ORIGINAL ARTICLE

# NEURO-OPHTHALMOLOGY PRACTICE DURING COVID-19 PANDEMIC

***Yuri Dwi Mayasari[1] Syntia Nusanti[2]***
*[1]Resident of Department of Ophthalmology, Faculty of Medicine Universitas Indonesia – Cipto Mangunkusumo Kirana Eye Hospital, Jakarta, Indonesia*
*[2]Neuro-Ophthalmology Division, Department of Ophthalmology, Faculty of Medicine Universitas Indonesia – Cipto Mangunkusumo Kirana Eye Hospital, Jakarta, Indonesia*
*Email: yuri.dwi.mayasari@gmail.com*

## ABSTRACT

**Introduction:** Ophthalmology practice including neuro-ophthalmology (NO) adopted the American Academy of Ophthalmology recommendation to provide only urgent or emergent care during the COVID-19 pandemic.

**Methods:** This report aimed to present demographical and patient visit data regarding the characteristic of outpatient in neuro-ophthalmology clinic and to evaluate the patients regulation and priority mitigation according to IOA guideline during COVID-19 pandemic.

**Result:** There were 207 visits from 160 patients during the pandemic, which was 33.9% of the total visits before pandemic. Most patients were reffered from internal referral (54.5%). However, new patients from external referral mostly came with onset of more than 2 weeks (40.6%). Most common diagnosis during pandemic were NAION (12.6%), toxic optic neuropathy (8.7%), and paretic eye movement disorder (7.7%). The diagnosis were classified further into neuro-ophthalmology clinic guideline and IOA guideline based on diagnosis and tele-ophthalmology. The most common category were non-priority patients (55.6%), 3B priority level (26.5%), and first priority level (59,9%), respectively.

**Conclusion:** A major difference characteristic of neuro-ophthalmology outpatients during pandemic was the number of patients visit. New patients mostly came from internal and local (Jabodetabek) referral which can be caused by mobility limitation, new hospital regulation and patients insecurity due to COVID-19. Priority mitigation in this study found non-priority patients were the majority who visited the clinic during COVID-19 pandemic, which may need further evaluation on referral and triage systems.

**Keywords:** neuro-ophthalmology practice**,** COVID-19, outpatients

## INTRODUCTION

Coronavirus disease (COVID-19) began in December 2019 in Wuhan, China, as a group of "mysterious" pneumonia cases that spread at an alarming rate. Within a month, cases were spread rapidly outside China, followed by a high mortality. On March 11, 2020, The World Health Organization (WHO) declared COVID-19 as a global pandemic. The entire global community participates in preventing the spread of COVID-19 in a comprehensive manner which aims to minimize the impact of the pandemic on various aspects of life.[1,2]

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is the causal agent of COVID-19 with an incubation period of 2-14 days. Transmission occurs by direct and indirect contact, such as through droplets, aerosols produced during medical procedures, and contact with contaminated objects/environments.[3-5] In some cases, ophthalmological complaints were found, namely conjunctivitis which is suspected to be caused by the contact of SARS-CoV-2 with ocular mucous membranes, as in the story of Dr. Li Wenliang, an ophthalmologist who suspected the possibility of a new virus resembling SARS which he eventually succumbed to.[6]

Until January 2021, the number of COVID-19 confirmed cases in Indonesia continues to escalate. This is not followed by an increase of frontline health workers. The alarming rise of cases can exceed the capacity of health facilities to provide health services, thus elevating the risk of mortality.[7-11]

Generally, ophthalmological examinations done by ophthalmologists are performed at close range which allows the risk of contact with people with COVID-19, especially in asymptomatic cases. Therefore, The Indonesian Ophthalmologists Association (IOA) had released guidelines on ophthalmology services in the era of the COVID-19 pandemic to facilitate safe health practices for both patients and health workers.[7-11]

In the field of Neuro-ophthalmology, barriers are experienced from the aspect of both ophthalmological and supporting examination that need to be done promptly to determine the diagnosis and therapy. The existence of these barriers will hinder the recognition of sight and/or life-threatening conditions from non-emergency conditions. A complete history taking and several examinations such as visual acuity and pupillary examination can still be done through teleophthalmology, but examinations that require expertise, such as visual fields examination and funduscopy, are difficult to be performed in telemedicine. The establishment of a diagnosis that requires supporting examinations and immediate intervention is prioritized during the COVID-19 pandemic.[12,13]

## METHODS

This study design is a retrospective descriptive study using medical records of outpatients from the Neuro-ophthalmology Division (NO) of the Department of Ophthalmology, Cipto Mangunkusumo Hospital (RSCM) Kirana in the period of 1 April – 30 June 2020 and 1 April – 30 June 2019. Inclusion criteria were all new patients visiting the neuro-ophthalmology clinic during the study period. Subjects with incomplete or missing medical record data were excluded.

