

Review on the Reliability of Medical Contents on YouTube

<https://doi.org/10.3991/ijoe.v16i01.11558>

Hilary I. Okagbue (✉), Pelumi E. Oguntunde, Sheila A. Bishop
Covenant University, Ota, Nigeria
hilary.okagbue@covenantuniversity.edu.ng

Emmanuela C. M. Obasi
Federal University, Otuoke, Nigeria

Abiodun A. Opanuga, Opeyemi P. Ogundile
Covenant University, Canaanland, Nigeria

Abstract—Social media and YouTube, in particular, has become an avenue for quick dissemination of information. Patients now search the YouTube website for information on diseases, treatment options, surgery, and general health information. This paper reviews the different reliability methods, results, conclusions and recommendations of contributions on the medical videos on YouTube. A keyword search was done on different databases such as PubMed, Scopus, Web of Science and Google Scholar to generate articles related to the subject matter. No eligibility criteria were defined because the research is partly systematic. Descriptive statistics were used to present the information obtained from the analysis of the previously published papers in this context. The results are as follows: (i). DISCERN, JAMAS and GQS are the most frequent assessment tools used by authors in the determination of the reliability of medical videos on YouTube. (ii). 60% of the independent reviewers that assessed the reliability of the YouTube videos are often two in number. (iii). 65% of the articles concluded that medical videos on YouTube contain misleading information. (iv). User engagements for low and high-quality videos are 58% and 42% respectively. (v). 36.3 % of the total videos were uploaded by trusted sources such as medical and health professionals from recognized or prestigious hospitals, while 63.7% were uploaded by other sources whose affiliations cannot be independently verified. (vi). Out of the total 2675 medical videos assessed, 1589 (59%) are categorized as having useful contents that can influence positively on patient education while 1086 (41%) are categorized as misleading and (vii). Only 35% of the papers strongly recommended that medical videos on YouTube are useful and can be a good source of patient education. Awareness is needed to educate patients on the benefits and dangers of assessing medical videos on YouTube. Videos uploaded by authentic medical personnel or organizations are strongly recommended.

Keywords—YouTube; patient education; statistics; DISCERN; GQS; JAMA criteria, user engagement, social media.

1 Introduction

Social media provides an adequate platform for social interaction and cross-pollination of ideas between people across different places, cultures, religions, races and time zones. Social media is an agent of globalization that has led to the collapse of conventional boundaries that hitherto restricts the transmission of ideas among people and organizations. Social media is usually web-based which permits the creation of web networks and endorsement or disapproval of the users' content shared or uploaded on social media websites. Some of the most popular social media websites are YouTube, Facebook, Twitter, Instagram, Snapchat, Viber and others. YouTube is a video-sharing website designed to facilitate uploading and sharing of video and related contents between authorized users and others. Individuals or organizations can use YouTube to grow audiences. Sharing, likes, dislikes, and comments on the uploaded user contents are the defining characteristics of YouTube.

Bibliometric YouTube is not only used in connecting friends, family members, colleagues, and friends, it is used as a tool for patient education. YouTube is sometimes used to educate patients that are undergoing treatment or being diagnosed with some identified diseases [1-5]. YouTube can be used to share videos from peer-reviewed content on websites to the general public [1].

Arguments for and against the quality of videos uploaded for medical contents are the motivation behind this review paper. The literature is saturated with authors voicing their opinions based on their findings [2]. This paper creates a pattern of the issue by quantitatively and qualitatively assessing the research findings on this issue and come to a conclusion that will educate the readers on the level of quality of medical contents available on the YouTube website.

2 Materials and Methods

A thorough search was made and articles on the use of YouTube for patient education were obtained. A keyword search was done on different databases such as PubMed, Scopus, and Web of Science to generate articles related to the subject matter.

The following eligibility criteria were applied:

- The latest 100 articles on PubMed, Scopus, and Web of Science were selected based on the following query terms; “the use of YouTube for patient education” OR “YouTube for medical information” OR “YouTube for patients information” OR “Assessing medical information via YouTube” OR “the use of YouTube for assessing patients information”
- The authors limited the search to the newest research on the area, hence, purposive sampling was adopted. The search was carried out on the databases between April 25 and 30, 2019
- Editorial notes and conference papers were excluded
- Only articles published in English were included

- The papers reduced to the final seventy-four articles after redundant and duplicate articles from the databases were excluded
- The abstract analysis was used to obtain the data for the recommendation aspect of this paper

Thematic analysis and descriptive statistics were used to present the information obtained from the analysis of the previously published papers in this context. Descriptive statistics were used to present the findings.

3 Assessment of the Quality of Videos

Several authors have reported different results on the assessment of the reliability of medical videos available online at the YouTube website [3-45]. The articles were published to assess the quality of medical contents on YouTube for different diseases such as prostate cancer, infantile spasm, surgery methods and others [3-45]. The results are mixed as the videos were obtained systematically using search queries. The videos are further scrutinized using some predefined inclusion or eligibility criteria, which now becomes the sample size. Thereafter, the educational quality of the video is assessed using different methods. In addition, the technical quality of the videos can be used to supplement the educational quality assessment tools.

Different quality assessment tools are available and have been applied in this context. These tools are used to categorize videos that contain useful or misleading information. They are as follows: DISCERN, Journal of American Medical Association (JAMAS) benchmark criteria, Global Quality Scores (GQS), Arrhythmia Alliance, 14 point criteria, customized scoring-system (CSS), FA-DQS, category by topics, predetermined criteria, usefulness score 0-10, Suitability Assessment of Materials (SAM) and others.

It appears that DISCERN, JAMAS, GQS are the most frequent assessment tools used by authors in the determination of the reliability of medical videos on YouTube. A look at the 23 articles that provided information on assessment tools, DISCERN, JAMAS, GQS, CSS, and OTHERS was used in 7, 4, 6, 3 and 14 articles respectively as shown in Figure 1.

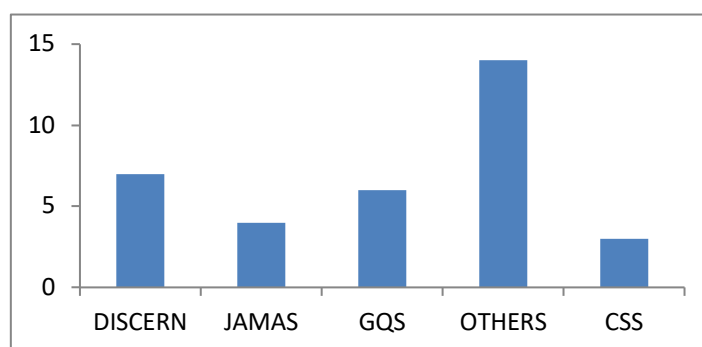


Fig. 1. The Frequency of the Assessment tools used by the Researchers

DISCERN Tool: This was used in [3-6], [10], [12] and [15]. It is an online assessment tool used in evaluating the quality of online medical information. It is a 16-item questionnaire, of which information about the perceived quality and reliability of videos can be assessed and scored.

