SARS-CoV-2 / COVID-19

RADIOLOGIE

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~~COVID -19~~

Zoönotische ziekte (via ander gewerveld dier) veroorzaakt door severe acute respiratory syndrome coronavirus 2 (SARS-CoV 2), voor ~~het eerst aangetroffen in Wuhan,~~ China in 2020.

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Symptomen

Koorts, Droge hoest, Dyspneu, Myalgie, Hoofdpijn, Malaise, Buikpijn, lijkend op pancreatitis

- Griepsymptomen
- Ook gastro-intestinale klachten in klein deel.

R_0> 1,4-3,8

- Kans op verspreiding hoog bij R_0>1.
- Lager in populatie die gealarmeerd is.
- Nog niet volledig accuraat te bepalen

Besmetting als Verkoudheid

- (4/6 coronavirussen bij mensen veroorzaken verkoudheid)
- Dus niezen en hoesten of nauw contact met besmet individu.
- Deurklinken / oppervlakken etc, lijkt plausibel.
- Oro-fecaal niet duidelijk. Bij SARS kon dit wel.

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Quarantaine

- Asymptomatische verspreiding is mogelijk, ook 1-2 dagen voor symptomen al besmettelijk?
- Besmettelijke periode onduidelijk; tot 10 dagen of meer na de incubatieperiode
- In westerse democratie individueel gedrag zeer belangrijk
- Inmiddels een pandemie.
- De tijd van symptomen tot isolatie reduceren is vitaal! (CT?)

How will country-based mitigation measures influence the course of the COVID-19 epidemic? Anderson et al. Lancet. Published:March 09, 2020DOI:

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Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. Wu et al. 2020 Feb 24.
doi: 10.1001/jama.2020.2648. [Epub ahead of print]

Symptomen

Ernstig 14%. Kritiek 5%. +/- 80% Mild. 1-2% Asymptomatisch

17-29% van gehospitaliseerde patiënten ontwikkeld ARDS

- Sterke impact op gezondheidszorg.
- Met name bij ouderen en/of co-morbiditeit.

Case fatality rate grootste studie 2,3%

- Case fatality rate SARS: 9,6%
- Deel besmette patiënten nog niet hersteld.
- Kritieke cases 49% mortaliteit
- In Hubei 2,9% case fatality rate, daarbuiten 0,4%.
  - Meer besmettingen in Hubei?
- Ook ten dele afhankelijk van beschikbare voorzieningen

Rest-Morbiditeit?

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Ernst Vaak pas ernstig 1 week na start van de klachten

Kan zeer snel ernstig worden, binnen enkele uren.

- Ongewenst om dan thuis te zijn en niet in ziekenhuis.

CT kan mogelijk ernst bepalen, met name herhaalde CT 24-48 uur na eerste CT met duidelijke toename van afwijkingen (>50%).

Vroege voorspellers voor ernstige en kritieke patiënten (volwassenen):

- Progressieve afname lymfocyten
- Progressieve toename inflammatoire markers (CRP, IL-6)
- Progressieve toename lactaat.
- ***Snelle toename CT-afwijkingen.***

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7th COVID guideline China

COVID -19

Ontslag Criteria

- 3 dagen normale lichaamstemperatuur
- Duidelijk verbetering luchtwegsymptomen
- ***Evidente verbetering van (exudatieve) afwijkingen op imaging (CT)***
- 2 opeenvolgende negatieve PCR in respiratoire sample

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7th COVID guideline China

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Co-morbiditeit en oudere leeftijd

Sterk verhoogd risico overlijden

- Ouderen: 14,8% ≥ 80, 8% 70-79
- Cardiovasculaire ziekte: 10,5%
- Diabetes: 7,3%
- Chronische longziekten: 6,3%
- Hypertensie: 6,0%
- Maligniteiten: 5,6%

Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. Wu et al. 2020 Feb 24. doi: 10.1001/jama.2020.2648. [Epub ahead of print]

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Tests

Real-time reverse transcriptase Polymerase Chain Reaction (rt-PCR)

- Laag sensitief: 60-70%. Relatief laat positief tot na 8 dagen pas. Veel vals negatieven
- Zeer specifiek indien positief.
- Wordt schaars(er).

Labafwijkingen:

- Lymfocytopenie (tot 82%)
- Verhoogde prothrombinetijd (PT)
- Verhoogd Lactaatdehydrogenase (LDH)

Radiologie

- ***CT-Thorax*** eerder positief voor afwijkingen dan PCR positief wordt!
- Eerste 2 dagen nog negatief.
- ***CT-Thorax*** mist weinig (+/-4%)

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Tests

Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. Ai et al. Radiology. DOI:

Chest CT for Typical 2019-nCoV Pneumonia: Relationship to Negative RT-PCR Testing. Xie et al. Radiology Published Online:Feb 12 2020

Clinical Characteristics of Coronavirus Disease 2019 in China. Guan et al. 2020 Feb 28. doi: 10.1056/NEJMoa2002032. [Epub ahead of print]

Coronavirus Disease 2019 (COVID-19): Role of Chest CT in Diagnosis and Management. Li et al. AJR:215, October 2020

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Seriële CT thorax vs meerdere PCR (1014 patienten)

