# Assessing Role of HRCT Screening Policy among COVID-19 Test-Negative Symptomatic Patients in Ahmedabad, India

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#### Abstract:

**Introduction:** To effectively contain the disease and controlling the progression of the COVID19 pandemic, Ahmedabad Municipal Corporation (AMC) implemented a unique policy to screen symptomatic individuals with negative diagnostic tests using the High-Resolution Computed Tomography (HRCT) scan. **Objective:** To analyse the findings of the HRCT screening policy during the COVID19 pandemic situation. **Method:** During the period of HRCT Screening policy, i.e., 23<sup>rd</sup> July 2020 to 31<sup>st</sup> December 2020, a total of 41034 scan record from 25 CT scan centers were available. A retrospective analysis of these secondary data available with the health department of AMC was carried out after due permission from the local authority. **Results:** A total of 11337 [27.63%, 95% Confidence Interval (CI) 27.20-28.06] were reported as COVID positive. Males reported higher positivity (27.87%) than females (27.17%), however the difference was statistically not significant (Z=1.512, p=0.131). Age wise positivity shows increasing trend, while zone wise comparison shows positivity in line with the cases from respective zone. Analysis of CT severity score shows that 66.15% had Mild, 26.07% had moderate and 7.78% had severe lung involvement. **Conclusion:** HRCT screening policy identified additional cases of COVID19 and helped in isolation/admission of a large number of suspected cases which helped immensely in better control of the pandemic. HRCT, when used in combination with other diagnostic tests, plays a crucial role in controlling the pandemic situation.

**Key Words :** COVID19, High Resolution Computed Tomography, Public health policy, Screening, Test negative symptomatic

#### Introduction:

A large outbreak of a novel Coronavirus infection started from Wuhan, China in December 2019.<sup>[1]</sup> The International Committee on Taxonomy of Viruses named this novel corona virus as Severe Acute Respiratory Syndrome CoronaVirus2 (SARS-CoV-2).<sup>[2]</sup> The disease caused by the SARS-CoV2 was named as Corona virus Disease-2019 (COVID-19) by the World Health Organization (WHO).<sup>[3]</sup> The outbreak was declared as a Public Health Emergency of International Concern.<sup>[4]</sup> Later on, concerned by the alarming levels of spread and severity, WHO declared it as Pandemic on March 11, 2020.<sup>[5]</sup>

Reverse Transcription based Polymerase Chain Reaction (RT-PCR) is considered as 'gold standard' for identifying viral presence.<sup>[6]</sup> Even though, it requires more time and has low sensitivity, it played a crucial role during the pandemic as it was the only

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available test initially. Various factors like quality of sample, skill and procedure of sample collection, maintenance of cold chain, quality control in laboratory etc. are also known to affect the sensitivity of the RT-PCR.<sup>[7,8]</sup> Very soon, Rapid Antigen Test (RAT) kits were developed, which were very handy and useful in hospital and field settings as the results were available quickly. Limitations of RAT also includes low sensitivity. Various guidelines, including from ICMR, mentions only RTPCR and RAT as standard tests recommended for diagnosis of COVID-19.<sup>[9]</sup>

Since respiratory involvement and pneumonia are common presenting symptom along with fever, a high-resolution CT scan not only helps in accurate diagnosis of viral pneumonia but also gives an early indication of pneumonia.<sup>[10,11]</sup> This is particularly important when close contact and thorough clinical examination is usually avoided during pandemic of COVID19. HRCT not only helps in early and proactive case detection, identifying disease severity but also explicate the involvement of lungs.<sup>[12]</sup> Subjective CT findings were categorized by experts and diagnosis of viral pneumonia based on 'radiologic features as defined by radiologists' were developed and followed for diagnosis of COVID-19 by many clinician consultants and radiologists.<sup>[13]</sup>