JAMAS: This was used in [6], [15], [33] and [45]. It was created in 1997 and contains a set of criteria of medical information which can be effectively assessed.

GQS: This was used in [6], [12], [22], [24], [26] and [41]. It is the aggregate score of the assessment of online content based on relevance, popularity and reputation and user engagement.

3.1 Independent Assessors of the Sampled Videos

Most often as seen in [6], [8-16], [21-23], [25], [30-32], [34], [37-38], [40], [42] and [43], more than one assessor or expert in that area are used to independently assess the quality of the videos. A third assessor may be recruited where there is the existence of ties as seen in [21-22]. Statistical tools such as the intraclass correlation coefficient are usually used to determine the degree of agreement or otherwise of the assessors. Out of the 23 research works considered, 14 reported that 2 independent assessors were used. The details are presented in Figure 2.

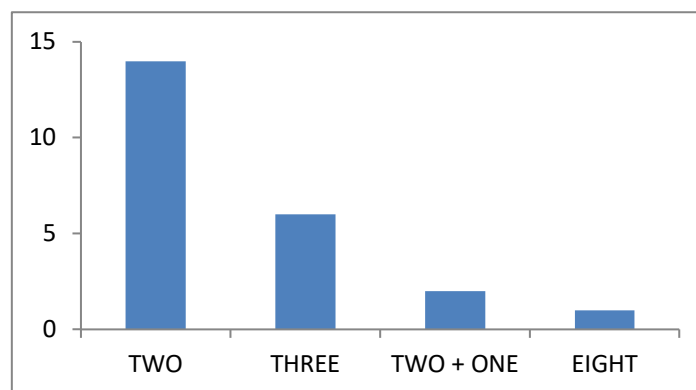


Fig. 2. The Frequency of independent Assessors used reported by the Researchers

It can also be seen from Figure 2 that there are only two instances (TWO + ONE), where an additional assessor is required to determine the reliability of the videos where ties between the previously recruited two assessors were observed.

3.2 Analysis of the concluding remarks of the surveyed articles

Concluding remarks follow a successful analysis of the data obtained during the assessment of the videos on medical contents on YouTube. The concluding remarks of the authors on their findings are classified into four, namely; poor quality (PQ),

precautionary (PR), Useful (US) and Undecided (UD). The frequency of the concluding remarks is presented in Figure 3.

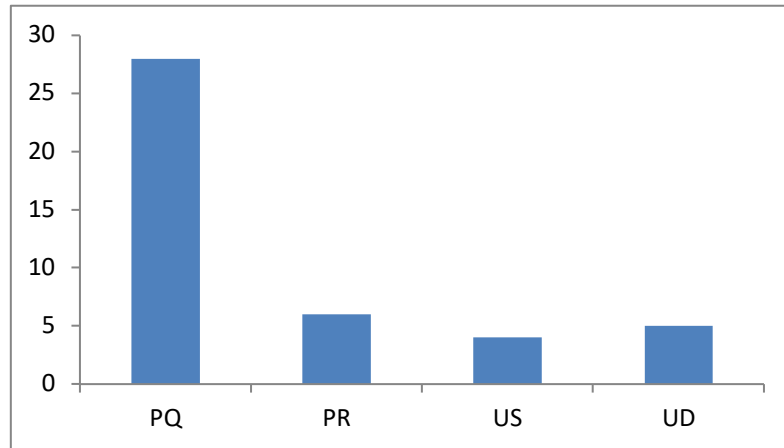


Fig. 3. The Frequency of concluding remarks after successful assessment of the videos

It appears that 28 out of the 43 pieces of research concluded that medical videos on YouTube are of poor quality. 6 out of 28 insisted that precautionary measures are to be taken if the medical videos uploaded on YouTube websites are to be a source of patient education. Only 4 out of 28 concluding that the videos are very useful and can be trusted.

3.3 User engagement on low-quality videos

It can be seen from the surveyed articles that user engagement for the medical videos on YouTube adjudged by the independent assessors to be of low quality is sometimes higher than useful videos. Videos from individual users and for advertisement purposes are usually the ones with many likes, comments and are widely viewed.

In this review, it was observed that user engagement for low-quality videos is higher than the useful sampled videos in 7 out of 12 instances and lower in 5 out of 12 instances as shown in Figure 4. The high users' engagements on misleading videos were reported in [3-4], [7], [24], [30], [39] and [41].

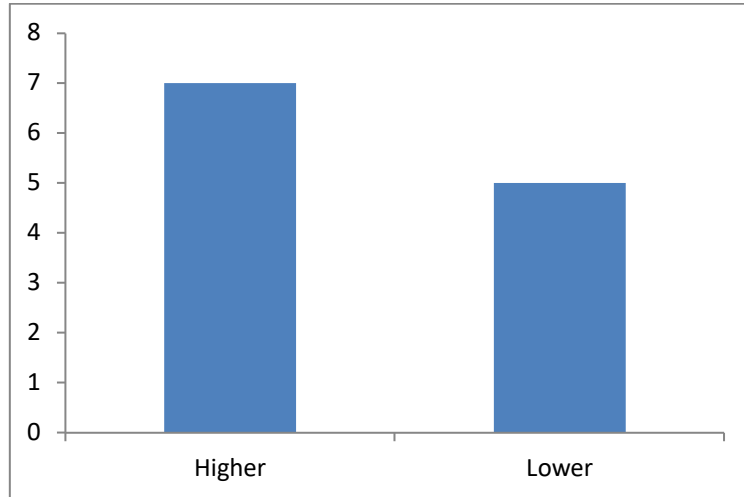


Fig. 4. Frequency of User engagement on low quality Videos

3.4 Sources of the uploaded medical videos on YouTube

Several authors have reported that medical videos uploaded on YouTube by health or medical professionals are of high quality compared with those uploaded by patients, advertising firms and others [9], [11], [14], [16] and the references therein. The videos often score high on the assessment score because of their perceived higher reliability.