- 601 uiteindelijk rt-PCR positief en 413 negatief; CT 888 Positief en 126 negatief.
  - 59% rt-PCR positief vs 88% CT positief
- Sensitiviteit CT 97%, specificiteit laag 25%, accuracy 68%
- Patiënten rt-PCR - : 75% CT +. (308 / 413 patiënten)
- Conversie PCR - naar + had 67% initiële CT positief
  - 93% hiervan typische features
- Interval tussen initieel CT + en conversie rt-PCR naar +: 5,1 +/- 1.5 dagen

Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. Ai et al. Radiology. DOI:

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The Clinical and Chest CT Features Associated with Severe and Critical COVID-19 Pneumonia. Li et al. Investigative Radiology, Publish Ahead of Print DOI: 10.1097/RLI.0000000000000672

CT goede voorspeller

Patiënten die ernstiger ziek zijn tonen meer afwijkingen: consolidatie, lineaire opaciteiten, 'crazy-paving' en bronchuswandverdikking en hebben vaker pleuravocht, pericardvocht en lymfadenopathie.

CT severity score gecorreleerd aan ernst.
Afkapwaarde van 7 punten:

- Sensitiviteit 80% Specificiteit 82.8% voor onderscheid normaal beloop vs ernstig/kritiek.

CT severity score:
Per kwab:

<5% aangedaan:	1 punt
5-25%:	2 punten
26-49%:	3 punten
50-75%:	4 punten
>75%:	5 punten

Max 25 punten

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CT goede voorspeller

Primaire CT: Perifeer bilateraal matglas en/ consolidaties

56% primaire CT normaal (0-2dagen negatief)

Latere CT:

Meer longbetrokkenheid dan op de primaire CT's

Consolidatie, bilateraal en perifeer.

Lineaire verdichtingen

Crazy paving

Reverse halo/ atoll: vergelijkbaar met organiserende pneumonie

Bilateraliteit vaker in later stadium.

Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection.
Bernheim et al. Published Online:Feb 20 2020

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CT-Beeld (vervolg)

Patchy matglas, meest perifeer
Segment 6 en 10 meeste aangedaan
Vaak mixed matglas en consolidatie.
+/- 30% alleen matglas, 20 % alleen consolidatie

Clinical characteristics and imaging manifestations of the 2019 novel coronavirus disease (COVID-19) A multi-center study in Wenzhou city, Zhejiang, China. Yang et al. 2020 Feb 26. pii: S0163-4453(20)30099-2. doi: 10.1016/j.jinf.2020.02.016. [Epub ahead of print]*

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Chest CT Findings in Patients with Corona Virus Disease 2019and its Relationship with Clinical Features. Wu et al. 2020 Feb 21. doi: 10.1097/RLI.0000000000000670. [Epub ahead of print]

CT-Beeld (vervolg)

Matglas 91%, consolidatie 63% interlobulaire septale verdikking 59%

- Meestal subpleuraal
- Karakteristiek crazy paving (29%) en spider web sign (25%)

Meestal multiple afwijkingen en niet 1

Aangedane segmenten:

- Dorsaal ROK (86%)
- Posterior basaal ROK (85%)
- Lateraal basaal ROK (80%)

- Dorsaal LOK 76%
- Posterior basaal LOK (81%)

Weinig voorkomend

- Pleuravocht en lymfadenopathie (beide 4%)

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COVID -19

Performance of radiologists in differentiating COVID-19 from viral pneumonia on chest CT, Bai et al. Radiology. Published Online:Mar 10 2020 https://doi.org/10.1148/radiol.2020200823

CT Performance, probleem: specificiteit?

4 geblindeerde radiologen VS:

- Sensitiviteit: 73-93% Specificiteit: 93-100% Accuracy: 83-97%

3 geblindeerde radiologen China

- Sensitiviteit: 72-94% Specificiteit: 24-94% (1 outlier) Acurracy: 60 tot 83%

Meest discriminerend COVID-19 vs non-COVID pneumonie

- Perifere distributie (80% COVID vs 57%)
- Matglas (91% COVID vs 68%)
- ~~Vasculaire verdikking (58% COVID vs 22%)~~
- Centraal en perifeer (14% COVID vs 35%)
- Reversed halo (11% vs 1%)
- Pleuravocht (4,1 % COVID vs 39%)
- Lymphadenopathie (2,7% vs 10%)

