writing - review and editing. **Agbeno EK -** writing review and editing. **Morhe ESK -** writing review & editing.

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# UTILIZING POINT-OF-CARE ULTRASOUND (POCUS) FOR DIAGNOSIS IN A RESOURCE-LIMITED SETTING: A CASE REPORT OF PULMONARY EMBOLISM

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## Abstract

***Introduction:*** Acute pulmonary embolism (PE) is a common cause of cardiovascular-related deaths and poses diagnostic challenges due to its variable and non-specific symptoms. Computed tomography pulmonary angiography (CTPA) is the gold standard imaging method for PE diagnosis, but its availability is limited in resource-constrained settings. Point-of-care ultrasound (POCUS) has emerged as a valuable tool for emergency physicians, aiding accurate diagnoses, procedural guidance, and resuscitation efforts.

***Case Presentation:*** This case report presents a 76-year-old woman with non-specific symptoms diagnosed with PE using POCUS in the Emergency Department of the Korle Bu Teaching Hospital**.** The POCUS findings included an enlarged right ventricle with a flattened septum (D sign), poor cardiac contractility, thrombi in the right ventricle and a plethoric Inferior Vena Cava (IVC). Prompt diagnosis facilitated timely management, leading to improved patient outcomes.

***Conclusion:*** POCUS has proven to be indispensable in resource-constrained settings where confirmatory diagnostics are limited. Incorporating POCUS training into emergency medicine residency programs and establishing emergency ultrasound fellowships in under-resourced regions like Africa can enhance its utilization and empower clinicians in such environments. Equipping emergency room clinicians with POCUS skills enables timely diagnosis, early interventions, shorter Emergency Department stays, and improved patient outcomes. This approach can contribute to building an African faculty proficient in emergency ultrasound, facilitating the education and training of more clinicians in POCUS, and ultimately enhancing healthcare outcomes in resource-limited environments.

***Keywords:*** Point-of-care ultrasound (POCUS), pulmonary embolism, ultrasound, emergency medicine

## Introduction

The occurrence of acute Pulmonary Embolism (PE), which is a serious consequence of Venous Thromboembolic Disease (VTE) is one of the most common causes of cardiovascular-related deaths[1]. It has the potential to result in fatality[2]. Symptoms of PE can be varied and non-specific, often presenting as a diagnostic challenge[1,2,3]. Imaging plays a crucial role in both diagnosing and managing patients with suspected PE with the multi-detector Computed Tomography Pulmonary Angiography (CTPA) being the most frequently utilized imaging method for evaluating PE[1]. Other imaging modalities exist and may be more suitable in certain environments, especially in resource-constrained settings where CTPA is not always readily available[1]. One such modality is the use of Point-of-Care Ultrasound (POCUS) in the Emergency Department (ED). POCUS has become an indispensable tool for emergency physicians, enabling them to obtain accurate diagnoses, assist in various procedures and guide resuscitation efforts[4]. The diagnosis and management of PE necessitate prompt recognition and intervention within the Emergency Department. Implementing POCUS in resource-constrained settings can significantly influence the clinical management of 50-70% of patients[5]. We present a case of a 76-year-old woman who presented to the ED with non-specific symptoms and was diagnosed with PE using POCUS.

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## Case Presentation

A 76-year-old Ghanaian woman presented to the Emergency Department of the Korle Bu Teaching Hospital with seizures, which started the day before the presentation. She had a history of hypertension and diabetes and was compliant with her medications. The patient had tonic-clonic seizures at home with a brief post-ictal confusional state. She was taken to a private lab for routine laboratory investigations where she had another episode of the seizures and was immediately rushed to our ED. At the ED, she had another tonic-clonic seizure which self-aborted with no post-ictal confusion. She had had a syncopal attack a month earlier which had been managed on out-patient basis by her primary physician after an initial head CT scan which was ordered showed chronic ischemic disease. She denied headache, fever, chest pain, unilateral leg swelling, recent long travel or a history of malignancy during her interview.

Initial examination revealed an elderly woman, in some respiratory distress receiving oxygen via nasal prongs at 5L/min with $SPO_2$-93%, Pulse rate-78bpm, RBS-11.8mmol/l, T-35.0C, BP-105/68mmhg, GCS-



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15/15. The respiratory rate was 22cpm with clear lungs. ECG showed sinus rhythm, left axis deviation, right bundle branch block, s1q3t3 pattern, and T wave inversions in V1-V6, with no ST elevation seen. (See Figure 1 for patient's ECG). Point-of-care ultrasound (POCUS) revealed an enlarged right ventricle with a flattened intraventricular septum (D sign), poor cardiac contractility, thrombi in the right ventricle, and a plethoric Inferior Vena Cava (IVC). See Figure 2 showing enlarged right ventricle (thrombi in right ventricle not captured in this image).

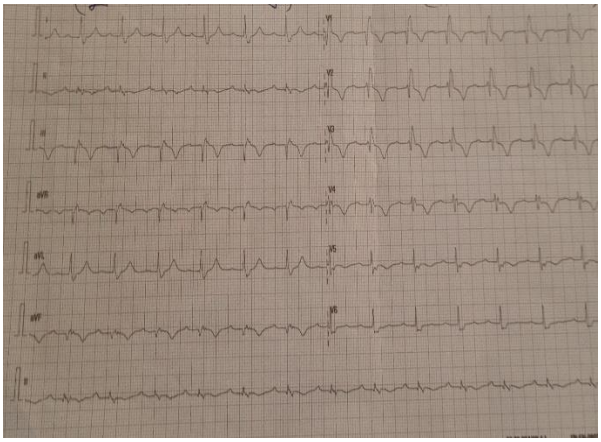

***Figure 1 ECG of patient***

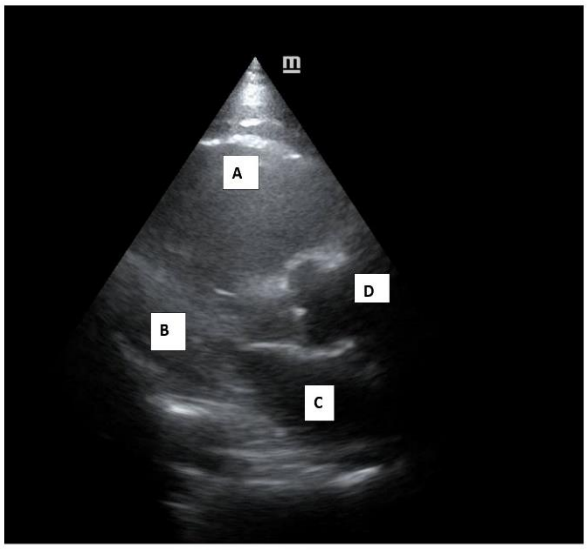


***Figure 2. Bedside Echo showing long parasternal axis view. A-Right ventricle, B-Left Ventricle, C-Left atrium D-Ascending Aorta/Aortic outflow tract (thrombi was not captured in this image)***

The patient's BP dropped to 70/43mmhg with an increased respiratory rate to 40cpm and she appeared lethargic though conscious. An initial diagnosis of Obstructive Shock secondary to massive pulmonary embolism, seizures due to electrolyte imbalance/ hypoxia was made. Complete blood count and levels of blood glucose, serum electrolytes, blood urea and creatinine and liver function tests and the clotting profile were within normal ranges. A non-contrast enhanced CT scan of the head was unremarkable. The patient received standard thrombolytic treatment with Alteplase. She also received intravenous infusion of normal saline (2 litres) and dobutamine to manage shock and intravenous phenytoin for seizure control. Within 2-3hrs after administration of alteplase, patient's symptoms improved. The patient was transferred to the Medical Ward on day three. A repeat bedside transthoracic echocardiogram on day eight of admission showed no thrombus in the right ventricle. She was discharged the following day on oral rivaroxaban to be followed up by the Cardiology Team on out-patient basis.