Computation of the figures culled from [3-45] showed that 36.3 % of the total videos were uploaded by trusted sources such as medical and health professionals from recognized or prestigious hospitals, while 63.7 % were uploaded by other sources such as patients, advertising firms and users whose affiliations cannot be independently verified. This is depicted as a pie chart in Figure 5.

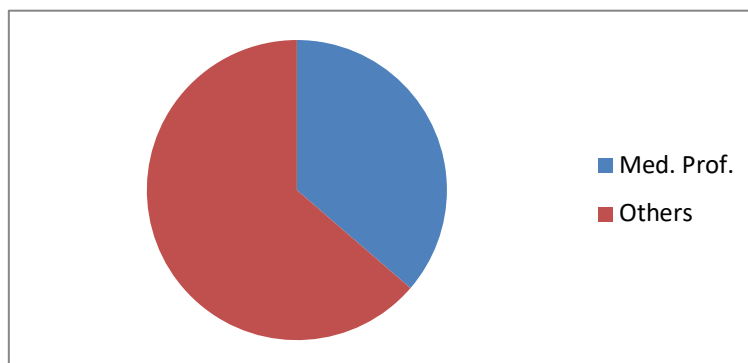


Fig. 5. Percentage of Medical videos uploaded by different sources

3.5 Quality of medical videos on YouTube

The various results on the useful and misleading medical videos as reported by 23 papers are shown in Table 1. The results were as a result of using different assessment tools and basement by independent reviewers. In all, out of the total 2675 medical videos assessed, 1589 (59%) are categorized as having useful contents that can impact positively on patient education while 1086 (41%) are categorized as misleading as shown in Figure 6.

Table 1. Categorization of medical videos obtained from 23 research papers

Total	Useful	Misleading	References
150	35	115	[3]
200	146	54	[4]
14	2	12	[5]
69	8	61	[7]
111	0	111	[8]
9	2	7	[10]
142	71	71	[12]
117	82	35	[13]
39	5	34	[15]
154	127	27	[16]
175	175	0	[19]
228	171	57	[21]
60	58	2	[22]
133	21	112	[23]
51	37	14	[24]
70	64	6	[26]
344	183	161	[28]
25	19	6	[29]
115	96	19	[30]
131	57	74	[36]
223	154	69	[38]
102	71	31	[41]
13	5	8	[44]
2675	1589	1086	

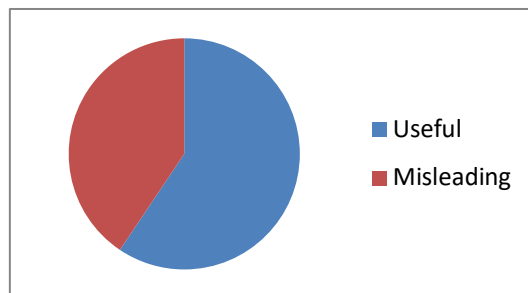


Fig. 6. Percentage of Useful and Misleading Medical Video Contents on YouTube

3.6 Recommendation on the use of YouTube as a source of patient education

A look at 31 articles [46-76] showed 3 different recommendations. 11 (35%) papers strongly recommended that medical videos are useful and can serve as a source of patient education. 12 (39%) recommended that medical videos on YouTube cannot serve the aforementioned purpose. Lastly, 8 (26%) of the papers recommended that caution must be exercised in using medical videos on YouTube as a means of patient education. These are shown in Table 2 and Figure 7 respectively.

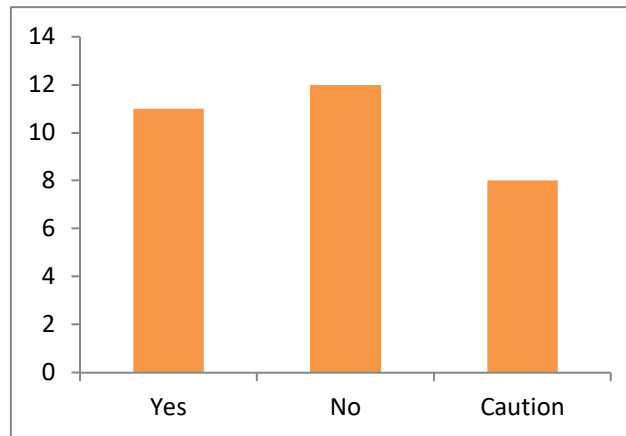


Fig. 7. Percentage of Useful and Misleading Medical Video Contents on YouTube

Table 2. Authors' Recommendation Types on the reliability of the Medical Videos on YouTube

Author	Recommendation	Author	Recommendation
[46]	Yes	[62]	Yes
[47]	No	[63]	No
[48]	Caution	[64]	Caution
[49]	No	[65]	Yes
[50]	Yes	[66]	Yes
[51]	Caution	[67]	Yes
[52]	No	[68]	Caution
[53]	Yes	[69]	No
[54]	Yes	[70]	No
[55]	No	[71]	No
[56]	Caution	[72]	No
[57]	Yes	[73]	Caution
[58]	No	[74]	Yes
[59]	Caution	[75]	Caution
[60]	No	[76]	Yes
[61]	No		

4 Summary of Findings

The review has unearthed some key findings that will help to guide researchers and patients using YouTube as a source for patient education. These are listed as follows:

- DISCERN, JAMAS and GQS are the most frequent assessment tools used by authors in determining the reliability of medical videos on YouTube.
- 60% of the independent reviewers that assessed the reliability of the YouTube videos are often two in number.
- 65% of the articles concluded that medical videos on YouTube contain misleading information.
- User engagement for low-quality videos is 58% and 42% for high-quality videos
- 36.3 % of the total videos were uploaded by trusted sources such as medical and health professionals from recognized or prestigious hospitals, while 63.7% were uploaded by other sources whose affiliations cannot be independently verified.
- Out of the total 2675 medical videos assessed, 1589 (59%) are categorized as having useful contents that can impact positively on patient education while 1086 (41%) are categorized as misleading.

Only 35% of the papers strongly recommended that medical videos on YouTube are useful and can be a good source of patient education.