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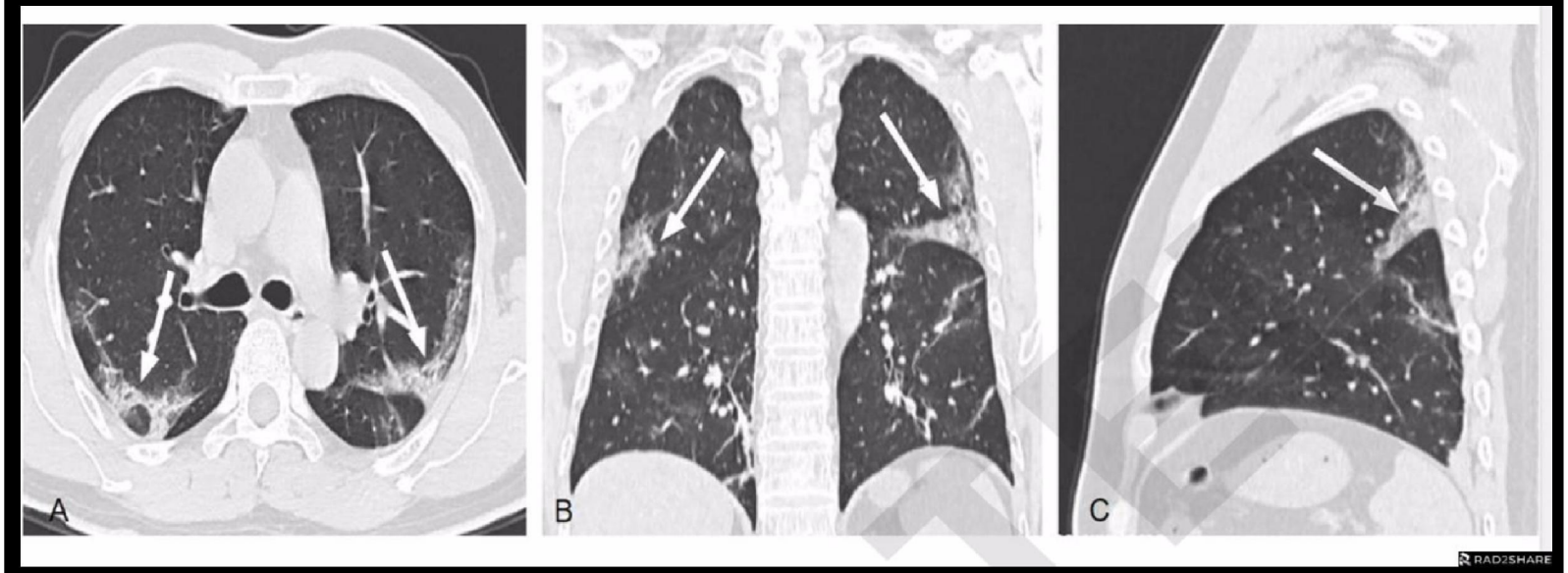

A-C. Chest CT of a 44 years old male. The clinical manifestations were fever (38.5 °C), cough, dizziness and headache. C-reactive protein increased. “spider web sign”(white thin arrow) were

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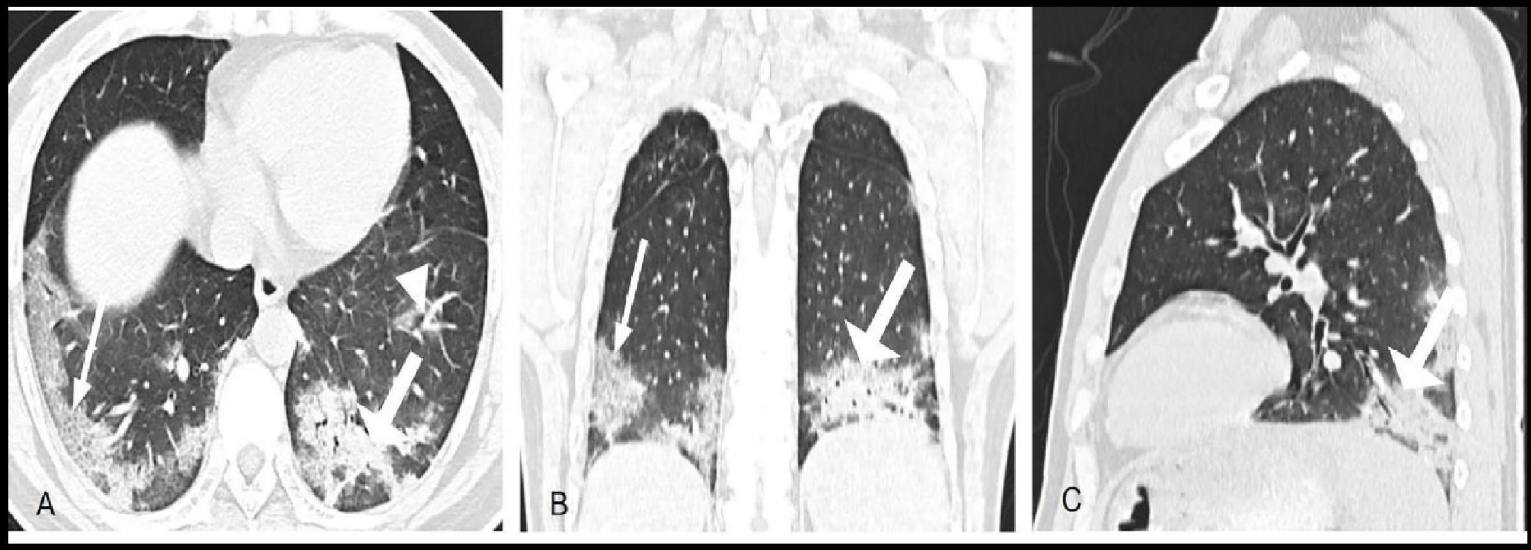
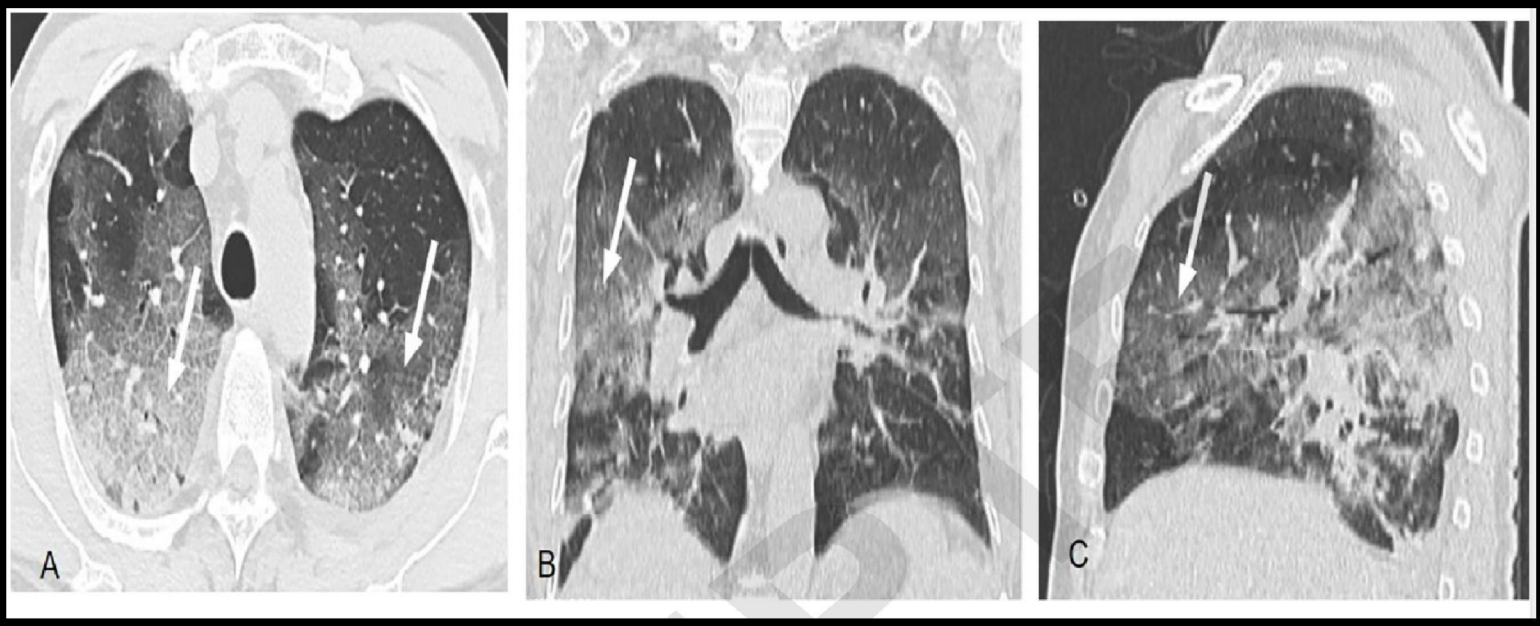