## Discussion

Pulmonary embolism (PE) is a potentially life-threatening condition[2] that requires prompt recognition and management in the Emergency Department (ED). When a patient presents with symptoms suggestive of PE, the Emergency Department healthcare team must initiate a timely and systematic approach to ensure accurate diagnosis and appropriate treatment. Although CTPA is the gold standard for diagnosing PE, other alternate diagnostic tools such as clinical decision rules based on X-ray findings, patient-specific risk factors like Wells scores and Pulmonary Embolism Rule-out criteria, and D-dimer testing can be used[2]. The use of CTPA is also associated with risks such as exposure to ionizing radiation, the potential for injury from the injection of iodinated intravenous contrast agents and the possibility of nephrotoxicity[2]. Point-of-Care Ultrasound is a readily accessible and cost-effective imaging modality[6].

In the ED, emergency physicians utilize a diverse range of point-of-care ultrasound applications[5]. It helps with the rapid evaluation of the cardiopulmonary function of undifferentiated patients[7], enhances prompt diagnoses of conditions, provides guidance during resuscitation efforts, improves the success of procedures and minimizes complications[5]. Before the onset of POCUS, emergency physicians employed the conventional approach of placing a request for an ultrasound with Radiology and relying on the Radiologist who may not have the full clinical history of the patient to make the clinical interpretation of the results[8]. This often led to delays in conducting the imaging study, in the interpretation of the results and its transmission to the requesting doctor and ultimately the patient receiving definitive care[8].

Currently in the United States (US), POCUS training has been incorporated into the Emergency Medicine Residency programs and is often led by Emergency Ultrasound-trained Faculty aiming to create more leaders in POCUS education[5]. POCUS is now a standard part of Emergency Medicine training as established by the American College of Graduate Medical Education (ACGME) in 190 Emergency Medicine training programs and in the over 95 Emergency Medicine Ultrasonography Fellowship training programs across the US[8]. Additionally, other specialties like Internal



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Medicine, Paediatrics and Critical Care have also begun incorporating POCUS in their training[5]. In many under-resourced regions like Africa, POCUS is usually unavailable in the Emergency Room not to talk about training opportunities like Emergency Ultrasound (EUS) Fellowships in such settings[5]. Challenges such as the cost of the ultrasound machine, lack of training, lack of understanding of the imaging modality and sticking to the traditional way of clinical examination to arrive at a diagnosis exist[9]. In such resource-constrained settings, the establishment of traditional radiology faces numerous challenges, including the availability and maintenance of equipment, the need for trained staff and specialists to interpret imaging, and the associated costs[5]. These obstacles often hinder the development of a robust radiology infrastructure within the Emergency Department, limiting access to essential imaging modalities such as ultrasound services in some of these settings.

In this case report, the PE diagnosis was made via POCUS and this ultimately saved the patient from delays associated with imaging especially when she presented with atypical symptoms of PE such as seizures. Patients with PE often have variable presentations with common symptoms such as chest pain, syncope, palpitations, cough, breathlessness and hemoptysis with up to two-thirds of patients being asymptomatic[1]. Apart from the commonly observed symptoms of chest pain and breathlessness, about 5-8% of patients who present to the ED with pulmonary embolism also exhibit near or full syncope, experience new-onset seizures or convulsion-like activity, or display new-onset confusion[10]. Although our patient had a syncopal episode a month previously, she presented at the ED with recurrent seizures having had another one at a diagnostic facility just before coming to the ED. The use of POCUS in this patient revealed the following: thrombi in the right ventricle, an enlarged right ventricle with a flattened septum (D sign), poor cardiac contractility, and a plethoric Inferior Vena Cava which were all suggestive of PE.

Approximately 30-40% of patients with pulmonary embolism (PE) exhibit specific criteria indicating right ventricular (RV) overload such as the presence of a right-sided cardiac thrombus, a diastolic RV diameter greater than 30 mm, an RV-to-left ventricular (LV) diameter ratio exceeding 1, systolic flattening of the interventricular septum, acceleration time less than 90 ms, or a tricuspid regurgitation gradient higher than 30 mmHg, all of which demonstrate RV involvement in the absence of right ventricular hypertrophy (RVH)[1]. Massive pulmonary embolism (PE) manifests with hypotension, shock, or cardiac arrest. Patients experiencing right heart strain may exhibit electrocardiography (ECG) changes such as the S1Q3 pattern, S1Q3T3 pattern, notched S wave in lead V1, inverted T waves in V1-V4, and right bundle branch block[1]. Sinus tachycardia is thought to be the commonest ECG change in PE[3]. Additionally, T wave inversions are more common in patients with right ventricular dysfunction compared with the S1Q3T3 pattern which is thought not to be specific for PE[3]. In patients with suspected high-risk PE, POCUS can play a crucial role in distinguishing and prioritizing various causes that may lead to hemodynamic instability[1]. POCUS becomes particularly significant in determining the urgency of treatment by revealing RV overload and dysfunction, as well as the presence of right heart thrombi[1]. Our patient was haemodynamically unstable for transport to have the CTPA done outside the Hospital and therefore POCUS played a key role in providing a prompt diagnosis for the patient. The treatment for PE includes anticoagulation which can increase the risk of bleeding[2]. Our patient received intravenous Alteplase after going through the fibrinolytic checklist. She had mild gum bleeding the next day, which was self-limiting, and was attributed to the Alteplase. Clinicians must weigh the risks and benefits associated with thrombolysis in a PE patient.

In resource-limited settings where confirmatory diagnostics are expensive and not always readily available, POCUS becomes an indispensable tool in the clinical management of patients[5]. Emergency physicians trained in POCUS can integrate the findings from POCUS into the management plans of their patients especially because they have full knowledge of the case and its presentation[8]. The implementation of POCUS in resource-limited settings has the potential to significantly influence the clinical management of 50-70% of patients[5].