5 Conclusion

This paper has investigated different convergent and divergent views on the reliability of the quality of medical videos on YouTube and consequently, the use of YouTube as a source of open and transparent patient education [77-81]. Generally, YouTube has been helpful in recruiting patients for medical research, peer support, advancing patient loyalty, patient health education, modulating patient attitude and patient empowerment. Others are publicizing current research on medical issues, including treatment options and creating awareness on some health-related issues [82-85]

Descriptive statistics were useful in discerning patterns in the study, which has been applied to these few selected works [86-88]. The present research corroborates similar findings on the evaluation of online contents [89-91]

The assessment of the quality of medical information for patient education available on YouTube has been a subject of intense debate [92-95], and this review has succeeded in categorizing the views into groups. Charts, tables, and percentages were used to precipitate the needed information from the data of the published articles. The result of the analysis led to the following conclusions;

- User engagement was higher for videos with a lower quality of information and does not guarantee that the information is trustworthy. That is videos with a great number of views, likes, comments, and thumbs up to do not mean that the content

is reliable. Statistically, the quality does not correlate positively with the user engagement of the videos.

- Videos uploaded by verified medical professionals; medical organizations such as the National Health Service, educational and news videos are very useful, reliable, comprehensive and constitute fewer amounts of misleading medical information on YouTube. However, physicians are reluctant to upload videos on YouTube for the fear of copyright infringement and privacy concerns, for example, the Health Insurance Portability and Accountability Act (HIPAA).
- The videos that showed treatment options of a disease are often misleading because the source is often from patients or advertising firms that uploads information that are yet to be subjected to scientific scrutiny. Hence, the available videos are published without quality checks or verification of the source.
- Videos created with commercial intents are very risky and should be viewed with caution. The same heritage is shared with the patient based videos, which ordinarily portray non-verified and sometimes-unscientific claims of the patients, which come in the form of personal experiences or perspectives. Perhaps, videos that promote alternative treatment options are most likely to be sourced by patients and should be engaged with caution.
- Videos uploaded by a university-affiliated physician had high scores in the different assessment methodologies when subjected to assessment.
- In most cases, the available videos lack sufficient information for a reasonable understanding of the disease or health condition. The insufficient information is the consequence of a lack of peer review of the videos by medical experts and lack of a platform that ensures constant monitoring or vetting of uploaded medical videos on YouTube.
- The videos created on YouTube often lack updates and reviews which ultimately lead to the erosion of their quality over time. Animated medical videos of high quality are more likely to be viewed.
- Videos on awareness, treatment or management of rare diseases available on YouTube are reliable because medical experts often upload them.

6 Acknowledgement

The support from Covenant University is greatly appreciated.

7 References

- [1] Finnegan, G., Holt, D., English, P.M., Glismann, S., Thomson, A., Salisbury, D.M., Bogaerts, H. & Bonanni, P. (2018). Lessons from an online vaccine communication project. *Vaccine*, 36(44), 6509-6511. <https://doi.org/10.1016/j.vaccine.2018.05.007>
- [2] Ortiz-Martinez, Y., Ali-Salloum, W., González-Ferreira, F. & Molinas-Arguëllo, J. (2017). HIV videos on YouTube: Helpful or harmful? *Sex. Trans. Infect.*, 93(7), 481. <https://doi.org/10.1136/sextrans-2017-053197>

- [3] Loeb, S., Sengupta, S., Butaney, M., Macaluso, J.N., Czarniecki, S.W., Robbins, R., Braithwaite, R.S., Gao, L., Byrne, N., Walter, D. & Langford, A. (2019). Dissemination of Misinformative and Biased Information about Prostate Cancer on YouTube. *Euro. Urology*, 75(4), 564-567. <https://doi.org/10.1016/j.eururo.2018.10.056>
- [4] Esen, E., Aslan, M., Sonbahar, B.Ç. & Kerimoğlu, R.S. (2019). YouTube English videos as a source of information on breast self-examination. *Breast Cancer Res. Treat.*, 173(3), 629-635. <https://doi.org/10.1007/s10549-018-5044-z>
- [5] ReFaey, K., Tripathi, S., Bohnen, A.M., Waddle, M.R., Peterson, J., Vazquez-Ramos, C., Bondoc, C.M., Quiñones-Hinojosa, A. & Trifiletti, D.M. (2019). The Reliability of YouTube Videos Describing Stereotactic Radiosurgery: A Call for Action. *World Neurosurgery*, <https://doi.org/10.1016/j.wneu.2019.01.086>.
- [6] Ferhatoglu, M.F., Kartal, A., Ekici, U. & Gurkan, A. (2019). Evaluation of the Reliability, Utility, and Quality of the Information in Sleeve Gastrectomy Videos Shared on Open Access Video Sharing Platform YouTube. *Obesity Surgery*, <https://doi.org/10.1007/s11695-019-03738-2>.
- [7] Thapa, P., Thapa, A., Khadka, N., Bhattarai, R., Jha, S., Khanal A. & Basnet B. (2018). YouTube lens to attention deficit hyperactivity disorder: A social media analysis. *BMC Research Notes*, 11(1), Article Number 854. <https://doi.org/10.1186/s13104-018-3962-9>
- [8] Camm, C.F., Russell, E., Ji Xu, A. & Rajappan K. (2018). Does YouTube provide high-quality resources for patient education on atrial fibrillation ablation? *Int. J. Cardiology*, 272, 189-193. <https://doi.org/10.1016/j.ijcard.2018.08.066>
- [9] Bae, S.S. & Baxter, S. (2018). YouTube videos in the English language as a patient education resource for cataract surgery. *Int. Ophthalmology*, 38(5), 1941-1945. <https://doi.org/10.1007/s10792-017-0681-5>
- [10] ReFaey, K., Tripathi, S., Yoon, J.W., Justice, J., Kerezoudis, P., Parney, I.F., Bendok, B.R., Chaichana, K.L. & Quiñones-Hinojosa, A. (2018). The reliability of YouTube videos in patient's education for Glioblastoma Treatment. *J. Clin. Neurosci.*, 55, 1-4. <https://doi.org/10.1016/j.jocn.2018.07.001>
- [11] Singh, S.K., Liu, S., Capasso, R., Kern, R.C. & Gouveia, C.J. (2018). YouTube as a source of information for obstructive sleep apnea. *Amer. J. Otolaryngology - Head & Neck Med. & Surgery*, 39(4), 378-382. <https://doi.org/10.1016/j.amjoto.2018.03.024>
- [12] Tolu, S., Yurdakul, O.V., Basaran, B. & Rezvani, A. (2018). English-language videos on YouTube as a source of information on self-administer subcutaneous anti-tumour necrosis factor agent injections. *Rheumatology Int.*, 38(7), 1285-1292. <https://doi.org/10.1007/s00296-018-4047-8>
- [13] Abukaraky, A., Hamdan, A.A., Ameera, M.N., Nasief, M. & Hassona, Y. (2018). Quality of YouTube TM videos on dental implants. *Medicina oral, Patologia oral y Cirugiabuccal*, 23(4), e463-e468. <https://doi.org/10.4317/medoral.22447>
- [14] Reddy, K., Kearns, M., Alvarez-Arango, S., Carrillo-Martin, I., Cuervo-Pardo, N., Cuervo-Pardo, L., Dimov, V., Lang, D.M., Lopez-Alvarez, S., Schroer, B., Mohan, K., Dula, M., Zheng, S., Kozinetz, C. & Gonzalez-Estrada, A. (2018). YouTube and food allergy: An appraisal of the educational quality of information. *Pediatr. Allergy & Immunol.*, 29(4), 410-416. <https://doi.org/10.1111/pai.12885>
- [15] Cassidy, J.T., Fitzgerald, E., Cassidy, E.S., Cleary, M., Byrne, D.P., Devitt, B.M. & Baker, J.F. (2018). YouTube provides poor information regarding anterior cruciate ligament injury and reconstruction. *Knee Surgery, Sports Traumatology, Arthroscopy*, 26(3), 840-845. <https://doi.org/10.1007/s00167-017-4514-x>