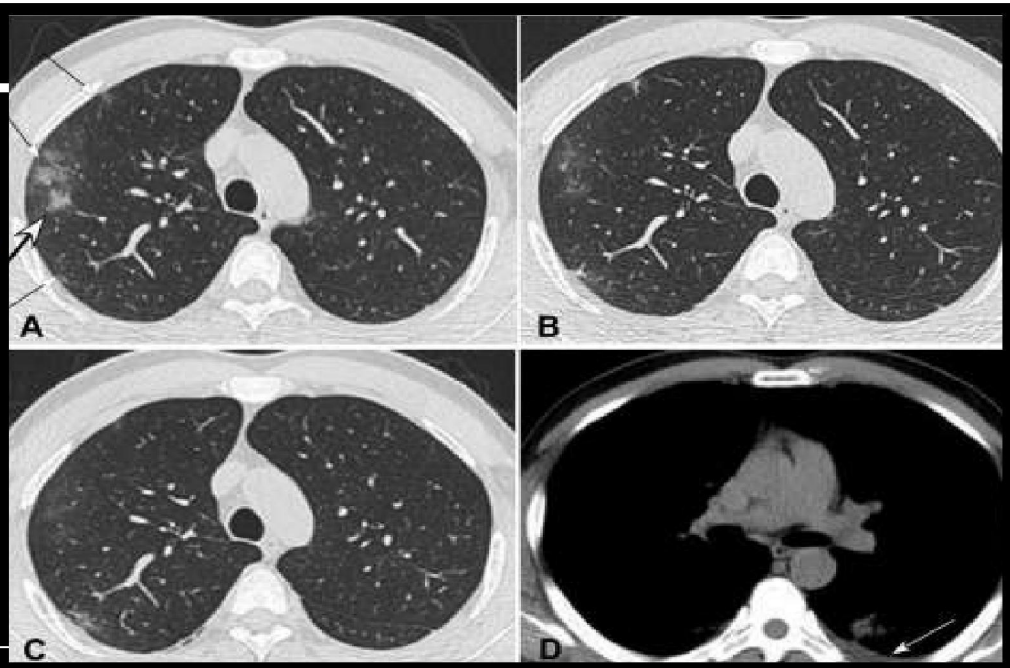
A-C. Chest CT of a 38 years old male. The clinical manifestations were fever (38 °C), cough, expectoration, muscle pain and dyspnea. C-reactive protein and procalcitonin increased. Ground glass opacity (GGO) (white triangle), consolidation (white thick arrow) and interlobular septal thickening (white thin arrow) distributed under the pleura were seen. Ninelung segments including the lateral basal segment, posterior basal segment, posterior basal segment, anterior basal segment of the both lower lobes, and the dorsal segment of the left inferior lobe were involved.