An early identification of lung involvement, benefits the patient by timely medical interventions to prevent worsening of the pneumonia, at the same time it benefits the society at large by identifying and isolating the patient/suspected cases and thereby preventing further spread and protecting the society at large.<sup>[14]</sup> Breaking the chain of transmission is crucial in pandemic control, but low sensitivity coupled with a high false negative result from both the tests (RTPCR as well as RAT) missed so many individuals with infection, contributing to further spread of the disease.<sup>[15]</sup> Scientific studies have also documented that due to low sensitivity, RTPCR/RAT alone is insufficient to diagnose COVID19, as many suspected cases with typical clinical features and radiological findings were not diagnosed by RTPCR.<sup>[16,17]</sup> To effectively contain the disease and

preventing the further spread of the pandemic, Ahmedabad Municipal Corporation (AMC) adopted a policy to screen symptomatic individuals with negative test results using the High Resolution Computed Tomography (HRCT) scan, and is described in detail elsewhere.<sup>[18]</sup> A retrospective analysis of secondary data regarding HRCT screening policy available with the health department of AMC was carried out to assess the role of HRCT screening policy and analyze its findings during the COVID19 pandemic situation in Ahmedabad.

# Method:

Retrospective record-based study was carried out with an attempt to scientifically document the analysis of available HRCT data and for sharing the findings to the larger scientific community in general. Ahmedabad city with approximately 7 million population is divided into 48 wards distributed across 7 zones. There are 75 Urban Primary Health Centers which cater the primary health care services to the people of Ahmedabad. During first half of 2020, Ahmedabad was one of the earliest cities from India to witness the high COVID19 cases. This was documented in one of the seroprevalence study by ICMR in the containment zones during May '2020 reported >50% seroprevalence in Ahmedabad, one of the highest in entire country.<sup>[19]</sup> In the background of low sensitive diagnostic tests for COVID19, keeping the need to screen test-negative symptomatic individuals and need of the poor to get the HRCT screening services, AMC created a low cost public-private model with cooperative-coordinated referral system.<sup>[18]</sup> As per this model, Medical Officers from various health centers including UPHC / CHC / Referral hospitals / Dhanvantri OPD etc. referred symptomatic but test-negative individuals for screening through HRCT at no cost to patients. As part of the memorandum of understanding (MOU), the Health department reimbursed the cost directly to the CT scan centers at a predefined rate. The CT scan centres need to produce the referral slip with all necessary details and signature with stamp of the referring Medical Officers for their payment.

The screening policy evolved gradually and it was in force from 23<sup>rd</sup> July 2020 to 31<sup>st</sup> December 2020. A summary of all the HRCT carried out by the designated private CT scan centre was available with the health department of Ahmedabad Municipal Corporation. The present study is a record based retrospective study which covered a total of 41034 HRCT scans. The individual patient details also included CORADs scoring and CT severity score.<sup>[20,21]</sup> There were few CT scan centres who were following 40 points reporting system.<sup>[20]</sup> On the other hand remaining majority were following 25 points system to report the CT severity.<sup>[21]</sup> To make them uniformly comparable, authors categorized the CT severity score into Mild, Moderate and Severe as per their respective standard classification.<sup>[20,21]</sup>

After getting written permission, authors analyzed the HRCT screening data to assess the role of the policy and to document its overall findings. Confidentiality was ensured while handling all the scan data and the results.

Data were entered and analysed using Microsoft Excel. Z test was applied as a test of significance for statistical analysis. A "p" value was considered significant at <.05 level.

# **Results:**

As part of the policy, health department of AMC, through 25 CT scan centers enrolled with a MOU carried out a total of 41034 HRCT scans. Analysis of these HRCT screening among the symptomatic patients (Table 1) shows that a total of 11337 [27.63%, 95% Confidence Interval (CI) 27.20-28.06] were reported as COVID positive.

There were 26823 (65.37%) male and 14211 (34.63%) females, who were screened under this policy. The positive HRCT was reported among 7476 (27.87%) males whereas, 3861 (27.17%) HRCT were reported as positive among females. The difference in positivity across both the sex group was statistically not significant (Z=1.512, p=0.131).

Looking at the age group wise details, majority of the individuals belong to young and middle-aged

groups. The age groups 20-50 years covered 62.26% of the individuals. There were very few on both the extremes of the age. Looking at the positivity of HRCT, the lowest positivity was recorded for 0-9 years age group (4.45%) and the highest was recorded for 90-99 years age group (45.00%) and the positivity consistently shows increasing trend with increase in the age-groups with some exceptions. Creating wider and fewer age-groups for the purpose of analysis shows 5.55% positivity for children and adolescent (< 18 years), 16.31% for 19-35 years, 35.64% for 36-60 years and 42.78% for 60> years age group.