Data on demographic characteristics (age, gender, visit status, origin of referral, and purpose of visit), clinical characteristics (clinical diagnosis, abnormalities, and onset), and stratification criteria (according to the service flow of the NO Division of RSCM Kirana and IOA Guidelines) were assessed. Statistical descriptive analysis of categorical variables is presented in the form of numbers and percentages, while numerical variables are presented in the form of mean and standard deviation (data with normal distribution) or median (data with abnormal distribution).

## RESULTS

In the period of 1 April – 30 June 2019, there were 712 visits from 458 patients and in the period of 1 April – 30 June 2020, there were 224 visits from 170 patients. Of the 628 patients recorded, 83 patients were excluded due to untraceable medical records. A total of 818 visits (611 visits from the 2019 period and 207 visits from the 2020 period) of 545 patients were analyzed in this study. The data on the distribution of age and sex in the NO Division of RSCM Kirana during the pandemic and non-pandemic periods have relatively equal proportions, as presented in Table 1.

**Table 1.** Demographic characteristics

| **Variable** | **Total (%)** | |
|---|---|---|
| | **2019 (n = 611)** | **2020 (n = 207)** |
| **Age*, in years** | 45 (2-81) | 41 (5-75) |
| 0-20 | 55 (9) | 25 (12.1) |
| 21-40 | 177 (29) | 71 (34.3) |
| 41-60 | 297 (48.6) | 94 (45.4) |
| > 60 | 82 (13.4) | 17 (8.2) |
| **Sex** | | |
| Male | 275 (45) | 103 (49.8) |
| Female | 336 (55) | 104 (50.2) |

*Median (minimum-maximum)

There was a higher number of new patient visits during the pandemic compared to the non-pandemic period, where the majority of visits were follow-up patients. Referrals to the NO clinic came as internal referrals (from other departments at RSCM and other divisions at RSCM Kirana) or external referrals (from hospitals within and outside the Jabodetabek agglomeration area). There were similar proportions of referrals during the pandemic and non-pandemic periods, most of the referrals were internal, 54.5% and 57.9%, respectively. External referrals, especially from hospitals outside the Jabodetabek area, decreased during the pandemic to 1.8% from 5% during the non-pandemic period. The most common purpose of visits during the pandemic was diagnostic or screening examination such as hydroxychloroquine (HCQ) tolerance, Nasopharyngeal Carcinoma (NPC) staging, and neuro-ophthalmological

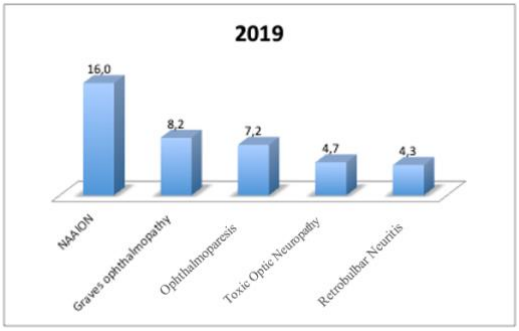
examination of neurosurgery patients, at 34.8% proportion. Meanwhile, during the non-pandemic period, purposes of visits were quite varied with the three most common being examination result consult (24.7%), diagnostic examination (HCQ tolerance, NPC staging, neuro-ophthalmological examination of neurosurgery patients) (23.7%), and new referrals of NO cases (new patients referred both internally and externally with abnormalities in the field of NO that require further evaluation and management) (23.9%). The characteristics of these visits are summarized in Table 2.