A-C. Chest CT of a 60 years male. Clinical manifestations were fever (37.8 °C), cough, expectoration and dyspnea. Neutrophil count,lymphocyte count and C-reactive protein increased. “crazy paving sign”(white thin arrow) were seen.

Common novel coronavirus pneumonia in a 37-year-old man with fever for six days and cough for two days before admission.
A. Axial plane of computed tomography scan in the lung window showed multiple irregular pieces (arrows) of ground glass opacity under the pleura with consolidation (bigger arrow) and thickened interlobular sept in the right upper lobe.

B. Seven days after treatment, the extent of the lesions decreased with fibrosis formation. C. Ten days after treatment, the extent of disease further shrank with decreased density. D. Axial plane in the mediastinal window revealed a small amount of pleural effusion (arrow).



Clinical and computed tomographic imaging features of Novel Coronavirus Pneumonia caused by SARS-CoV-2. Hu et al. Journal of infection. https://doi.org/10.1016/j.jinf.2020.02.017

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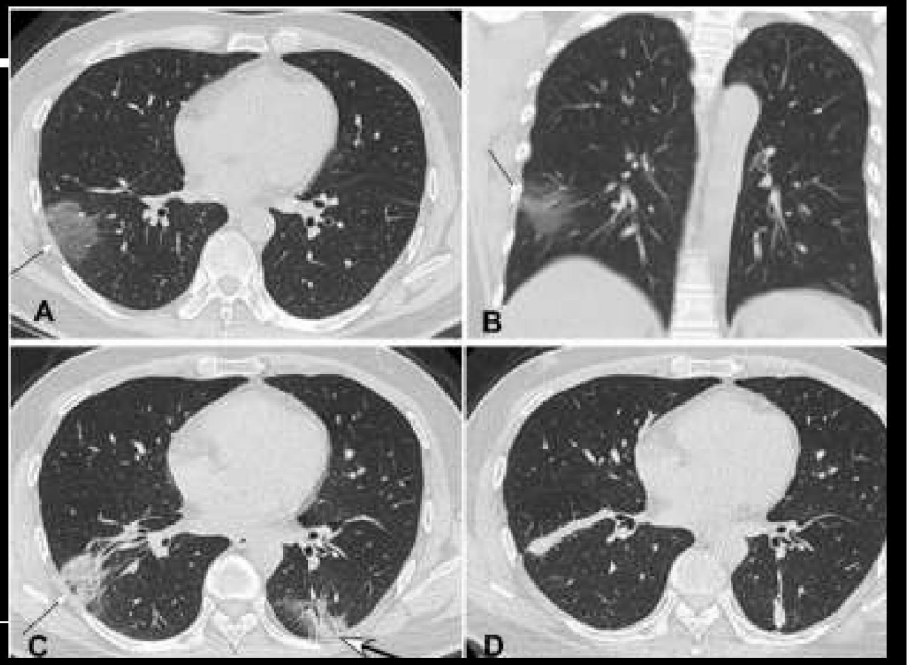
Common novel coronavirus pneumonia in a 46-year-old man with intermittent fever for five days before admission.

A-B. Computed tomography pulmonary scan in the axial (A) and coronal (B) plane demonstrated a piece of ground glass opacity (arrow) under the pleura in the right lower lobe.

C. Four days after treatment, the extent of lesion (small arrow) was decreased but with increased density, and a new lesion (bigger arrow) appeared in the left lower lobe with air bronchogram inside.

D. Eleven days later, the extent of disease in both lungs shrank further and became consolidated with thickened interlobular septa.



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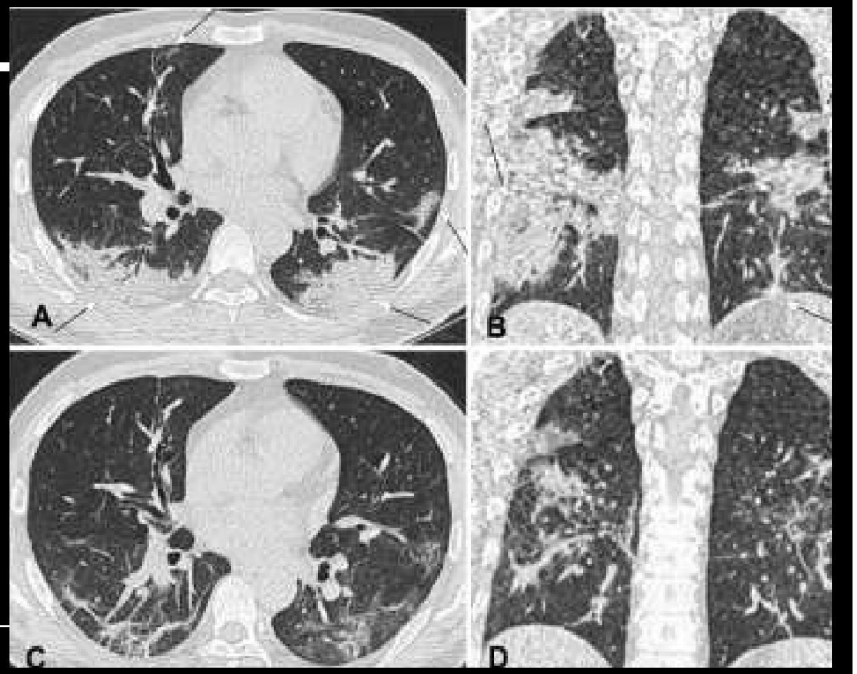
Severe novel coronavirus pneumonia in a 34-year-old man with fever and cough for ten days before admission.