The growing adoption of POCUS in Emergency Departments has prompted accreditation bodies worldwide to incorporate POCUS training into their educational programs[5]. The International Federation for Emergency Medicine (IFEM) has developed a consensus document outlining a suggested framework for incorporating POCUS into emergency medicine training[11]. Despite the wide use of POCUS in high-income countries, emergency physicians in Africa are limited by various factors such as scarcity of portable ultrasound machines, lack of comprehensive training programs with rigorous standards and accreditation and limited availability of consumables such as gel[12]. It is worth noting that African countries with emergency medicine programs have reported educational initiatives in POCUS but training appears to vary greatly across, both within individual countries and across borders[12]. In Ghana, Emergency Medicine Residency commenced at the Komfo Anokye Teaching Hospital under the leadership of the Ghana College of Physicians and Surgeons and The Ghana Michigan Emergency Medicine Collaborative in 2009. POCUS training has been part of the curriculum since its inception.

With the commencement of another training site at the Emergency Department of the Korle Bu Teaching Hospital (KBTH) in 2022, emergency medicine residents have had POCUS training incorporated into their program as well. The involvement of external



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clinicians with Point-of-Care Ultrasound (POCUS) expertise in resource-limited settings has yielded significant advantages[5]. In KBTH, with support from external faculty, specifically, the Emergency Department of the University of Florida, an ultrasound curriculum has been developed to facilitate context specific POCUS training for emergency medicine residents which includes online lectures as well as in-person practical sessions. In resource-limited settings, numerous POCUS training strategies heavily depend on external expertise and often involves clinicians with extensive POCUS experience, which typically takes years to develop, or foreign Emergency Ultrasound Fellowship-trained faculty[5]. Sadly, in Ghana, and many other African countries there is no established emergency ultrasound fellowship in the emergency medicine residency programs. South Africa stands out as a notable exception, boasting five domestic programs dedicated to POCUS education which follows a curriculum of the Emergency Medicine Society of South Africa, accredited by the College of Emergency Medicine of South Africa[12].

The use of POCUS should not be limited only to emergency physicians and residents. All doctors working in the Emergency Department should have training in POCUS. A systematic review by Abrokwa *et al* focused on task shifting for POCUS in primary healthcare within low- and middle-income countries[6]. Task shifting involves delegating specific responsibilities from highly qualified healthcare professionals to those with shorter training and lower qualifications, aiming to optimize human resources[6,13]. The review found that in three studies assessing the focused abdominal sonography in trauma (FAST) exam, general physicians and non-physician clinicians, including medical students, clinical officers, and community health workers, successfully obtained high-quality ultrasound images and accurately interpreted the results with improvement in diagnostic accuracy following specialist feedback[6]. In another study, the utilization of non-radiologist clinicians for diagnostic breast ultrasound was shown to be both feasible and effective in developing trainees' knowledge and skills and these findings aligned with similar studies in the literature that demonstrate the positive outcomes of such practices[14]. Providing clinicians in the emergency room with Point-of-Care Ultrasound (POCUS) skills can result in prompt diagnosis, early interventions, reduced ED stay and ultimately improved patient outcomes.

## Conclusions

To enhance the utilization of Point-of-Care Ultrasound (POCUS) in under-resourced regions like Africa, it is recommended that an emergency ultrasound fellowship program is established as a subspecialty within the field of Emergency Medicine in countries with established residency programs. This initiative would focus on training Fellows who possess specialized expertise in POCUS. By doing so, Africa can cultivate a pool of fellowship-trained faculty in Emergency Ultrasound to educate and generate a greater number of physicians and Emergency Room doctors proficient in POCUS across different African countries. By providing ultrasound machines and imparting POCUS training to Emergency Room doctors in African countries, the potential arises for improved diagnostic accuracy in critically ill patients. Additionally, this approach will enable timely and essential interventions for such patients and can be instrumental in augmenting healthcare outcomes in under-resourced regions.

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# NONCIRRHOTIC PORTAL HYPERTENSION – A CASE REPORT ON A SEQUELA OF PORTAL VEIN CAVERNOMA

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## Abstract

***Introduction:*** Increased pressures in the portal vein (portal hypertension) which occurs following portal vein thrombosis, results in cavernous transformation of the portal vein. Though portal vein thrombosis (PVT) is a frequent complication in cirrhotic patients, it may also exist as a basic vascular condition without any liver damage. Among the predisposing factors for portal vein cavernoma are deficiencies in protein C, S & antithrombin III, antiphospholipid syndrome and mutations in factor V Leiden and JAK2. Determination of the aetiology aids in the management plan to not only relieve symptoms of the patient but also to treat the underlying cause. Gastroesophageal variceal bleeding, splenomegaly, portosystemic collaterals, and ultimately hematologic abnormalities are among the prominent clinical features.

***Case Presentation:*** We present a case of a 16-year-old male with portal vein cavernoma complicated by bleeding oesophageal varices presenting with a second episode of hematemesis and melena within a 10-year period. He underwent endoscopic variceal band ligation and was put on oral warfarin and propranolol. The patient was followed up once at the outpatient clinic after discharge without the laboratory investigations we requested due to financial constraints. He has since been lost to follow up.

***Conclusion:*** Bleeding oesophageal varices from noncirrhotic causes are common and a high index of suspicion is needed to make a diagnosis. Though investigations tailored towards identifying the underlying cause presents a challenge in a resource constrained setting like ours, management of complications and symptoms to reduce morbidity and mortality cannot be over-emphasized.

***Keywords:*** *Portal vein cavernoma, endoscopic variceal band ligation, esophagogastroduodenoscopy, anticoagulant*

## Introduction

Portal vein thrombosis (PVT) is an obstruction of the portal vein by a thrombus.[1] This leads to the creation of multiple collaterals to bypass this obstruction. Clinically, PVT may be acute or chronic, though symptoms and signs are different, one remains a sequela of the other.[2]

Local and systemic pathogenetic factors have been identified as possible causes of PVT. Infections (commonly umbilical cord sepsis), toxins, immunologic & prothrombotic tendencies, genetic disorders (low levels of protein C, protein S, and anti-thrombin III, increased VIII endothelial factor) are possible causes of portal vein thrombosis.[3] Prothrombotic[4] and local factors around the portal vein may lead to extrahepatic portal vein obstruction and thus portal hypertension.[5] PVT may be associated with liver cirrhosis but it can also be the result of other disorders, such as inherited thrombocytopaenia, malignancies, abdominal infections, or bowel diseases.[6]

Presentation of portal vein cavernoma varies from asymptomatic, yellowing of the sclera, abdominal mass, abdominal distension, recurrent torrential hematemesis and consequently symptoms of anaemia (dizziness, easy fatigue, palpitations).