Zone wise comparison shows that the numbers screened varies widely. The Central Zone (CZ) has very few persons screened by HRCT whereas North West Zone (NWZ) and West Zone (WZ) had the highest number of persons screened. In spite of such variations the positivity across all zones varied in a narrow range of 24.62% to 29.14%.

The analysis of all HRCT according to referral centre shows that majority (30634, 74.65%) were referred by the UPHC. The positivity among patients referred by UPHC was higher (29.01%) as compared to those referred by Dhanvantri (21.47%).

The month wise HRCT data shows that there were very few HRCT done during July 2020. The total monthly scan increased up to October and then reduced during November and December months. It was important to get the profile of those who are HRCT positive. The analysis of these positive patients (11337, 27.63%) shows that there were more positive males than positive females. The proportion of males among positives (65.94%) was higher than the proportion of males among total screened (65.37%). On the other hand, proportion of females among positives (34.06%) was lower than the proportion of females among total screened (34.63%).

Age group wise analysis of these positive patients shows a near normal bell-shaped distribution with very few positives at the extremes of the age groups with the peak reaching at 50-59 years age group. Majority of the positive patients (78.38%) were referred by the UPHC, whereas 14.40% were referred by Dhanvantri.

CT severity score records were reported differently by different CT scan centres. While most CT scan centres followed reporting by 25-point system, a few centres were following 40-point system. To compare both the CT severity scoring system, they were converted into mild, moderate and severe as per their uniform standard classification. With this standardization, as shown in Figure 1, majority had severity score in the range of "Mild" infection (7499, 66.15%). There were fewer in the

Variables	Total screened	Positive	% Positive
Total	41034	11337	27.63
Gender			l
Male	26823	7476	27.87
Female	14211	3861	27.17
Age Group (Years)			
0-9	292	13	4.45
10-19	2394	139	5.81
20-29	8828	1079	12.22
30-39	9372	2283	24.36
40-49	7349	2474	33.66
50-59	6310	2585	40.97
60-69	4426	1925	43.49
70-79	1703	708	41.57
80-89	340	122	35.88
90-99	20	9	45.00
Zones			L
Central Zone (CZ)	2080	561	26.97
East Zone (EZ)	5498	1570	28.56
North West Zone (NWZ)	8798	2343	26.63
North Zone (NZ)	5797	1653	28.51
South West Zone (SWZ)	5660	1586	28.02
South Zone (SZ)	4936	1215	24.62
WestZone (WZ)	8266	2409	29.14
Referred By			
Dhanvantri	7602	1632	21.47
UPHC	30634	8886	29.01
Data Not Available	2798	819	29.27
Month (2020)			
July	551	131	23.77
August	7673	1547	20.16
September	12422	3128	25.18
October	14483	4146	28.63
November	5169	2019	39.06
December	736	366	49.73

Table 1: Analysis of HRCT screening among COVID19 test negative symptomatic Patients (N=41034)



Figure 1: Distribution of Patients according to CT severity category

moderate category (2956, 26.07%) and even fewer in the severe category (882, 7.78%).

# Discussion:

Multiple studies focusing on the role of HRCT in COVID19 have been published, which have helped in justifying its usefulness and effectiveness. This retrospective record-based study is one more such study which focused on the HRCT screening data among the test negative symptomatic patients. It is based on the HRCT policy adopted by the Health Department of the Ahmedabad Municipal Corporation, from Gujarat, India. The present study is one of the biggest in terms of the number of HRCT included for the purpose of analyzing COVID19 screening.

Current study included HRCT data of 41034 scans carried out from July to December 2020 during the COVID19 pandemic. Authors calculated the HRCT positivity of 27.63%. Analysis shows that the positivity among both the sex group was not significantly different statistically, which is similar to findings from other studies.<sup>[22]</sup>

In this study data analysis included patients with all age groups. Although children are less likely to develop symptoms, usually have milder infection and for shorter duration, there are reports of severe infection among children as well which are reported through HRCT.<sup>[23]</sup> This is the reason why the HRCT policy by AMC included children as well, when indicated. The age-group wise analysis also reflected that the HRCT positivity among the symptomatic patients shows increasing trend with the age. This finding is in line with multiple other scientific studies on COVID19, which have clearly documented that as the age increases the chances of symptomatic infection with severe symptoms lasting for longer duration is more likely.<sup>[24-28]</sup> Such a clinical picture and age association is also reflected through data analysis of age group wise HRCT positivity.