A-B. Computed tomography axial (A) and coronal (B) plane revealed multiple lesions of ground glass opacity, consolidation and fibrosis with symmetrical distribution in bilateral lungs, with the lesion extending towards the pulmonary hilum. Air bronchogram was observed within the lesion.

C-D. Four days after treatment, the extent of lesion shrank with decreased density and formation of fibrosis.



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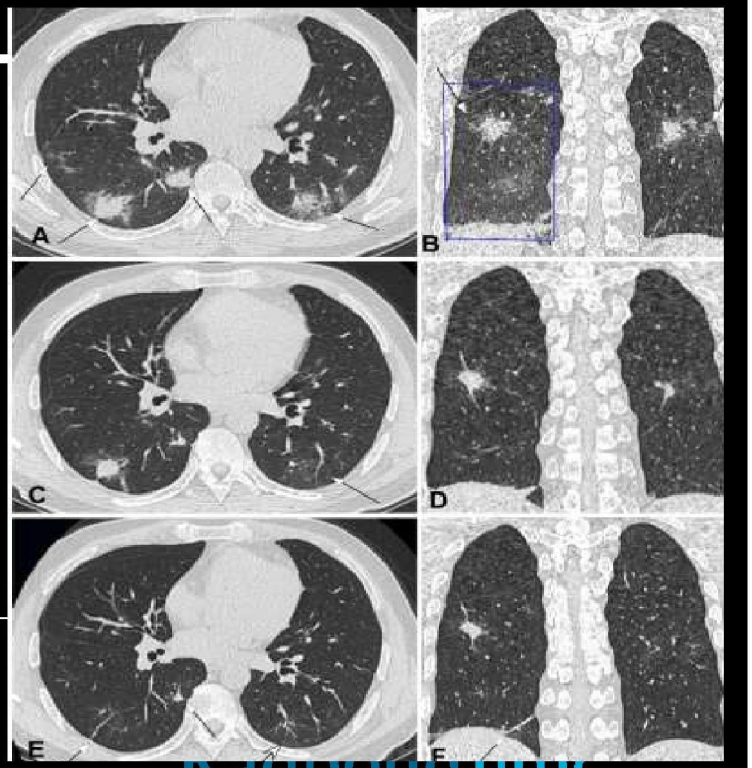
Severe novel coronavirus pneumonia in a 48-year-old ~~man with fever for seven days before admission~~.

A-B. Computed tomography axial (A) and coronal (B) plane revealed multiple lesions (arrows) of ground glass opacity accompanied with consolidation under or near the pleura in bilateral lower lobes, with air bronchogram and thickened interlobular septa. A large piece of ground glass opacity (square box) could also be seen in the right lower lobe (B).

C-D. Seven days after treatment, the right lesion was significantly reduced with formation of fibrotic stripes, and the left lesion was also absorbed with decreased density like ground glass opacity (arrow in C).

E&F. Ten days after treatment, bilateral lesions were mostly absorbed with only some nodules and stripes of fibrosis left (arrows).

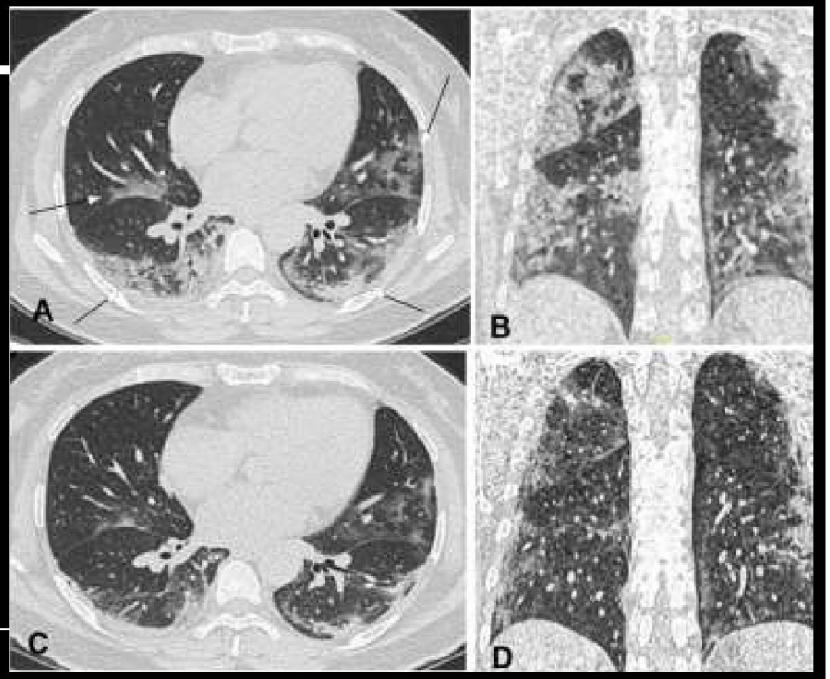


Clinical and computed tomographic imaging features of Novel Coronavirus Pneumonia caused by SARS-CoV-2. Hu et al. Journal of infection. https://doi.org/10.1016/j.jinf.2020.02.017

Critically severe novel coronavirus pneumonia (NCP) in a 50-year-old woman with fever, cough, dizziness and fatigue for five days before admission.