Ultrasound is the initial screening modality in investigating PVT.[7] The absence of portal vein with presence of cavernoma formation which is seen as multiple tubular anechoic structures surrounding the porta to non-visualization of portal vein is diagnostic. However, colour doppler is considered superior as it demonstrate periportal collaterals, a recently formed anechoic thrombus and or reduced or absence of flow in the portal vein.[8] CT scan clearly depicts the cavernous transformation of the portal vein, presence of the intra and extrahepatic portions of the parabiliary and peribiliary plexuses, and gallbladder varices. Though not preferred because of radiation exposure, CT is also useful in providing additional information about the cause of portal vein obstruction and excluding neoplastic causes such as tumoral thrombosis.[9] MRI has replaced direct cholangiography as the imaging investigation of choice for PVC with direct cholangiography being reserved for interventional purposes.[8]

Patients with portal cavernoma usually present with upper gastrointestinal haemorrhage, a complication of the disease process. This requires emergency resuscitation with intravenous fluids(crystalloids and or colloids), intravenous octreotide[10] and gram negative intravenous antibiotic cover. Once haemodynamically stable, an upper GI endoscopy is performed to confirm the presence of oesophageal varices and ligate them. The

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ASGE and ESGE guidelines recommend the use of the Glasgow Blatchford score[11], pre-endoscopic Rockall score[12] or AIMS-65 score to prognosticate each patient. Preferably, all cases should have an oesophogastroduodenoscopy (OGD) done within 24 hours of admission to the emergency room, where either endoscopic sclerotherapy (EST) or endoscopic variceal band ligation (EVL) is performed.[13] Nonselective beta-blockers are used for secondary prophylaxis to reduce hepatic venous portal gradient by inducing splanchnic vasoconstriction and reducing cardiac output. Multiple systematic reviews and meta-analyses state that carvedilol is more effective in decreasing hepatic venous pressure than propranolol with fewer side effects.[14]

Anticoagulation initiation with unfractionated heparin or low molecular weight heparin (LMWH) is recommended for patients with portal vein cavernoma. This is followed by maintenance of anticoagulation with either LMWH or the vitamin K antagonist, warfarin, is the treatment of choice.[7] The use of direct oral anticoagulants (DOACs) has also proven to be a promising alternative to traditional anticoagulants in patients with PVT with or without cirrhosis. However, there is the need for further randomized controlled trials in this area.[15] Transjugular intrahepatic porto-systemic shunt (TIPSS) is considered for patients with variceal bleeding that cannot be controlled by medical and endoscopic treatment.[16]

## Cases Presentation

We report the case of a 16-year-old male who was referred to the emergency unit of the Eastern Regional Hospital as a case of anaemia secondary to upper gastrointestinal bleeding. He presented to the referral site with a second episode of haematemesis and melaena. The patient was resuscitated at the referring hospital and then sent to the Eastern Regional Hospital for further management. At presentation, he was symptomatic of anaemia (easy fatigability, palpitations) and complained of nonspecific abdominal pain but no jaundice. This was his second episode of hematemesis; the first had occurred 10 years prior. Following the first episode, OGD was performed, but neither he nor his relatives remember the findings. He did not have sickle cell disease, neither was he diabetic nor hypertensive. He had no history of umbilical cord sepsis or childhood exchange transfusion.

At the emergency unit, the patient was alert and not in distress. There was moderate conjunctival pallor, no icterus, and his temperature was 36.5˚C. Physical examination revealed a flat abdomen, no caput medusae. His liver span was normal(10cm) with massive splenomegaly (11cm) below the left costal margin. Both kidneys were not ballotable. Examination of other systems were essentially normal with BP101/50mmHg and pulse 100bpm. These signs raised a high suspicion for bleeding oesophageal varices from non-cirrhotic portal hypertension. For laboratory investigations haemoglobin was 7.6gdL$^{-1}$; MCV 76.5fL MCH 26.7 HCT 45; Platelets 52x10$^{9}$, white cell count and its differentials were all normal. Likewise renal function test, liver panel and clotting profile was also all normal. The HB electrophoresis of our patient is AS and G6PD test showed no defect. An abdominopelvic ultrasound scan revealed non-visualization of portal vein with multiple periportal collaterals and massive splenomegaly which is suggestive of cavernous transformation of portal vein was seen on abdominal ultrasound. Both Pre-endoscopic Rockall score and AIMS-65 score were 0 pts which means 0.2% mortality risk and 0.3% in-hospital mortality respectively. However, his Glasgow-Blatchford score was 8 pts which placed him at a high risk of GI bleed.

He was transfused with a unit of packed cells and an upper gastrointestinal endoscopy was performed. Multiple columns of grade III oesophageal varices were seen and 8 bands were deployed to ligate these varices with a recommendation of repeat band ligation in 6 weeks. Liver biopsy has long been regarded as the gold standard to diagnose cirrhosis. However, there exists the problem of sampling error and interobserver variability. Cirrhosis can still be diagnosed in the absence of liver biopsy. An APRI score of greater than 2 strongly suggests cirrhosis. As does a Bonacini cirrhosis discriminant score of greater than 7. In the case of our patient, his APRI score was 1.4, and his Bonacini discriminant score was 6. Coupled with this was the ultrasound findings that did not suggest cirrhotic changes. The patient and his relatives were thus, counselled on the condition and need to do the requested laboratory investigations which included antithrombin III, protein C and protein S deficiencies, mutations in JAK2 and factor V Leiden however they could not do them due to financial constraints. He was put on anticoagulation therapy with a possible surgical intervention (Transjugular intrahepatic portosystemic shunt) if need be. With an initial INR of 1.2, he was started on propranolol, warfarin 2mg, ferrous iron haematinics on day 5 of admission and discharged home to see the gastroenterologist for review with a repeat international normalized ratio.

## Discussion

Portal hypertension is not always from a hepatic pathology but can also be from non-cirrhotic causes which are often underdiagnosed.[7] Neonatal events (prematurity) have been implicated as a cause of PVT. This is similar to what was found in Egyptian children but contrary to our case, he had no known perinatal attributable risk factors.[17] Splenomegaly followed by thrombocytopaenia, hepatomegaly and sarcopenia are the most common features.[7] We similarly identified thrombocytopaenia and massive splenomegaly in our patient. Upper gastrointestinal bleeding is one of the commonest presentations of portal hypertension. It may spontaneously stop but rebleeding is common as was seen in our patient.[18] Emergency resuscitation with intravenous fluids and vasoactive agents should be

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instituted to raise the haemoglobin while monitoring vital signs closely. Excessive resuscitation should be avoided because of the risk of rebound portal hypertension and rebleeding.[19] Whilst correcting anaemia, an attempt to control bleeding is instituted pharmacologically and endoscopically. Pharmacological agents such as somatostatin analogues help to reduce bleeding by reducing splanchnic blood flow.[20] The use of tranexamic acid, which acts by inhibiting fibrinolysis by inhibiting the action of plasmin, in acute gastrointestinal bleeding has shown not to reduce mortality but is rather linked with unwanted blood clots and seizures.[21] To prevent bacterial translocation across the gut wall, patients with suspected or confirmed variceal bleeding may be placed on prophylactic gram negative antibiotic treatment[22] however, antibiotics were not administered to our patient. As soon as our patient was haemodynamically stable, we performed an upper gastrointestinal endoscopy to confirm our suspicion of variceal bleeding and ligate oesophageal varices. Besides variceal band ligation, endoscopic sclerotherapy with ethanol can be used albeit an inferior option.[23]

Post endoscopy, our patient was counselled on his diagnosis and put on a nonselective beta-blocker to reduce hepatic venous pressure gradient by decreasing cardiac output (beta1-receptor antagonism) and inducing splanchnic vasoconstriction (beta 2- receptor antagonism). The expected aim would be reduction in the portal pressures.[24] Other patients have received carvedilol and it was found to be more efficient in decreasing hepatic portal vein pressure gradient with less drug adverse effects.[14] He was also put on warfarin to prevent further thrombi from developing in the future while the specific cause of his diagnosis is investigated.[15] Several mandatory labs like mutations in factor V Leiden and JAK2 that are required for investigating portal cavernoma are unavailable in Ghana others deficiencies in protein C,S and antithrombin III which were initially being run at the time of patient presenting were not being run in Ghana. However, patients' samples are often sent to South Africa, at a high cost to the patient.