Zone wise comparison of HRCT positivity shows that the Central Zone (CZ) which had reported more cases during the earliest phase of pandemic in Ahmedabad, had very few persons screened by HRCT. The North West Zone (NWZ) and West Zone (WZ) which were reporting higher number of COVID19 positive patients during the study period, had the highest number of persons screened with HRCT. In spite of this variation in the numbers screened, the HRCT positivity across all zones varied in a narrow range of 24.62% to 29.14%.

Majority of patients referred for HRCT are referred by UPHCs. This is also due to the fact that UPHCs are established health centres catering primary health care services to the urban population. These were the only initial referring centre to begin with during the starting point of implementation of the policy. Later on, Dhanvantri Raths (mobile clinics) were permitted to refer patients for HRCT.

The policy was implemented from 23<sup>rd</sup> July 2020 and so month wise analysis shows very few screenings were done in July. This was due to the fact that, there were limited number of HRCT centre during the initial phase of the policy and the operational reality that the roll-out of policy take some time at the ground level. Gradually more HRCT centres came forward to join through a MOU with the Health Department of Ahmedabad Municipal Corporation. So, the screening increased and reached its peak in October. It is this high level of screening which identified more cases at an early stage and helped in predicting a surge in cases at an early stage. During the months of November and December, with high number of cases, the testing increased to a great extent and the numbers required to screen were reduced. But, the positivity among HRCT increased from around 20.16% (August) to almost 49.73% (December). During the December, the authority took the decision of discontinuing the policy which resulted into a limited number of screening during December before the policy came to an end on 31<sup>st</sup> December 2020.

Implementing this HRCT policy was like a natural experiment. Looking back, at the earlier situation now, it seems that a large number of probable cases of COVID were identified with this policy. These were either isolated or admitted in hospitals under the suspect category which helped them in early recovery with favorable outcome. This has also helped in reducing the further ongoing transmission. In the absence of this policy, Ahmedabad would have recorded an even greater peak and higher number of cases. In the absence of this policy, many people would have to pay out of pocket for various investigations and hospital admission, which in the critical times of COVID pandemic would have been like a mortal blow on the low middle class families who are surviving with great difficulty in the times of pandemic. Implementing this policy suggests that it helps in

identifying a greater number of suspected COVID patients, in spite of a negative diagnostic test (RAT/RTPCR). When used judiciously along with low sensitive diagnostic tests, such policy might help in reducing the speed of disease transmission and helps in flattening the curve of the pandemic, facilitating higher recovery rate and reducing the mortality. It thus plays a crucial role in controlling the pandemic situation. There are scientific evidences which suggest that HRCT can be used as a diagnosis or prognostic test.<sup>[29]</sup> Based on the study findings, it can be safely claimed that HRCT, when used in combination with other diagnostic tests, plays a crucial role in controlling the pandemic situation.

# Limitations:

Firstly, it's a record-based study where authors have analyzed the available secondary data and so only a limited amount of information was available. Authors acknowledge the limitation in ruling out other causes of pneumonia on CT scan. We also acknowledge limitation in converting CT severity score from 2 different methods of reporting into 3 simple categories.

#### **Conclusion:**

Present study included 41034 HRCT scan as part of COVID19 screening among test negative symptomatic patients, which reported 27.63% scans as positive. Age group wise positivity shows increasing trend while Gender wise difference in positivity was statistically not significant. Analysis of CT severity score shows that majority i.e., 66.15% had Mild, 26.07% had moderate and 7.78% had severe lung involvement. This screening helped in isolation/admission of many suspected cases which resulted into reduced transmission and better control of the pandemic wave. HRCT, when used in combination with other diagnostic tests, plays a crucial role in controlling the pandemic situation.