**Table 2.** Patients visit characteristics

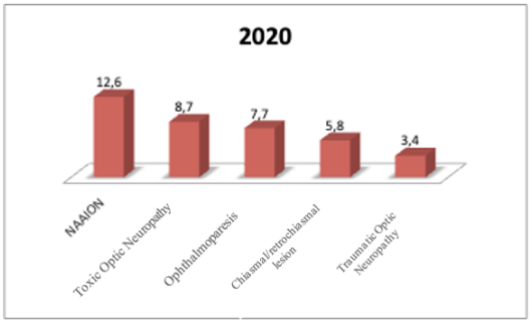
| Variable | Total (%) | |
|---|---|---|
| | 2019 (n = 611) | 2020 (n = 207) |
| **Cases** | | |
| New | 242 (39.6) | 110 (53.1) |
| Follow up | 369 (60.4) | 97 (46.9) |
| **Origin of referral*** | | |
| Jabodetabek Area | 90 (37.2) | 48 (43.6) |
| Outside Jabodetabek Area | 12 (5) | 2 (1.8) |
| Within RSCM | 96 (39.7) | 48 (43.6) |
| Within Kirana | 44 (18.2) | 12 (10.9) |
| **Purpose of visit** | | |
| A | 151 (24.7) | 35 (16.9) |
| B | 145 (23.7) | 72 (34.8) |
| C | 146 (23.9) | 58 (28) |
| D | 65 (10.6) | 22 (10.6) |
| E | 7 (1.1) | 2 (1) |
| F | 97 (15.9) | 18 (8.7) |

*n = amount of new patient visits (period of 2019, n = 242; period of 2020, n = 110); Purpose A: examination result consult; B: diagnostic examination; C: new neuro-ophthalmology cases; D: steroid therapy monitoring; E: new complaints; F: follow up without complaints.

The five most common diagnoses in NO clinic during the pandemic and non-pandemic periods are summarized in **Graphs 1a and 1b**. NAION was the most common diagnosis in both pandemic and non-pandemic periods.



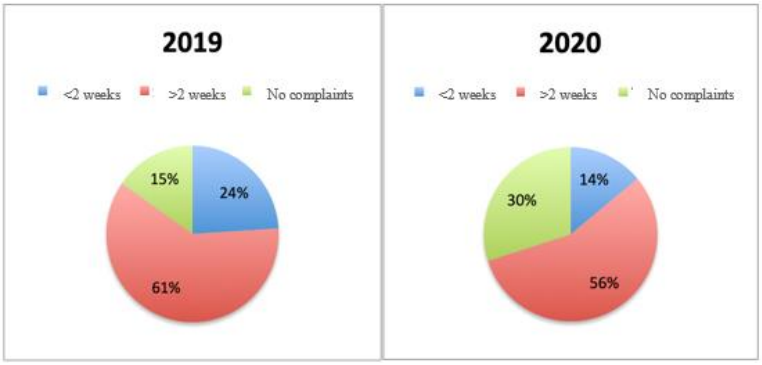

a.




b.

**Graph 1.** Most common diagnoses a) non-pandemic period ; b) pandemic period.

The onset of NO complaints was assessed in new patients. There were fewer patients with less than 2 weeks onset of complaints compared to the more than 2 weeks onset. The proportion of patients with less than 2 weeks onset of complaints in 2020 is smaller than in 2019. The onset of patient complaints is shown in Graph 2.




**Graph 2.** Onset of complaints in 2019 (non-pandemic) and 2020 (pandemic)

Patient visits were classified based on the 2020's criteria for stratification of the patient flow at the NO clinic RSCM Kirana (Table 3) and the IOA's guideline for ophthalmology service during the COVID-19 pandemic era (Tables 4 and 5).

**Table 3.** Classification of visits based on the criteria for stratification of the Neuro-ophthalmology clinic patient flow during the COVID-19 pandemic era.

| Variable | Total (%) (n = 207) |
|---|---|
| **New** | |
| Optic neuritis/ traumatic/ toxic (< 2 weeks) | 2 (0.9) |
| Ischaemic optic neuropathy (< 2 weeks) | 5 (2.4) |
| Acute diplopia | 13 (6.3) |
| Diagnostic examination | 50 (24.2) |
| Does not meet the criteria | 43 (20.8) |
| **Follow up** | |
| Steroid therapy | 22 (10.6) |
| Does not meet the criteria | 72 (34.8) |

This study also analyzed the priority level of patient visits based on the IOA's guideline. There were diagnosis-based priority (Table 4) and teleophthalmology-based priority (Table 5).