## Conclusions

Bleeding oesophageal varices secondary to portal hypertension from either cirrhotic causes or otherwise is not uncommon however there presents a challenge in investigating and diagnosing noncirrhotic causes like PVT in resource constrained setting. That notwithstanding managing complications and symptoms should be done to reduce morbidity and mortality.

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# PROPELLER FLAP: A FEASIBLE FLAP FOR DISTAL THIRD OF LEG DEFECTS – TWO CASES DONE AT THE PLASTIC SURGERY UNIT OF THE GREATER ACCRA REGIONAL HOSPITAL

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## Abstract

***Introduction:*** The traditional way of reconstructing soft tissue defects of the lower limb utilized muscle flaps as the 'gold standard' for Gustillo Anderson Grade III B fractures of the upper and middle thirds of the leg. Defects of the lower third of the leg are usually reconstructed with free flaps because of paucity and decreased reach of muscles. In resource constrained environments where free flaps are not routine with high failure rates, fasciocuataneous flaps are the only option left. We present our experience with the novel pedicled propeller perforator flaps for reconstruction of soft tissue defects in the lower limb.

***Case Presentation:*** Between June and October 2020, 2 consecutive patients - a 34-year-old male and a 51-year-old female, were referred for cover for their distal leg defects from the Orthopedics and trauma Unit. All patients were operated on under spinal anaesthesia. Perforators from posterior tibial and peroneal arteries respectively, were identified pre-operatively with hand-held doppler and the propeller-pattern skin paddle was designed around the perforator closest to defect.

After elevation of flaps and skeletonization of perforators, they were then rotated (180 degrees) and inset into defects. Case 1 had whole flap (104 $cm^2$) surviving with only minor marginal epidemiolysis at tip whilst the second flap (58.5$cm^2$) had necrosis of only the business end of the flap but subsequently healed by secondary intention after serial dressings. Both had secondary defects proximally after the rotation, which were skin grafted with 100% take.

***Conclusion:*** Propeller flap in our experience, is a feasible versatile option for reconstruction of soft tissue defects in the distal third of the leg.

***Keywords:*** *propeller flap, perforators, distal third of leg*

## Introduction

To the plastic and orthopaedic surgeon management of soft tissue loss of the distal third of the leg can be very challenging especially to those in Low- and Middle-Income countries where equipment for complex free flap reconstruction are largely unavailable. The subcutaneous nature of the tibia with the concomitant poor vascularity and attendant paucity of the muscle cover in lower third of the leg results in bone exposure whenever fractures occur in that part of the body.

The traditional way of reconstructing soft tissue defects of the lower limb utilized muscle flaps has the 'gold standard' for Gustillo Anderson Grade III B fractures of the proximal two-thirds of the leg. Defects in the distal third of the leg ("no man's land') are elsewhere reconstructed with free flaps which require fenese in microsurgery and availability of operating microscope. In resource constraint environments such as ours, free flaps are done only occasionally and because of that failure rates are high and so is not a viable option for such defects. Currently in our environment, reverse sural flap (unreliable), cross leg flaps (cumbersome) and local distally based transposition fasciocutaneous flaps – which maybe in the trauma zone and hence unreliable or unavailable have been used. The use of these fasciocutaneous flaps minimize morbidity from muscle inclusion into the flap. The perforasome concept by Saint-Cyr et al.[1](2009) popularized the use of free and pedicled perforator flaps based on perforators which are tiny connecting vessels from major source vessels to the skin and other intervening structures. The propeller flap is a perforator flap which has been raised and rotated 90 or 180 degrees into a defect for cover.

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## Cases Presentation

Two patients with distal third of leg defects were referred to the Plastic Surgery and Burns Unit of the Greater Accra Regional Hospital between June and October 2020, having been seen earlier by the Orthopeadics and Trauma Unit of the same hospital. Case 1 was a 34-year-old man, two weeks post fall from a height with Gustillo 3B opened fracture just above the medial malleolus (figure 1). Figure 2 and 3 shows intraoperative pictures and figure 5, post-operative picture with flap in place and consolidated skin graft proximally. Case 2, a 51-year-old woman with chronic osteomyelitis and ankylosed ankle joint who had had sequestrectomy with non-healing ulcer in the area of the lateral malleolus. Perforators from posterior tibial and peroneal arteries respectively, were identified pre-operatively with a 4-Hz hand-held doppler, and a propeller flap was designed around the identified



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perforator closest to defect. Intra-operatively the flap was designed with the length of the proximal limb (distance from perforator to the proximal tip) being equal to the remaining length of the of the flap plus the transverse length of the defect. Then, under spinal anaesthesia and tourniquet, an exploratory incision (Fig. 2) was made on one side of designed flaps down into subfascial plane to look for perforators. After identifying perforator of the right size in the right location (closest to defect), the whole marked flap was raised, care being taken to preserve the skeletonized perforator. Flaps were then rotated (180 degrees) and inset into defects care been taken not to put undue traction on pedicle. Table 1 gives the summary of the salient aspects of the two cases and the complications seen post-op.

**Table 1 – Intra-operative findings and post-operative complications**

| | Case 1 | Case 2 |
|---|---|---|
| Size of defect | 4.5 x 5 cm | 3 x 3 cm |
| Location of defect | Medial malleolus | Lateral malleolus |
| Perforator source | Posterior tibial artery | Peroneal artery |
| Perforator location from proximal margin of defect | 5cm | 4.5 cm |
| Type of perforator | musculocutaneous | musculocutaneous |
| Total Flap size/Area | 16 x 6.5(104cm$^2$) | 13 x 4.5(58.5cm$^2$) |
| Proximal limb length | 10 | 8 cm |
| Management of Secondary defect | Split Skin Grafting | Split Skin Grafting |
| Complications | Marginal epidermiolysis | Congestion, Wound infection, tip necrosis |