#### **Declaration:**

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Conflict of Interest: Nil

#### **References:**

- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. N Engl J Med. 2020 Feb 20;382(8):727-33. doi:10.1056/ NEJMoa2001017
- 2. Coronaviridae Study Group of the International Committee on Taxonomy of Viruses. The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. Nat Microbiol. 2020;5(4):536-44. doi: 10.1038/s41564-020-0695-z
- World Health Organization. WHO Director-General's remarks at the media briefing on 2019-nCoV on February 11, 2020. https://www.who.int/dg/speeches/detail/who-directorgeneral-s-remarks-at-the-media-briefing-on-2019-ncov-on-11-february-2020. Published February 11, 2020. Accessed June 3, 2021.
- 4. World Health Organization, Novel Coronavirus (2019-nCoV) Situation Report -11, (2020) https://www.who.int/docs/ default-source/coronaviruse/ situation-reports/20200131sitrep-11-ncov.pdf?sfvrsn=de7c0f7\_4. Accessed June 3, 2021.
- Cucinotta D, Vanelli M. WHO Declares COVID-19 a Pandemic. Acta Biomed. 2020;91(1):157-60. Published 2020 Mar 19. doi:10.23750/abm.v91i1.9397
- Shen M, Zhou Y, Ye J, Abdullah Al-Maskri AA, Kang Y, Zeng S, Cai S. Recent advances and perspectives of nucleic acid detection for coronavirus. J Pharm Anal. 2020 Apr;10(2):97-101. doi: 10.1016/j.jpha.2020.02.010.
- Li Y, Xia L. Coronavirus Disease 2019 (COVID-19): Role of Chest CT in Diagnosis and Management. AJR Am J Roentgenol. 2020;214(6):1280-86.doi:10.2214/AJR.20.22954
- Nairz M, Bellmann-Weiler R, Ladstätter M, Schüllner F, Zimmermann M, Koller AM et al. Overcoming limitations in the availability of swabs systems used for SARS-CoV-2 laboratory diagnostics. Sci Rep. 2021 Jan 26;11(1):2261. doi: 10.1038/s41598-021-81782-8.
- 9. Advisory on Use of Rapid Antigen Detection Test for COVID-19 Dated 14 June, 2020. ICMR. https://www.icmr.gov.in/ pdf/covid/strategy/ Advisory\_for\_rapid\_antigen\_ test14062020.pdf. [Last accessed on 2021 June 3].
- Kanne JP. Chest CT Findings in 2019 Novel Coronavirus (2019nCoV) Infections from Wuhan, China: Key Points for the Radiologist. Radiology. 2020;295(1):16-7. doi:10.1148/ radiol.2020200241
- 11. Pan Y, Guan H. Imaging changes in patients with 2019-nCov. Eur Radiol. 2020;30(7):3612-13. doi:10.1007/s00330-020-06713-z
- Fang Y, Zhang H, Xie J, Lin M, Ying L, Pang P et al. Sensitivity of Chest CT for COVID-19: Comparison to RT-PCR. Radiology. 2020 Aug;296(2):E115-E117. doi:10.1148/ radiol. 2020200432.
- National Health Commission of the People's Republic of China website. Diagnosis and treatment of novel coronavirus infection (trial version 6). www.nhc.gov.cn/yzygj/

s7653p/202002/8334a8326dd94d329df351d7da8aef c2.sht ml. Published February 18, 2020. Accessed June 3, 2021.