A-B. Computed tomography axial (A) and coronal (B) plane revealed multiple lesions of ground glass opacity accompanied with consolidation. The lesions extended towards the pulmonary hilum and had air bronchogram and thickened interlobular septa.

C-D. Five days after treatment, the extent of disease shrank with decreased density but stripes of fibrosis.



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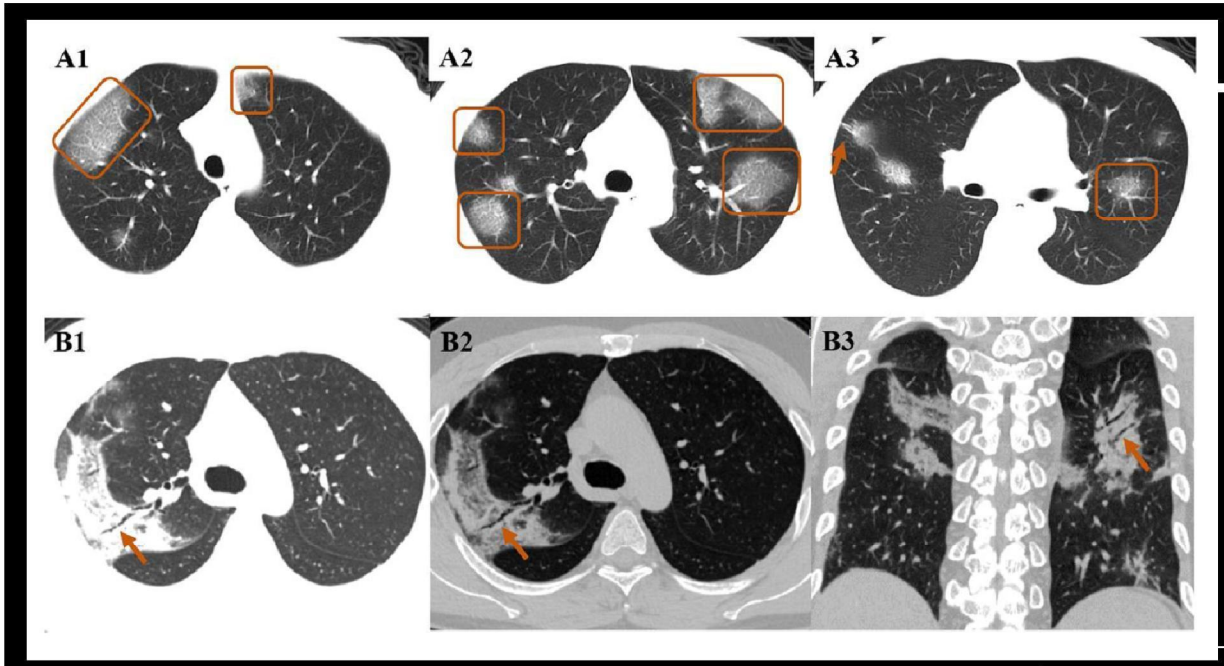
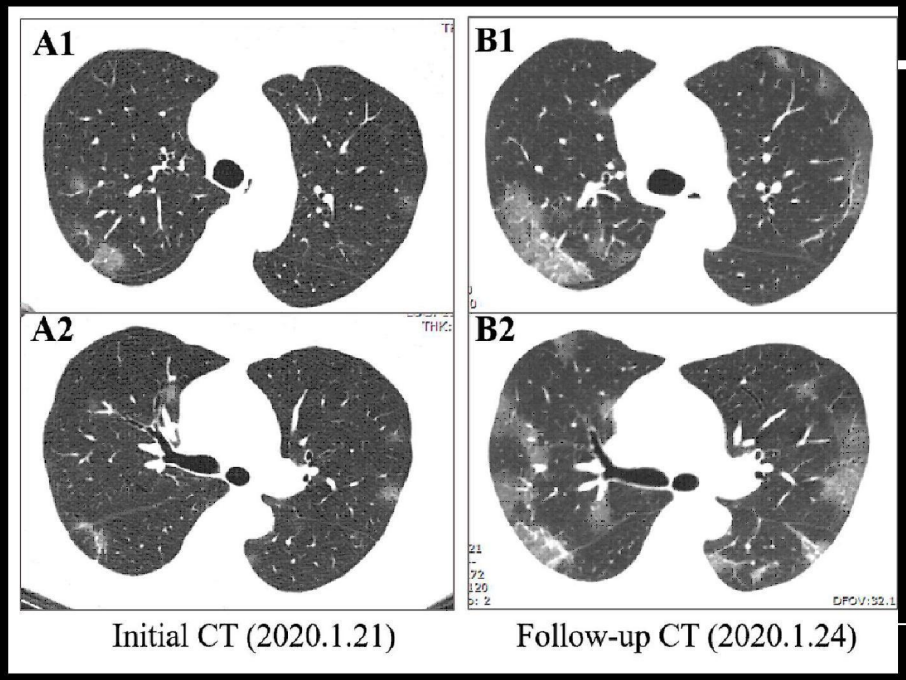


Clinical and High-Resolution CT Features of the COVID-19 Infection: Comparison of the Initial and Follow-up Changes. *Xiong et al. Invest Radiol. 2020 Mar 3. doi: 10.1097/RLI.0000000000000674. [Epub ahead of print]*

A1-A3: The HRCT images at admission of a 44-year-old male patient (5 days from onset). Multiple ground-glass opacities (GGO) and GGO with interlobular septal thickening (like reticulation or "paving stone sign"; boxes) and thin fibrous stripes (arrow) are shown in different cross-sections.
B1-B3: The HRCT images of a 38-year-old male patient, who is also medical personnel (9 days from onset). Diffuse opacities and consolidation, as well as air bronchograms (arrows) can be seen.