***Figure 1: Open tibial fracture distal third of leg***

***Figure 2: Flap marked out with pivot point (dotted)***

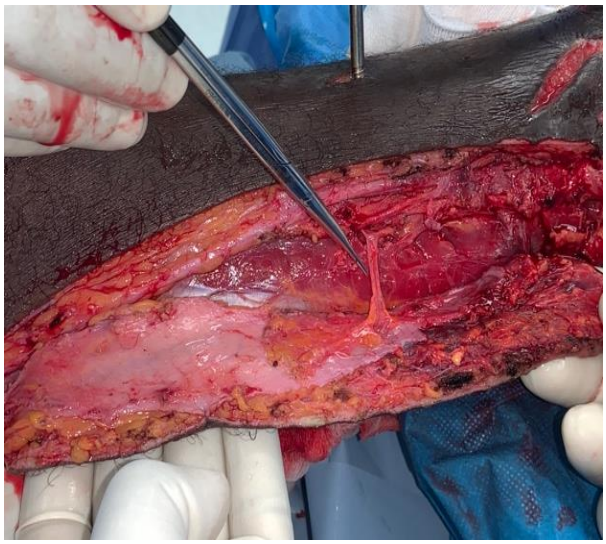

***Figure 3: Flap raised with perforator skeletonized***

***Figure 4: Flap inset after 180$^0$ rotation, shown with arrow***



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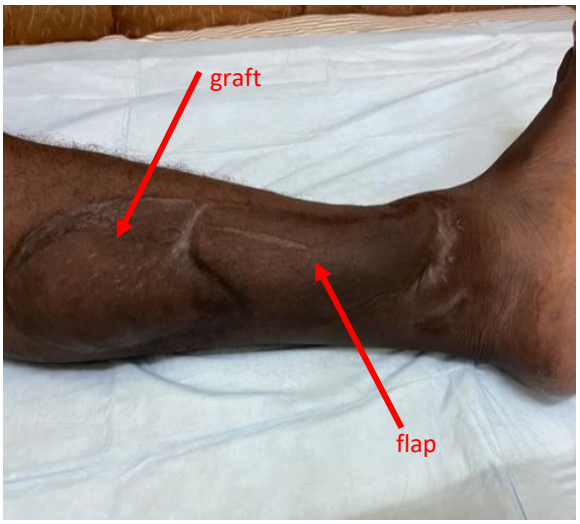


***Figure 5: 2-years post operative with flap and Graft consolidated***

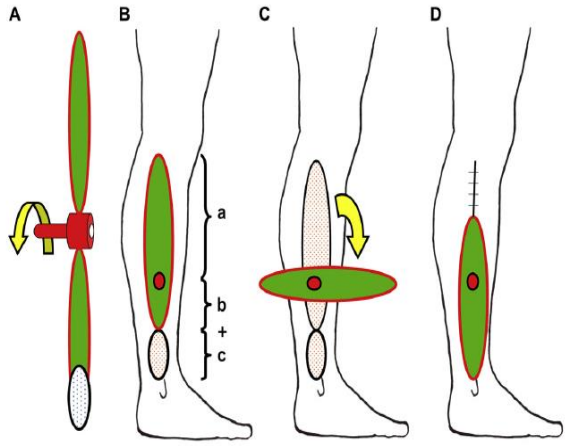


***Figure 6: Pictorial illustration of propeller flap concept (curled from Dr Teo's article)[8]***

## Discussion

The propeller perforator flap is useful addition to the armamentarium of plastic surgeons, especially in the local reconstruction of the lower leg. Arguably, the era of perforator flaps begun in 1989 when Koshima and Soeda published the survival of paraumbilical skin and subcutaneous fat based on islanded muscular perforator, used to reconstruct a groin and a tongue defect post tumour excision.[2]

It was Hyakusoku and colleagues who advanced the concept of propeller flaps with their raising of adipocutaneous flap based on a subcutaneous perforator, in which the flap was designed like the blades of the propeller of an aeroplane.[3] The propeller flap so described was made of two portions with the pedicle or perforator as the pivot point. The two portions of the skin paddle can rotate around the pedicle, like the propeller blades around the hub, from 90 to 180 degrees as required, taking care not to kink the pedicle. Hallock defines a perforator as any vessel that enters the superficial plane through a defined opening in the deep fascia.[4] Perforators on their way from source vessels to supply superficial structures including skin may travel directly (Direct perforators) made traverse different structures (In direct perforators).

The in direct perforators may either pass through muscle or the intermuscular septum and are named accordingly, i.e., muscular and septal perforators respectively. The "Gent" consensus meeting on perforator vessels and perforator flaps grouped perforators into 5 different types.[5] With the increasing popularity of the propeller flap concept the first consensus meeting was held in Tokyo in 2009, it was classified based on:

1. the nourishing vessel (3 types: subcutaneous pedicled-, perforator pedicled - and supercharged propeller flap)
2. the degrees of skin island rotation (90 to 180 degrees) and,
3. when possible, the artery of origin of the perforator.[6]

Other factors used in their classification is the shape of flap and position of nourishing vessel.[6] In 2020, Pignatti et al. added two new subtypes based on the nourishing vessel in their comprehensive classification of propeller flaps (Table 2).[7] These are the muscle and chimeric propeller flap. At the inception, propeller flap was applied only to a skin island vascularized only by an isolated perforator, but with this new classification, the term has been expanded to include other tissues like muscle which can also be raised in a propeller fashion and rotated into defects.

A detailed knowledge of this vascular anatomy of skin perforators is required for successful flap elevation. In the lower limbs, the popliteal artery, which is a continuation of the common femoral artery after it pierces the adductor hiatus, gives of a number of branches around the knee joint and then trifurcates into – peroneal, anterior and posterior tibia arteries which supply the leg and foot.

They give off perforators to the skin along their course. At the ankle, the anterior tibial artery becomes the dorsalis pedis artery which, along with the terminal branches of the posterior tibial and peroneal arteries, supplies the ankle and foot. Saint Cyr et al. have identified 93 perforators from 21 vascular territories that supply the integument of the extremities with an average diameter and area supplied by a single perforator been approximately 0.7 mm and 47 $cm^2$ respectively.[1]

Perforator flaps and by extension propeller flaps can be raised based on all these identified perforators. The advantages include a much quicker procedure which can be performed with basic instrumentation.[8] This comes in handy to any plastic surgeon who may be working alone or in resource constraint areas without access to sophisticated microsurgical equipment.



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**Table 2 – New comprehensive classification of propeller flaps**

| Flap type | Pedicle | Rotation | Vessel of origin | Dissection technique | Details | Examples |
|---|---|---|---|---|---|---|
| 1.Subcutaneous pedicled propeller flap | Random (perforator not visualized) | Up to 90 degrees | Not known | Macroscopic | The first defined as propeller | Elbow in burns (first described) Lotus flap1 |
| 2.Perforator pedicled propeller flap | Dissected perforator | Up to 180 degrees | Plausible or visualized | Magnification needed | The one mostly used | Propellers of the leg |
| 2a. Supercharged perforator pedicled propeller flap | Dissected perforator + extra vein or artery | Up to 180 degrees | Known (constant)/visualized | Magnification needed + Microsurgical anastomosis | In case of congestion (venous anastomosis) or for larger flaps (artery / vein_) | Trunk, limbs |
| 3. Axial pedicled propeller flaps | Known axial vessel | Up to 180 degrees | Known (constant)/visualized | Magnification needed | Evolution of axial flaps | Lingual artery propeller |
| 4. Muscle propeller flaps | Main vessel or branch to the muscle | Up to 180 degrees | Known (constant)/visualized | Magnification advisable | Evolution of muscular flaps | Trapezius muscle propeller |
| 5. Chimeric propeller flaps | Vessel to the first tissue + dissected perforator | 180 degrees + 180 degrees | Known + visualized | Magnification needed | Bone or muscle flap + perforator pedicled propeller | Razor flap |

***Design of the flap***

Dr Tiew Chong Teo, an authority on propeller flaps who wrote the paper "The Propeller Flap Concept." who as at the year 2010 had performed 130 propeller flap surgeries with only 3 cases of total flap loss, describes explicitly the design and raising of propeller flaps in his article.[8] The process starts with locating the best perforator in the vicinity of the defect with a handheld doppler and provisionally design the flap about the perforator as pivot. The distance between the perforator and the distal limit of the defect is measured (In Fig. 6 =b + c). This distance is then projected proximal to the perforator to mark the proximal extent of the flap (In Fig. 6= a; a=b+c). According to Dr Teo, 1cm and 0.5cm may be added to length and width to cover for retraction and avoid tension on closure.[8] It is also recommended not to exceed proximal limb length of 15cm to decrease incidence of tip necrosis.