- [16] Kiedrowski, M., Mróz, A., Gajewska, D., Nurzyński, P. & Deptała, A. (2017). Celiac disease on YouTube – a study of the Polish content available on the popular video-sharing website. *PolskimerkurszlekarSKI*, 43(256), 168-171.
- [17] Bademci, M.Ş., Yazman, S., Güneş, T., Ocakoglu, G., Tayfur, K. & Gokalp, O. (2017). YouTube as a potential source of information on deep venous thrombosis. *Phlebology*, 32(8), 543-547. <https://doi.org/10.1177/0268355516673795>
- [18] Basch, C.H., Kecojevic, A., Berdnik, A., Cadoret, V. & Basch, C.E. (2017). An analysis of widely viewed YouTube videos on anal cancer. *Int. J. Prevent. Med.*, 8, Article number 74,138-140.
- [19] Erdem, H. & Sisik, A. (2018). The Reliability of Bariatric Surgery Videos in YouTube Platform. *Obesity Surgery*, 28(3), 712-716. <https://doi.org/10.1007/s11695-017-2911-3>
- [20] Nissan, M.E., Gupta, A., Carron, J., Rayess, H. & Carron, M. (2017). Rhytidectomy: Analysis of Videos Available Online. *Facial Plastic Surgery*, 33(3), 311-315. <https://doi.org/10.1055/s-0037-1602163>
- [21] Kwok, T.M.Y., Singla, A.A., Phang, K. & Lau, A.Y.S. (2017). YouTube as a source of patient information for varicose vein treatment options. *J. Vascul. Surgery: Venous & Lymphatic Disorders*, 5(2), 238-243. <https://doi.org/10.1016/j.jvsv.2016.10.078>
- [22] Wong, K., Doong, J., Trang, T., Joo, S. & Chien, A.L. (2017). YouTube videos on botulinum toxin a for wrinkles: A useful resource for patient education. *Dermatologic Surgery*, 43(12), 1466-1473. <https://doi.org/10.1097/dss.0000000000001242>
- [23] Koller, U., Waldstein, W., Schatz, K.D. & Windhager, R. (2016). YouTube provides irrelevant information for the diagnosis and treatment of hip arthritis. *Int. Orthopaedics*, 40(10), 1995-2002. <https://doi.org/10.1007/s00264-016-3174-7>
- [24] Rittberg, R., Dissanayake, T. & Katz, S.J. (2016). A qualitative analysis of methotrexate self-injection education videos on YouTube. *Clin. Rheumatol.*, 35(5), 1329-1333. <https://doi.org/10.1007/s10067-015-2910-5>
- [25] Hassona, Y., Taimeh, D., Marahleh, A. & Scully, C. (2016). YouTube as a source of information on mouth (oral) cancer. *Oral Diseases*, 22(3), 202-208. <https://doi.org/10.1111/odi.12434>
- [26] Delli, K., Livas, C., Vissink, A. & Spijkervet, F.K.L. (2016). Is YouTube useful as a source of information for Sjögren's syndrome? *Oral Diseases*, 22(3), 196-201. <https://doi.org/10.1111/odi.12404>
- [27] Hansen, C., Interrante, J.D., Ailes, E.C., Frey, M.T., Broussard, C.S., Godoshian, V.J., Lewis, C., Polen, K.N.D., Garcia, A.P. & Gilboa, S.M. (2016). Assessment of YouTube videos as a source of information on medication use in pregnancy. *Pharmacoepidemiology & Drug Safety*, 25(1), 35-44. <https://doi.org/10.1002/pds.3911>
- [28] Hickman, S.J. (2016). An evaluation of educational neurological eye movement disorder videos posted on internet video sharing sites. *J. Neuro-Ophthalmol.*, 36(1), 33-36. <https://doi.org/10.1097/wno.0000000000000292>
- [29] Farkas, C., Solodiuk, L., Taddio, A., Franck, L., Berberich, F.R., LoChiato, J. & Solodiuk, J.C. (2015). Publicly available online educational videos regarding pediatric needle pain: A scoping review. *Clin. J. Pain*, 31(6), 591-598. <https://doi.org/10.1097/ajp.0000000000000197>
- [30] Garg, N., Venkatraman, A., Pandey, A. & Kumar, N. (2015). YouTube as a source of information on dialysis: A content analysis. *Nephrology*, 20(5), 315-320. <https://doi.org/10.1111/nep.12397>
- [31] Abedin, T., Ahmed, S., Al Mamun, M., Ahmed, S.W., Newaz, S., Rumana, N. & Turin, T.C. (2015). YouTube as a source of useful information on diabetes foot care. *Diabetes*