**Table 4.** Characteristics of patient visits based on the diagnosis priority.

| Priority | Total (%) n = 207 |
|---|---|
| 1 | 40 (19.3) |
| 2 | 38 (18.4) |
| 3A | 27 (13) |
| 3B | 55 (26.5) |
| Non priority | 47 (22.7) |

**Table 5.** Characteristics of patient visits based on teleophthalmology priority.

| Priority | Total (%) n = 207 |
|---|---|
| 1 | 124 (59.9) |
| 2 | 30 (14.5) |
| 3 | 20 (9.7) |
| 4 | 33 (15.9) |

## DISCUSSION

During the pandemic, there were several adjustments of regulations at RSCM, including limiting the number of patients to minimize the risk of SARS-CoV-2 transmission as recommended by the WHO and the Ministry of Health of Indonesia.[14] In addition, adjustments were also made for the procedures of acquiring patient medical records. The difficulty in obtaining adequate patient data was one of the obstacles faced in this study, therefore, as many as 83 subjects were excluded due to incomplete medical record data.

This study showed that patients visiting the NO clinic during the pandemic were reduced by three times compared to the non-pandemic period. In accordance with a study conducted by Berkenstock et al[15], patient visits to ophthalmologists during the pandemic were reduced by four times. However, there was no significant difference at the NO visits.[15] Furthermore, the study also stated that NO abnormalities required a funduscopic examination which was not possible by telemedicine.[15]

Other demographic characteristics of the patients who visited during the pandemic were similar to those of the non-pandemic period. There was no difference in the number of patients by sex. The age group of 40-60 years is the largest in a study by Su Ann Lim et al[16], who also found that findings of NO abnormality increased with age.[16]

The smallest number of referrals came from hospitals outside the Jabodetabek area. The ratio of referrals from hospitals outside to within Jabodetabek area decreased during the pandemic, from 1:7 to 1:11 (complaints with onset less than 2 weeks) and 1:38 (complaints with onset more than 2 weeks). This was thought to be due to the large-scale social restrictions (PSBB) policy that was implemented in most parts of Indonesia at the beginning of the pandemic, resulting in a reduction of patient referrals from hospitals outside the Jabodetabek area and a longer recorded onset of complaints when the patients reached tertiary health facilities such as RSCM.[16]

The most prevalent purpose of patient visits during the pandemic period was for diagnostic examinations, one of the examinations being the hydroxychloroquine (HCQ) tolerance test, as it is needed for the management of patients with systemic lupus erythematosus (SLE). There is an increasing annual prevalence of SLE according to studies in Asia-Pacific, Bandung, and RSCM.[17-19] Current therapeutic guidelines for SLE from both the Indonesian Rheumatology Association (IRA) and the American College of Rheumatology (ACR) recommended the use of HCQ as the initial therapy that should be given to all degrees of SLE.[19,20] Therefore, screening steps before the administration of HCQ therapy are substantial.

The most common diagnosis during both pandemic and non-pandemic periods is NAION. This is in accordance with the range of age of most patients who visited, 40-60 years, as people in that age group are within the epidemiological characteristics of NAION.[23-26,29] Besides NAION, papilledema caused by toxic and traumatic optic neuropathy, paretic eye movement disorders,[20-23,27,28] and intracranial lesions are the most common diagnoses. A study by Berkenstock et al[15], showed that during the pandemic, NO visits were dominated by patients with papilledema, abducens nerve paresis, optic neuritis, and increased intracranial pressure.

Patients who visited during the pandemic were more likely to be new patients. Based on the NO clinic priority guideline, new visits and follow-up patients on steroid therapy were classified as a priority. As many as 54.6% of patients during the pandemic period were new patients. However, there is a question that needs to be answered, namely whether all new patients are clinically priority patient. Based on the priority criteria of the NO clinic RSCM Kirana patient flow, it was found that 33.8% of new patient visits and 10.6% of the follow-up patients were in accordance with the priority criteria. The total number of new patients and follow-ups who were not prioritized was 55.6%. The reason for a large number of non-priority patients visits might be caused by several factors, such as the lack of information from the referring hospital or other departments at the RSCM regarding the new patient flow at the NO clinic, as well as the limitations of resources in the referring hospital to perform certain

diagnostic tests, causing referrals of non-priority cases for the purpose of diagnostic examinations.