- 14. General Office of National Health Committee. Office of state administration of traditional Chinese medicine. Notice on the issuance of a programme for the diagnosis and treatment of novel coronavirus (2019-nCoV) infected pneumonia (trial fifth edition) (2020-02-06) [EB/OL]. http://bgs.satcm.gov.cn/ zhengcewenjian/2020-02-06/12847.html Accessed June 3, 2021.
- 15. Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. Lancet. 2020 Feb 15;395(10223):514-23. doi: 10.1016/S0140-6736(20)30154-9.
- 16. Wang Y, Kang H, Liu X, Tong Z. Combination of RT-qPCR testing and clinical features for diagnosis of COVID-19 facilitates management of SARS-CoV-2 outbreak. J Med Virol. 2020 Jun;92(6):538-39.doi:10.1002/jmv.25721.
- Tahamtan A, Ardebili A. Real-time RT-PCR in COVID-19 detection: issues affecting the results. Expert Rev Mol Diagn. 2020 May;20(5):453-4. doi:10.1080/14737159. 2020.1757437.
- Solanki B, Sheth J, Patel S, Patel D. High-resolution Computed Tomography Screening Policy among Test Negative Symptomatic in Ahmedabad – A Covid-19 Policy Perspective. AoCH. 2021;9(1):322-6.
- 19. The Economic Times. Prevalence of Covid-19 infection, at 55%, is the highest in Ahmedabad containment zones: Sources. Available: https://economictimes.indiatimes.com/ industry/ healthcare/ biotech/healthcare/prevalence-at-55-highest-in-abad- containment-zones/articleshow/77073909. cms?from=mdr. Accessed June 3, 2021
- Yang R, Li X, Liu H, Zhen Y, Zhang X, Xiong Q et al. Chest CT Severity Score: An Imaging Tool for Assessing Severe COVID-19. Radiol Cardiothorac Imaging. 2020 Mar 30;2(2):e200047. doi:10.1148/ryct.2020200047
- 21. Li K, Fang Y, Li W, Pan C, Qin P, Zhong Y et al. CT image visual quantitative evaluation and clinical classification of coronavirus disease (COVID-19). Eur Radiol. 2020 Aug;30(8):4407-16. doi:10.1007/s00330-020-06817-6
- 22. Dai H, Zhang X, Xia J, Zhang T, Shang Y, Huang R et al. Highresolution Chest CT Features and Clinical Characteristics of Patients Infected with COVID-19 in Jiangsu, China. Int J Infect Dis. 2020 Jun;95:106-12. doi: 10.1016/j.ijid.2020.04.003.
- 23. Liu M, Song Z, Xiao K. High-Resolution Computed Tomography Manifestations of 5 Pediatric Patients With 2019 Novel Coronavirus. J Comput Assist Tomogr. 2020 May/Jun;44(3):311-13. doi:10.1097/RCT. 000000000001023.
- 24. Wang X, Guo X, Xin Q, Pan Y, Hu Y, Li J et al. Neutralizing Antibody Responses to Severe Acute Respiratory Syndrome Coronavirus 2 in Coronavirus Disease 2019 Inpatients and Convalescent Patients, Clinical Infectious Diseases, 2020;71(10):2688-94.https://doi.org/10.1093/cid/ciaa721

- 25. Xiao T, Wang Y, Yuan J, Ye H, Wei L, Liao X et al. Early Viral Clearance and Antibody Kinetics of COVID-19 Among Asymptomatic Carriers. Front Med (Lausanne). 2021 Mar 15;8:595773.doi:10.3389/fmed.2021.595773.
- Hu WT, Howell JC, Ozturk T, Benameur K, Bassit LC, Ramonell R et al. Antibody Profiles According to Mild or Severe SARS-CoV-2 Infection, Atlanta, Georgia, USA, 2020. Emerg Infect Dis. 2020 Dec;26(12):2974-78. doi:10.3201/eid2612.203334.
- 27. Whitman JD, Hiatt J, Mowery CT, Shy BR, Yu R, Yamamoto TN et al. Evaluation of SARS-CoV-2 serology assays reveals a range of test performance. Nat Biotechnol. 2020 Oct;38(10):1174-83. doi:10.1038/s41587-020-0659-0.
- 28. Okba NMA, Müller MA, Li W, Wang C, GeurtsvanKessel CH, Corman VM et al. Severe Acute Respiratory Syndrome Coronavirus 2-Specific Antibody Responses in Coronavirus Disease Patients. Emerg Infect Dis. 2020 Jul;26(7):1478-88. doi:10.3201/eid2607.200841.
- 29. Shah SA, Gajbhiye MI, Saibannawar AS, Kulkarni MS, Misal UD, Gajbhiye DI. Retrospective analysis of chest HRCT findings in coronavirus disease pandemic (COVID-19)- An early experience. Indian J Radiol Imaging. 2021 Jan;31(Suppl 1):S101-S109. doi: 10.4103/ijri.IJRI\_483\_20.