- Res. Clin. Pract.*, 110(1), Article number 6452. <https://doi.org/10.1016/j.diabres.2015.08.003>
- [32] Tanwar, R., Khattar, N., Sood, R. & Makkar, A. (2015). Benign prostatic hyperplasia related content on YouTube: Unregulated and concerning. *Recenti Progressi in Medicina*, 106(7), 337-341.
- [33] Staunton, P.F., Baker, J.F., Green, J. & Devitt, A. (2015). Online curves: A quality analysis of scoliosis videos on YouTube. *Spine*, 40(23), 1857-1861. <https://doi.org/10.1097/brs.0000000000001137>
- [34] Macleod, M.G., Hoppe, D.J., Simunovic, N., Bhandari, M., Philippon, M.J. & Ayeni, O.R. (2015). YouTube as an information source for femoroacetabular impingement: A systematic review of video content. *Arthroscopy – J. Arthrosc. Related Surgery*, 31(1), 136-142. <https://doi.org/10.1016/j.arthro.2014.06.009>
- [35] Brooks, F.M., Lawrence, H., Jones, A. & McCarthy, M.J.H. (2014). Youtube™ as a source of patient information for lumbar discectomy. *Ann. Roy. Coll. Surgeons of England*, 96(2), 144-146. <https://doi.org/10.1308/003588414x13814021676396>
- [36] Lee, J.S., Seo, H.S. & Hong, T.H. (2014). YouTube as a source of patient information on gallstone disease. *World J. Gastroenter.*, 20(14), 4066-4070.
- [37] Sorensen, J.A., Pusz, M.D. & Brietzke, S.E. (2014). YouTube as an information source for pediatric adenotonsillectomy and ear tube surgery. *Int. J. Pediat. Otorhinolary.*, 78(1), 65-70. <https://doi.org/10.1016/j.ijporl.2013.10.045>
- [38] Stellefson, M., Chaney, B., Ochipa, K., Chaney, D., Haider, Z., Hanik, B., Chavarria, E. & Bernhardt, J.M. (2014). YouTube as a source of chronic obstructive pulmonary disease patient education: A social media content analysis. *Chronic Respiratory Disease*, 11(2): 61-71. <https://doi.org/10.1177/1479972314525058>
- [39] Desai, T., Shariff, A., Dhingra, V., Minhas, D., Eure, M. & Kats, M. (2013). Is content really king? An objective analysis of the public's response to medical videos on YouTube. *PLoS ONE*, 8(12), Article number e82469. <https://doi.org/10.1371/journal.pone.0082469>
- [40] Strychowsky, J.E., Nayan, S., Farrokhyar, F. & MacLean, J. (2013). YouTube: A good source of information on pediatric tonsillectomy? *Int. J. Pediat. Otorhinolary.*, 77(6), 972-975. <https://doi.org/10.1016/j.ijporl.2013.03.023>
- [41] Singh, A.G., Singh, S. & Singh, P.P. (2012). YouTube for information on rheumatoid arthritis - A wakeup call? *J. Rheumatol.*, 39(5), 899-903. <https://doi.org/10.3899/jrheum.11114>
- [42] Lim Fat, M.J., Doja, A., Barrowman, N. & Sell, E. (2011). YouTube videos as a teaching tool and patient resource for infantile spasms. *J. Child Neurol.*, 26(7), 804-809. <https://doi.org/10.1177/0883073811402345>
- [43] Heathcote, L.C., Pate, J.W., Park, A.L., Leake, H.B., Moseley, G.L., Kronman, C.A., Fischer, M., Timmers, I. & Simons, L.E. (2019). Pain neuroscience education on YouTube. *PEERJ*, 7: Article Number: e6603. <https://doi.org/10.7717/peerj.6603>
- [44] Deralchshan, A., Lee, L., Bhama, P., Barbarite, E. & Shaye, D. (2019). Assessing the educational quality of 'YouTube' videos for facelifts. *Amer. J. Otolaryngol.*, 40(2), 156-159. <https://doi.org/10.1016/j.amjoto.2019.01.001>
- [45] Ocaik, U. (2018). Evaluation of the content, quality, reliability and accuracy of YouTube videos regarding endotracheal intubation techniques. *Nigerian J. Clin. Pract.*, 21(12), 1651-1655.
- [46] Tenderich, A., Tenderich, B., Barton, T. & Richards, S.E. (2019). What Are PWDs (People With Diabetes) Doing Online? A Netnographic Analysis. *J. Diabetes Sci. Technol.*, 13(2), 187-197. <https://doi.org/10.1177/1932296818813192>

- [47] Dimov, V., Gonzalez-Estrada, A. & Eidelman, F. (2018). Social Media and Allergy. *Current Allergy and Asthma Reports*, 18(12), Article number: 76. <https://doi.org/10.1007/s11882-018-0822-6>
- [48] Jamnadass, E., Aboumarzouk, O., Kallidonis, P., Emiliani, E., Tailly, T., Hraby, S., Sanguedolce, F., Atis, G., Ozsoy, M., Greco, F. & Somani, B.K. (2018). The Role of Social Media and Internet Search Engines in Information Provision and Dissemination to Patients with Kidney Stone Disease: A Systematic Review from European Association of Urologists Young Academic Urologists. *J. Endourol.*, 32(8), 673-684. <https://doi.org/10.1089/end.2018.0319>
- [49] Di Stasio, D., Romano, A.N., Paparella, R.S., Gentile, C., Minervini, G., Serpico, R., Candotto, V. & Laino, L. (2018). How social media meet patients' questions: YouTube™ review for children oral thrush. *J. Biol. Regul. Homeo. Agents*, 32(2), 101-106.
- [50] Widmer, R.J., Arce, M.K., Aase, L.A. & Timimi, F.K. (2017). Social Media Platforms and Heart Failure. *J. Cardiac Failure*, 23(11), 809-812. <https://doi.org/10.1016/j.cardfail.2017.07.396>
- [51] Ho, A., McGrath, C. & Mattheos, N. (2017). Social media patient testimonials in implant dentistry: information or misinformation? *Clinical Oral Implants Research*, 28(7), 791-800. <https://doi.org/10.1111/clr.12883>
- [52] Sanchez Bocanegra, C.L., Sevillano Ramos, J.L., Rizo, C., Civit, A. & Fernandez-Luque, L. (2017). HealthRecSys: A semantic content-based recommender system to complement health videos. *BMC Med. Infor. Dec. Making*, 17(1), Article number 63. <https://doi.org/10.1186/s12911-017-0431-7>
- [53] Zheng, X. & Woo, B.K.P. (2017). E-mental health in ethnic minority: A comparison of youtube and talk-based educational workshops in dementia. *Asian J. Psychiatry*, 25, 246-248. <https://doi.org/10.1016/j.ajp.2016.12.002>
- [54] Lander, S.T., Sanders, J.O., Cook, P.C. & O'malley, N.T. (2017). Social media in pediatric orthopaedics. *J. Pediat. Orthopaedics*, 37(7), e436-e439. <https://doi.org/10.1097/bpo.0000000000001032>
- [55] Nason, K., Donnelly, A. & Duncan, H.F. (2016). YouTube as a patient-information source for root canal treatment. *Int. Endodontic J.*, 49(12), 1194-1200. <https://doi.org/10.1111/iej.12575>
- [56] Rosenkrantz, A.B., Won, E. & Doshi, A.M. (2016). Assessing the Content of YouTube Videos in Educating Patients Regarding Common Imaging Examinations. *J. Amer. Coll. Radiol.*, 13(12), 1509-1513. <https://doi.org/10.1016/j.jacr.2016.06.038>
- [57] Krag, A. & Holmes, G.L. (2016). Diagnosing infantile spasms: Accuracy of the internet. *Epilepsy and Behavior*, 64, 239-241. <https://doi.org/10.1016/j.yebeh.2016.09.004>
- [58] Gupta, H.V., Lee, R.W., Raina, S.K., Behrle, B.L., Hinduja, A. & Mittal, M.K. (2016). Analysis of youtube as a source of information for peripheral neuropathy. *Muscle and Nerve*, 53(1), 27-31. <https://doi.org/10.1002/mus.24916>
- [59] Haymes, A.T. & Harries, V. (2016). How to stop a nosebleed: An assessment of the quality of epistaxis treatment advice on YouTube. *J. Laryngol. Otolaryngol.*, 130(8), 749-754. <https://doi.org/10.1017/s0022215116008410>
- [60] Basch, C.H., Hillyer, G.C., MacDonald, Z.L., Reeves, R. & Basch, C.E. (2015). Characteristics of YouTube™ Videos Related to Mammography. *J. Cancer Educ.*, 30(4), 699-703. <https://doi.org/10.1007/s13187-014-0769-9>
- [61] Nagpal, S.J.S., Karimianpour, A., Mukhija, D., Mohan, D. & Brateanu, A. (2015). YouTube videos as a source of medical information during the Ebola hemorrhagic fever epidemic. *SpringerPlus*, 4(1), Article number 457. <https://doi.org/10.1186/s40064-015-1251-9>