***Some hints on Raising the Propeller Flap***

The flaps can be raised under tourniquet exsanguination but retaining some blood in the perforator vessels to allow for easier identification during exploration. The perforators in the vicinity are located through an initial exploratory incision, which can be suprafascial or subfascial.[8] Beginners are advised to use the latter approach which is easier and safer in terms of vessel visualization. Dr Teo advises avoiding perforators encased in scar tissue because of difficulty of dissection and also perforators at a distance from defect to avoid unnecessarily long flaps which are prone to tip necrosis. If the final pedicle chosen may differ from the one located by pre-operative doppler then the flap should be redesigned using it as pivot point. The chosen perforator should be carefully prepared and cleared of all muscular side branches for at least 2 cm to decrease kinking on rotation.[8] The relatively low-pressure venae comitantes are more susceptible to extrinsic compression during flap rotation. Dr Teo recommends release of tourniquet before rotation and allowing flap some time to perfuse and relax any spasm of vessel. The rotation direction which gives the least degrees of rotation is chosen, with a maximum allowable rotation of 180 degrees.[3,8]

Once the preferred rotation direction is determined and carried out, flap is initially secured with some stay sutures on either side of the transverse axis of the pedicle to ensure no traction on it during inset. The inset can be done with a drain underneath flap based on judgement of surgeon.

The donor defect can be closed primarily if there is no excessive tension or otherwise skin grafted in other to avoid torniquet effect. In summary the steps for raising a propeller flap are:

1. Pre-operative evaluation of perforators
2. Identification of perforators and selection
3. Designing the flap
4. Flap elevation
5. Dissection of perforator
6. Rotation/ Insetting

***Indications / reach***

Apart from the lower limbs, it can be used anywhere on the body as long as a near-by perforator is identified, and surrounding anatomy allows for its design. It can be applied for defects on any part of the leg but especially useful for distal third of leg and ankle defects. Can reach as far as defects of the lateral calcaneus.[8]



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***Complications***

Propeller flaps share same complications as other flaps. Venous congestion is the most common complication because of veins are at more risk of kinking on rotation.[9] This may also be due to inadequate flow in perforator vessel because of poor vessel selection or inadequate dissection. Partial necrosis occurs in 5% of cases and is usually restricted to skin.[10] This can be managed by debridement and skin grafting or allowing to heal by secondary intention. Total necrosis is rare but can occur in inexperienced hands.[9]

## Conclusions

Propeller flap surgery is a feasible alternative to free flap surgery especially useful in the armamentarium of a plastic surgeon in the developing world. It is straight forward with a low learning curve, quick to do and allows for reconstruction with local tissue with minimal donor site morbidity when traditional flaps are not an option. Finally, it presents several advantages over traditional pedicled/transposition flaps. We recommend that since on the legs it is a fasciocutaneous flap and it's a well-known fact that these fasciocutaneous flaps are not robust for infected beds, it should be used with caution in the setting of infection.

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# FROM THE PAST

## KWASHIORKOR

and

## Dr. Cicely Delphine Williams

Cicely Williams

Cicely Williams with severely malnourished child

Children suffering from Kwashiorkor

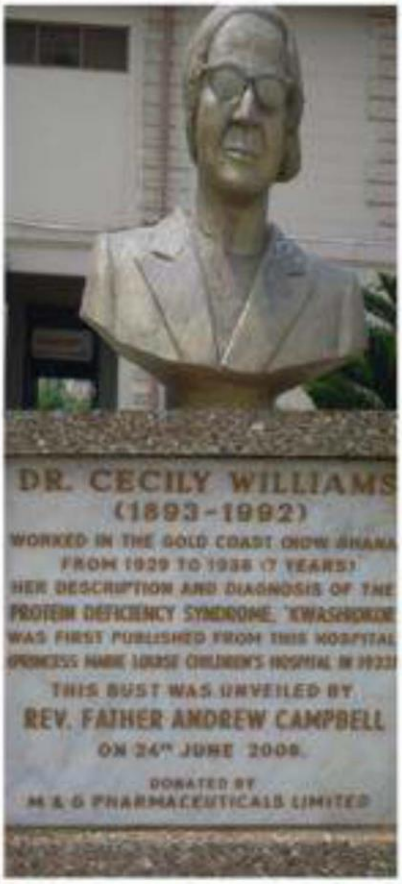
Princess Marie Louis Hospital (PML), where Dr. Williams first described Kwashiorkor

Dr. Cicely Williams was a Jamaican national who worked in the Gold Coast from 1929-1936.

She was the first woman to be appointed in the British Colonial Medical Service to be sent to Gold Coast (now Ghana).

Dr. Williams' most important work in the Gold Coast was her diagnosis of the common and often fatal condition **Kwashiorkor**. She learned that "Kwashiorkor" meant the sickness the older child gets when the next baby is born. This seemed to indicate that, when they were no longer breast-fed, children were not receiving enough to eat. Dr. Cicely Williams discovered that the medical symptom of swollen bellies, diarrhoea, and vomiting was protein-calorie malnutrition. The cure for kwashiorkor was therefore education on children's nutritional needs. She quickly published her diagnosis of kwashiorkor as a protein deficiency disease, which attracted the attention of the medical world.

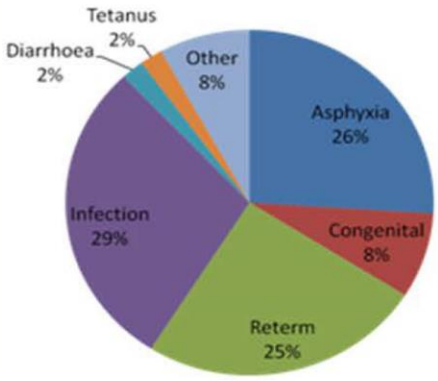
The first description and diagnoses of the protein deficiency syndrome "Kwashiorkor" was first published from the Princess Marie Louis Children's Hospital.