Based on the IOA's stratification criteria, priorities are divided as diagnostic and tele-ophthalmology priorities. This study found that most patients were priority 3B diagnosis followed by non-priority diagnosis cases. This finding showed that there was a multitude of patients that actually do not require physical visits. The non-priority cases that were found in this study included patients on HCQ therapy or HCQ tolerance test, NPC staging, and NO examination in pre- and post-surgical neurosurgery patients. However, diagnostic examination in this group of patients based on tele-ophthalmology priority stratification was classified as priority 1 due to the inability of the required examinations to be performed via tele-ophthalmology. Based on the tele-ophthalmology criteria, priority 1 was the most common case due to the characteristics of NO patients who require a funduscopic examination, which currently cannot be done via telemedicine.

A study in the United Kingdom by Christoph et al[31] found that more than a third of National Health Service referrals did not require face-to-face consultation at an ophthalmology center. There was a reduction of referrals following the introduction of an electronic referral system that allowed e-mailing of clinical images.[32] Moorfield Eye Hospital has also provided tele-ophthalmology services.[9,31,33] Lately, there has been an increasing need for telemedicine services in Indonesia since the COVID-19 pandemic, as evidenced by the increase in downloads of virtual health consultation applications.[34-37]

There were several factors that need to be considered to optimize telemedicine services in Indonesia, including patient considerations regarding the safety and quality of the platform, ease of use, internet access, and The Ministry of Health's support through regulations on telemedicine that assure health service activities to be carried out safely for both users and providers. In the field of neuro-ophthalmology, the impossibility of self-examinations by the patient and the existence of tests that need to be performed directly by the examiners, necessitated the patients to visit health facilities. However, telemedicine is expected to help patients and doctors get an initial information of the possible etiologies of the ophthalmological complaints and also the further steps needed for establishing a diagnosis and deciding treatment so that referrals and visits to eye health facilities can be made to be more effective.

## CONCLUSION

The demographic characteristics of this study were similar to those of the non-pandemic period. There was no difference in the number of patients by sex. The highest number of patients were in the age group of 40-60 years old.

There were reduction of patient visits by three times in the pandemic period compared to the non-pandemic period. The majority of visits in the pandemic period were new patients. There were fewer external referrals from outside the Jabodetabek area during the pandemic period. This showed a decrease in the number of inter-regional referrals.

Based on the priority guideline for the NO clinic RSCM Kirana during the COVID-19 pandemic, there was a higher number of non-priority patient visits. As a consequence of the abundance of non-priority cases, both new and follow-up priority patients, cannot be or are delayed to be addressed appropriately. Therefore, improvement of the patient administration and triage is crucial.

Based on the IOA's guidelines on diagnostic priority, the majority of cases found were priority 3B and followed by non-priority cases. Meanwhile, based on tele-ophthalmology priority, visits are dominated by priority 1, which were the cases that must be handled in ophthalmology facilities. This study recommends an additional diagnoses for the IOA's guideline on ophthalmology services regarding diagnoses that have not yet been included.