- [62] Patel, R., Chang, T., Greysen, S.R. & Chopra, V. (2015). Social media use in chronic disease: A systematic review and novel taxonomy. *Amer. J. Medic.*, 128(12), 1335-1350. <https://doi.org/10.1016/j.amjmed.2015.06.015>
- [63] Gonzalez-Estrada, A., Cuervo-Pardo, L., Ghosh, B., Smith, M., Pazheri, F., Zell, K., Wang, X.F. & Lang, D.M. (2015). Popular on YouTube: A critical appraisal of the educational quality of information regarding asthma. *Allergy & Asthma Proc.*, 36(6), e121-e126. <https://doi.org/10.2500/aap.2015.36.3890>
- [64] Dimov, V. & Eidelman, F. (2015). Utilizing social networks, blogging and YouTube in allergy and immunology practices. *Expert Rev. Clin. Immunol.*, 11(10), 1065-1068. <https://doi.org/10.1586/1744666x.2015.1065731>
- [65] Al-Silwadi, F.M., Gill, D.S., Petrie, A. & Cunningham, S.J. (2015). Effect of social media in improving knowledge among patients having fixed appliance orthodontic treatment: A single-center randomized controlled trial. *Amer. J. Ortho. Dentofacial Ortho.*, 148(2), 231-237. <https://doi.org/10.1016/j.ajodo.2015.03.029>
- [66] Cheung, D., Lieberman, L., Lin, Y. & Callum, J. (2014). Consent for blood transfusion: Do patients understand the risks and benefits? *Transfusion Med.*, 24(5), 269-273. <https://doi.org/10.1111/tme.12141>
- [67] Joshi, S. & Dimov, V. (2014). Use of new Technology to improve utilization and adherence to immunotherapy. *World Allergy Organ. J.*, 7(1), Article number 29. <https://doi.org/10.1186/1939-4551-7-29>
- [68] Boyers, L.N., Quest, T., Karimkhani, C., Connett, J. & Dellavalle, R.P. (2014). Dermatology on Youtube. *Dermatol. Online J.*, 20(6):
- [69] Hayes, K., Mainali, P., Deshmukh, A., Pant, S., Badheka, A.O. & Paydak, H. (2014). Utilization of YouTube as a tool to assess patient perception regarding implanted cardiac devices. *North Amer. J. Med. Sci.*, 6(7), 291-294. <https://doi.org/10.4103/1947-2714.136899>
- [70] Di Cerbo, A., Pezzuto, F., Laurino, C., & Palmieri, B. (2014). Web babel syndrome and false expectations during own multimedia oncological search. *Clinica Terapeutica*, 165(3), e225-229.
- [71] Steehler, K.R., Steehler, M.K., Pierce, M.L. & Harley, E.H. (2013). Social media's role in otolaryngology-head and neck surgery: Informing clinicians, empowering patients. *Otolaryngology - Head and Neck Surgery*, 149(4), 521-524. <https://doi.org/10.1177/0194599813501463>
- [72] Mukewar, S., Mani, P., Wu, X., Lopez, R. & Shen, B. (2013). YouTube® and inflammatory bowel disease. *J. Crohn's & Colitis*, 7(5), 392-402. <https://doi.org/10.1016/j.crohns.2012.07.011>
- [73] Fortinsky, K.J., Fournier, M.R. & Benchimol, E.I. (2012). Internet and electronic resources for inflammatory bowel disease: A primer for providers and patients. *Inflammatory Bowel Diseases*, 18(6), 1156-1163. <https://doi.org/10.1002/ibd.22834>
- [74] Libin, A., Schladen, M.M., Ljungberg, I., Tsai, B., Jacobs, S., Reinauer, K., Minnick, S., Spungen, M. & Groah, S. (2011). YouTube as an on-line disability self-management tool in persons with spinal cord injury. *Topics in Spinal Cord Injury Rehab.*, 16(3), 84-92. <https://doi.org/10.1310/sci1603-84>
- [75] Cain, J., Romanelli, F. & Fox, B. (2010). Pharmacy, social media, and health: Opportunity for impact. *J. Amer. Pharmacists Assoc.*, 50(6), 745-751. <https://doi.org/10.1331/japha.2010.09190>
- [76] Ben Naftali, Y., Duek, O.S., Rafaeli, S. & Ullmann, Y. (2018). Plastic Surgery Faces the Web: Analysis of the Popular Social Media for Plastic Surgeons. *Plastic & Reconst.*