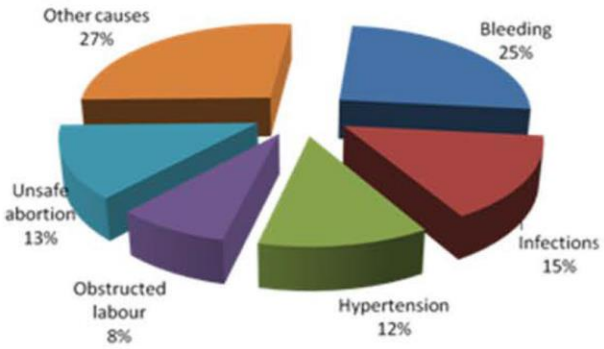

Due to her efforts in the hospital a sculpture of her was mounted in the hospital in memory of her. (Above)

# INFANT/ MATERNAL MORTALITY

**Estimated causes of Neonatal Deaths in 2000**




**Causes of maternal mortality in Ghana**




Because of African exclusion from the medical services, problems of maternal and child health in Africans were ignored by the Medical Department until 1915 when Dr. F. V. Nanka-Bruce gave prominence to the need for the proper training of African midwives and the construction of a properly equipped maternity hospital to reduce the high loss of lives among mothers and babies.

Governor Clifford appointed a committee to enquire into the causes of maternal and infant mortality but was unable to do much about the committees recommendations because of the First World War.

Governor Guggisberg appointed another committee in 1920 to consider the construction of a maternity hospital and training centre for midwives. In keeping with the committees recommendations the construction of a maternity block in Korle Bu was commenced in 1924, and the foundation stone of a children's hospital laid by Princess Marie Louis in 1925.

During the period 1998 to 2003 infant mortality rate rose from 57 per 1000 live births to 64 per 1000 live births. It has dropped to 50 (2008).

Maternal mortality ratio in Ghana is estimated at between 256 and 540 per 100,000 live births with a lifetime risk of 1 in 35.

# RURAL HEALTH:
# FROM DISEASE ERADICATION TO MEDICAL FIELD UNITS

During the 1930`s, reported rates of trypanosomiasis (Sleeping sickness) and yaws increased. Along with malaria, yaws was considered to be one of the biggest contributors to ill health in the country, with the heaviest burden in the north but a significant burden everywhere. In Accra, Cape Coast, Sekondi and Kumasi, 30% of children reporting to infant welfare centres had yaws. In 1937,the government undertook a trypanosomiasis control programme and 1944 a yaws eradication campaign was launched. Both campaigns where enormously successful in reducing the incidence of disease.

Governor Burns advocated for the continuation of medical services to rural areas as the eradication campaigns reached an end. He assigned personnel from the eradication campaigns to medical field units and arranged for them to receive additional training in the identification of several common diseases and pathogens in rural areas (such as malaria, guinea worm, bilharzias, leprosy) as well as training in basic vaccination and laboratory work. Headquarters was at Kintampo, centrally located for rural outreach work. Drs. Waddy and Saunders provided the leadership for the organization and development of the Medical Field Units.

Doctors such as Dr. Akiwumi, M.A. Barnor, and Frank Grant undertook groundbreaking medical research based out of the Medical Field Units, including the gathering of data on bilharzias, onchocerciasis, and guinea worm.

# PMJG Editorial Policy

## About

The Postgraduate Medical Journal of Ghana (PMJG) is a medical science journal published, twice a year by the Ghana College of Physicians and Surgeons (GCPS). The first issue is released in March and the second in September. The scope of the journal is centred on the specialities of the faculties of the GCPS. Broadly captured under the divisions of Physicians and Surgeons, these faculties include but are not limited to Laboratory Medicine, Paediatrics and Child Health, Psychiatry, Anaesthesia, Otorhinolaryngology, Orthopaedics and Trauma etc (visit ***www.gcps.edu.gh*** for the full list of specialties). Original research articles, case studies and special articles on any of the specialties of the GCPS are welcome for submission.

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**Manuscripts must be submitted via registered account at journal.gcps.edu.gh.**

All manuscripts are subject to peer review and are received with the explicit understanding that they are not under simultaneous consideration for publication in any other journal. This fact must be clearly stated in the cover letter.

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All submissions should be accompanied by a cover letter which must include statements on the following points:

1. All authors have made significant contributions to the methods and findings in the paper.
2. All authors have read and approved the final draft.
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4. The work has not already been published and has not been submitted simultaneously to any other journal.
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The order of the text should be as follows: **title page**, **abstract** (structured) of no more than 250 words with 2-8 key words (MeSH terms) at the bottom. The main text must be divided into the following sections: **introduction**, **subjects (or materials) and methods**, **results**, **discussion**, **conclusion**, **acknowledgements**, **references**, **tables**, **legends to figures** and **figures**. Each section should begin on a new page and all pages must be numbered consecutively, beginning with the title page.

***Title Page***: The first page should include the title, names of authors, centre where the work was carried out and a short running title. The full postal address of the corresponding author, with postal code, phone numbers, fax numbers and e-mail address must also be provided on the title page.

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high quality and submitted in three original copies. A size of 235 x 264 mm is advised and the figure number should appear on the back of each, together with an arrow indicating the top edge. For photomicrographs, details of stains and a scale bar should be provided. Where patient's identity is not concealed in a photograph, a written consent from the patient must be submitted.

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***Abbreviations***: Abbreviations should be defined on first use and then applied consistently subsequently. Non-standard abbreviations or those used less than three times in the text are not permitted.

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***Trade Names***: Non-proprietary (generic) names of products should be used. If a brand name for a drug is used, the British or International nonproprietary (approved) name should be given. The source of any new or experimental preparation should also be given.

***References:*** References should be limited to those relating directly to contents of the paper. References should be cited in sequence and numbered by Arabic numerals in superscript. The list of references at the end of the article should be numbered in the order in which they appear in the text. They should give the names and initials of **all** authors; in cases where the number of authors exceed **5**, the abbreviation "*et al"* should be used to represent remaining authors after the fifth is cited. The authors' names must be followed by the title of the article, the title of the journal, abbreviated in the style of the Index Medicus, the year of publication, the volume number and the first and last page numbers. References of books should give the title of the book, followed by the place of publication, the year and the relevant pages. References for websites should state the name of author(s), title of article, website publisher, date of publication and the URL to the article.

**EXAMPLES**

***Article***

McLendon WW. A historical perspective as a compass for the future of Pathology. *Arch Pathol Lab Med* 1986; 110: 284-288.

***Book***

Talbot CH. Medicine in Medieval England. Oldbourne, London. 1926 p 120-136.

***Book Chapter***

Philips SJ, Whisnan JP. Hypertension and stroke. In: Laragh JH, Bremner BM, editors, Hypertension: pathophysiology, diagnosis and management. 2nd Ed. New York: Raven Press, 1995, p465-478.

***Website references***

Doe J, Phils MR. A client's guide to rational emotive behaviour therapy. Conseil. 2017: https://www.conseil.com/

Special identification items like digital object identifiers (DOI) will be allowed inclusion to end text references, aside this, all references should be arranged as stated in the instructions.

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The PMJG will peer review all the material it receives. Manuscripts will be reviewed by external referees when it is deemed necessary. In studies that contain quantitative data and statistical inferences, the Editor may request that a statistician reviews them. For studies based on questionnaires, authors are required to attach the questionnaire to the manuscript, in order to facilitate the review process.

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