**REFERENCE**


1. WHO. Timeline of WHO's response to COVID-19 [Internet]. Available from: https://www.who.int/news-room/detail/29-06-
2. Ekpenyong B, Obinwanne CJ, Ovenseri-Ogbomo G, Ahaiwe K, Lewis OO, Echendu DC, et al. Assessment of Knowledge, Practice and Guidelines towards the Novel COVID-19 among Eye Care Practitioners in Nigeria–A Survey-Based Study. Int J Environ Res Public Health. 2020 Jul 16;17(14):5141.
3. WHO. Transmission of SARS-CoV-2: implications for infection prevention precautions [Internet]. Available from: https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-
4. Lai THT, Tang EWH, Chau SKY, Fung KSC, Li KKW. Stepping up infection control measures in ophthalmology during the novel coronavirus outbreak: an experience from Hong Kong. Graefes Arch Clin Exp Ophthalmol. 2020;258(5):1049–55.
5. Yang Y, Xiao Z, Ye K, He X, Sun B, Qin Z, et al. SARS-CoV-2: characteristics and current advances in research. Virol J. 2020 Dec;17(1):117.
6. Yunyun Zhou, Zeng Yuyang, Tong Yongqing, Chen Changzheng. Ophthalmologic evidence against the interpersonal transmission of 2019 novel coronavirus through conjunctiva:16.
7. Shetty R, Lalgudi V, Khamar P, Gupta K, Sethu S, Nair A, et al. Potential ocular and systemic COVID-19 prophylaxis approaches for healthcare professionals. Indian J Ophthalmol. 2020;68(7):1349.
8. Surat edaran dirjen P2P tentang revisi pedoman kesiapsiagaan menghadapi infeksi novel corona virus (COVID-19) [Internet]. Dokumen resmi dan protokol penanganan COVID-19. 2020. Available from: https://www.kemkes.go.id/article/view/20031700001/Dokumen-Resmi-dan-Protokol-Penanganan-COVID-19.html
9. Moorfields Ophthalmic Risk Stratification Implementation Guideline [Internet]. Available from: https://www.rcophth.ac.uk/ wpcontent/uploads/2020/03/Moorfields-Ophthalmic-Risk-Stratification-Implementation-Guideline-V2.0.pdf