- Surgery-Global Open*, 6(12), Article Number: e1958. <https://doi.org/10.1097/gox.0000000000001958>
- [77] Green, B. & Hope, A. (2010). Promoting clinical competence using social media. *Nurse Educator*, 35(3), 127-129. <https://doi.org/10.1097/nne.0b013e3181d9502b>
- [78] Knipel, V., Criée, C.P. & Windisch, W. (2013). Correct inhalation therapy: Instructions provided by internet-based video screens: An initiative of the German airway league. *Pneumologie*, 67(3), 157-161. <https://doi.org/10.1055/s-0042-121285>
- [79] Verkamp, J. (2013). Patient loyalty and the social media effect. *J. Med. Pract. Manag.*, 29(2), 96-98.
- [80] Azer, S.A. (2016). YouTube as a source of information on dialysis: What was investigated? *Nephrology*, 21(6), 530. <https://doi.org/10.1111/nep.12729>
- [81] Salem, J., Borgmann, H. & Murphy, D.G. (2016). Integrating Social Media into Urologic Health care: What Can We Learn from Other Disciplines? *Current Urology Reports*, 17(2): Article number 13. <https://doi.org/10.1007/s11934-015-0570-2>
- [82] Burton, A. (2008). YouTube-ing your way to neurological knowledge. *Lancet Neurology*, 7(12), 1086-1087. [https://doi.org/10.1016/s1474-4422\(08\)70252-7](https://doi.org/10.1016/s1474-4422(08)70252-7)
- [83] Freemyer, B., Drozd, B. & Suarez, A. (2018). A cross-sectional study of YouTube videos about atopic dermatitis. *J. Amer. Acad. Dermatol.*, 78(3), 612-613. <https://doi.org/10.1016/j.jaad.2017.09.005>
- [84] Nissan, M.E., Gupta, A., Rayess, H., Black, K.Z. & Carron M. (2018). Otoplasty Online Information: A Comprehensive Analysis of the Websites and Videos that Patients View Regarding Cosmetic Ear Surgery. *Facial Plastic Surgery*, 34(1), 82-87. <https://doi.org/10.1055/s-0037-1615280>
- [85] Reynolds, K.A., Pithadia, D.J., Lee, E.B. & Wu, J.J. (2019). A cross-sectional study of YouTube videos about psoriasis biologics. *Int. J. Dermatol.*, 58(3), e61-e62. <https://doi.org/10.1111/ijd.14317>
- [86] Adejumo, A.O., Suleiman, E.A., Okagbue, H.I., Oguntunde, P.E. & Odetunmbi, O.A. (2018). Quantitative Evaluation of Pregnant Women Delivery Status' Records in Akure, Nigeria. *Data in Brief*, 16, 127-34. <https://doi.org/10.1016/j.dib.2017.11.041>
- [87] Adamu, P.I., Oguntunde, P.E., Okagbue, H.I. & Agboola, O.O. (2018). On the Epidemiology and Statistical Analysis of HIV/AIDS Patients in the Insurgency Affected States of Nigeria. *Open Access Maced. J. Med. Sci.*, 6 (7), 1315-1321. <https://doi.org/10.3889/oamjms.2018.229>
- [88] Adamu, P.I., Adamu, M.O., Okagbue, H.I., Opoola, L. & Bishop, S.A. (2019). Survival Analysis of Cancer Patients in North Eastern Nigeria from 2004–2017 –A Kaplan - Meier Method. *Open Access Maced. J. Med. Sci.*, 7(4), 642-649. <https://doi.org/10.3889/oamjms.2019.109>
- [89] Yoosomboon, S. & Piriyastrawong, P. (2017). Design of an embedded engineering learning on social cloud model to enhance creative thinking and creative product. *Int. J. Online Engine.*, 13(1), 33-41. <https://doi.org/10.3991/ijoe.v13i01.5987>
- [90] Aşiksoy, G. (2018). Clicker supported team-based learning environment: A qualitative study. *Int. J. Online Engine.*, 14(9), 98-109. <https://doi.org/10.3991/ijoe.v14i09.8734>
- [91] Zalewski, J. & Gonzalez, F. (2017). Evolution in the education of Software Engineers: Online course on cyberphysical systems with remote access to robotic devices. *Int. J. Online Engine.*, 13(8), 133-146. <https://doi.org/10.3991/ijoe.v13i08.7377>
- [92] Vogel, L. (2011). YouTube will see you now. *CMAJ: Canadian Med. Assoc.*, 183(6), 647-648. <https://doi.org/10.1503/cmaj.109-3812>
- [93] Gabarron, E., Fernandez-Luque, L., Armayones, M. & Lau, A.Y.S. (2013). Identifying measures used for assessing quality of youtube videos with patient health information: A

- review of current literature. *J. Med. Internet Research*, 15(2): e6. <https://doi.org/10.2196/jmir.2465>
- [94] Tin, S.S. & Wiwanitkit, V. (2014). YouTube as a tool to assess patient perception. *Ann. Trop. Med. Pub. Health*, 7(5), 246-247. <https://doi.org/10.4103/1755-6783.154831>
- [95] Probst, K.A., Böhm, K., Borgmann, H. & Beyer, B. (2014) YouTube & Co.: What is the importance of video portals in modern medicine? *Urologe - Ausgabe A*, 53(6), 888-889. <https://doi.org/10.1007/s00120-014-3494-4>

8. Authors

Hilary I. Okagbue is a Faculty at Covenant University, Ota, Nigeria. Areas of specialization are Data Science, Mathematical Statistics and Statistical Learning.

Pelumi E. Oguntunde is a Faculty at Covenant University, Ota, Nigeria. Areas of specialization are Mathematical Statistics, Statistical Data Analysis and Distribution Theory.

Sheila A. Bishop is a Senior Faculty at Covenant University, Ota, Nigeria. Areas of specialization are Stochastic Analysis, Mathematical Statistics and Differential Equations.

Emmanuela C.M. Obasi is a Faculty at Federal University, Otuoke, Nigeria. Areas of specialization are Data Mining, Computer Security and Database management.

Abiodun A. Opanuga is a Faculty at Covenant University, Ota, Nigeria. Areas of specialization are Fluid Mechanics and Computational Analysis.

Opeyemi P. Ogundile is a Faculty at Covenant University, Ota, Nigeria. Areas of specialization are Mathematical Finance, Probability Theory and Numerical Analysis.

Article submitted 2019-08-22. Resubmitted 2019-09-27. Final acceptance 2019-09-28. Final version published as submitted by the authors.