10. Saxena R, Singh D, Jethani J, Sharma P, Sinha R, Sharma N, et al. Pediatric ophthalmology, strabismus and neuro-ophthalmology practice in the COVID-19 era: All India Ophthalmological Society guidelines. Indian J Ophthalmol 2020;68:1300-5.
11. Perdami.or.id. 2021. [Internet] Available from: https://perdami.or.id/wp-content/uploads/2021/01/Panduan-Pelayanan-Mata-Era-Pandemik-COVID-19-Adaptasi-Kebiasaan-Baru_Rekomendasi-PERDAMI.pdf [Accessed 11 Maret 2021].
12. Jammal H, Alqudah N, Khader Y. Awareness, Perceptions, and Attitude Regarding Coronavirus Disease 2019 (COVID-19) Among Ophthalmologists in Jordan: Cross-Sectional Online Survey. Clin Ophthalmol. 2020 Aug;14:2195–202.
13. Grossman SN, Calix R, Tow S, Odel JG, Sun LD, Balcer LJ, Galetta SL, Rucker JC. Neuro-ophthalmology in the Era of COVID-19: Future Implications of a Public Health Crisis. Ophthalmology. 2020 Sep;127(9): e72-e74.
14. Direktorat jenderal pelayanan kesehatan. Panduan Teknis Pelayanan Rumah Sakit Pada Masa Adaptasi Kebiasaan Baru. Jakarta: Kementerian Kesehatan RI; 2020.
15. Berkenstock, M.K., Liberman, P., McDonnell, P.J. et al. Changes in patient visits and diagnoses in a large academic center during the COVID-19 pandemic. BMC Ophthalmol.2021; 21,139.
16. Lim SA, Wong WL, Fu E, Goh KY, Seah A, Tan C, et al. The Incidence of Neuro-Ophthalmic Diseases in Singapore: A Prospective Study in Public Hospitals, Ophthalmic Epidemiology. 2009;16:2, 65-73.
17. Peraturan Menteri Kesehatan Republik Indonesia nomor 9 tahun 2020 [Internet]. Available from: http://hukor.kemkes.go.id/uploads/produk_hukum/PMK_No__9_Th_2020_ttg_Pedoman_Pembatasan_Sosial_Berskala_Besar
18. Jakes RW, Bae SC, Louthrenoo W, Mok CC, Navarra SV, Kwon N. Systematic review of the epidemiology of systemic lupus erythematosus in the Asia-Pacific region: prevalence, incidence, clinical features and mortality. Arthritis Care Res. 2012;64(2):159-68.
19. Ghassani NG, Hadi S, Hamijoyo L. Early Detection of Suspected Lupus Erythematosus in Community-Dwellings in West Java Indonesia. AMJ. 2017 Sept;4(3):358-62.
20. Perhimpunan Reumatologi Indonesia. Diagnosis dan Pengelolaaan Lupus Eritematosus Sistemik. Jakarta: Perhimpunan Reumatologi Indonesia; 2019.
21. Cullen JF, Tharvaratnam LK. Neuro-ophthalmic Disease Pattern in Southeast Asia with Particular Reference to Giant Cell Arteritis. Eye News 2016;22:1-3.
22. Costedoat-Chalumeau N, Dunogué B, Leroux G, Morel N, Jallouli M, Le Guern V, Piette JC, Brézin AP, Melles RB, Marmor MF. A Critical Review of the Effects of Hydroxychloroquine and Chloroquine on the Eye. Clin Rev Allergy Immunol. 2015 Dec;49(3):317-26.
23. Omoti AE, Waziri-Erameh MJ. Pattern of neuro-ophthalmic disorders in a tertiary eye centre in Nigeria. Niger J Clin Pract. 2007 Jun;10(2):147-51.
24. American academy of ophthalmology. 2019-2020 Basic Clinical Science Course, Section 5 Neuro-Ophthalmology. San Fransisco: American Academy of Ophthalmology; 2019.
25. Cestari DM, Gaier ED, Bouzika P, Blachley TS, De Lott LB, Rizzo JF, et al. Demographic, Systemic, and Ocular Factors Associated with Nonarteritic Anterior Ischemic Optic Neuropathy.Ophthalmology. 2016;123(12):2446–55.
26. Zulkarnaen M, Nusanti S, Sidik M, Rachman A. A Five-Year Data in Descriptive Study of Systemic and Ocular Risk Factors of Non-arteritic Anterior Ischemic Optic Neuropathy (NAION) and The Correlation to The Clinical Condition. Ophthalmol Ina.2021;47(1):93-101.
27. Tarantini A, Faraoni A, Menchini F, Lanzetta P. Bilateral simultaneous nonarteritic anterior ischemic optic neuropathy after ingestion of Sildenafil for erectile dysfunction. Case Rep Med. 2012.
28. Martin TJ, Corbett JJ. Practical neuro-ophthalmology. New York Mcgraw-Hill Education/Medical;2013.
29. Chen L, Deng C, Chen X, Zhang X, Chen B, Yu H, et al. Ocular manifestations and clinical characteristics of 534 cases of COVID-19 in China: A cross-sectional study. medRxiv.2020;(81974136):2020.03.12.20034678.
30. Ramaswamy, Ashwin & Yu, Miko & Drangsholt, Siri & Ng, Eric & Culligan, Patrick & Schlegel, Peter & Hu, Jim. (2020). Patient Satisfaction With Telemedicine During the COVID-19 Pandemic: A Retrospective Cohort Study (Preprint). Journal of Medical Internet Research. 22. 10.2196/20786
31. Kern C, Fu DJ, Kortuem K, et al. Implementation of a cloud-base referral platform in ophthalmology: making telemedicine services a reality in eye care. Br J Ophthalmol 2020;104:312–317.
32. Cameron JR, Ahmed S, Curry P, et al. Impact of direct electronic optometric referral with ocular imaging to a hospital eye service. Eye 2009;23:1134–40.
33. Kilduff CLS,Thomas AAP, Dugdill J, et al. Creating the Moorfields'virtual eye casualty: video consultations to provide emergency teleophthalmology care during and beyond the COVID-19 pandemic. BMJ Health Care Inform 2020;27:e100179.
34. Deloitte staff. 21st Century Health Care Challenges: A Connected Health Approach Megatrend in Healthcare. Indonesia: Deloitte Konsultan Indonesia; 2019.

35. Permenkes No. 20 tahun 2019 tentang penyelenggaraan pelayanan telemedicine antar fasilitas pelayanan kesehatan [Internet]. Available from: https://kebijakankesehatanindonesia.net/publikasi/arsip-pengantar/3938-regulasi-permenkes-nomor-20-tahun-2019
36. Surat Edaran Kementerian Kesehatan No. HK.02.01/MENKES/303/2020 tentang penggunaan teknologi infromasi dan komunikasi untuk mencegah penyebaran COVID-19 [Internet]. Available from: https://www.alomedika.com/komunitas/topic/surat-edaran-menteri-kesehatan-yang-memuat-tentang-peresepan-online.
37. Peraturan Konsil Kedokteran Indonesia No.74 tahun 2020 tentang kewenangan klinis dan praktik kedokteran melalui telemedicine pada masa pandemi COVID-19 di Indonesia [Internet]. Available from: http://www.kki.go.id/index.php/sideMenu/perundangan/2/72.