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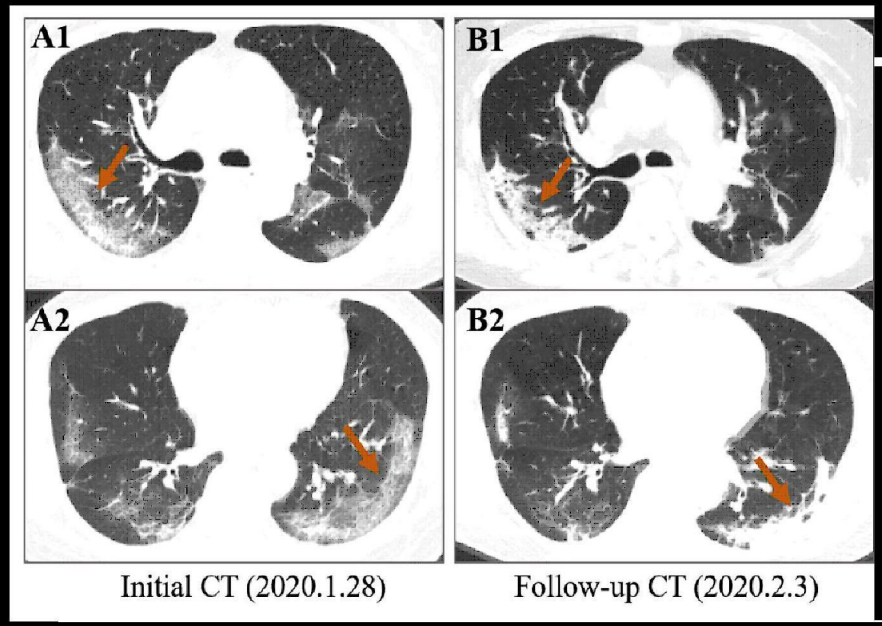
A case with progression after admission.

A1-A2: The HRCT images of a 57-yearold female patient (4 days from onset). Multiple GGO distributed bilaterally.

B1-B2: Three days later, more opacities, also with larger size, were seen bilaterally.



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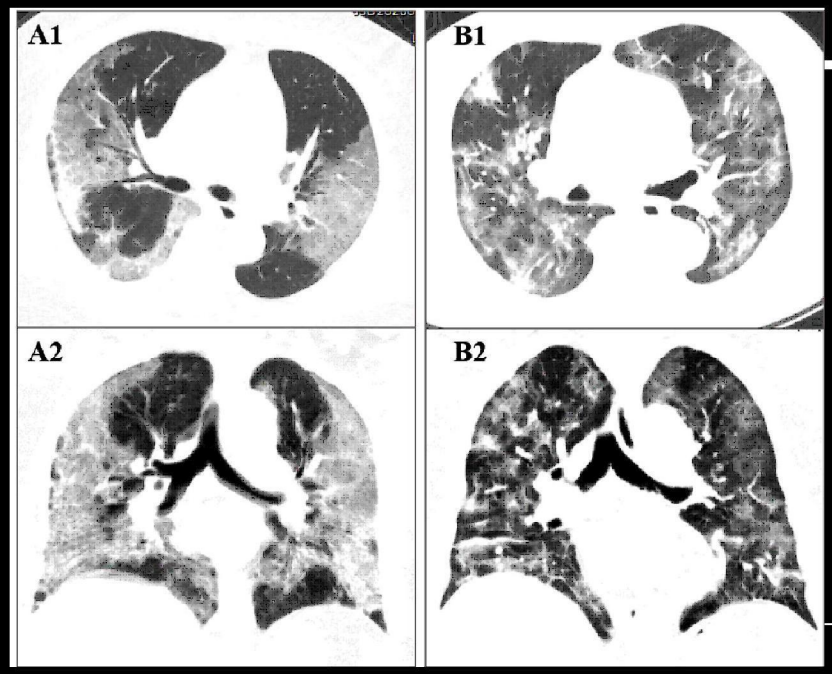
A case of slight improvement after admission.

A1-A2: The HRCT images of a 56-year-old female patient: 9 days from onset. Multiple GGO with interstitial thickening and thin fibrous stripes are shown.

B1-B2: Six days later, the lesion size is smaller and the density is slightly increased, also with more fibrous stripes. Arrows indicated the abnormalities.



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The most serious patients are usually accompanied by acute respiratory distress syndrome.

A1-A2: a 57-year-old female patient, 18 days from onset

B1-B2: a 75-year- old male patient, 15 days from onset.

There are diffuse lesions in the lungs bilaterally, which showed as “white lungs”.

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TAKE HOME MESSAGES

CT-Thorax: eerder positief dan PCR!

CT-Thorax: mist weinig (+/-4%)

CT-Thorax: kan mogelijk ernst bepalen

CT-Thorax: eerste 2 dagen nog negatief

CT-Thorax: specificiteit?? 24%/93% (training?)

CT-Thorax: eerder positief dan PCR!

CT-Thorax: mist weinig (+/-4%)

CT-Thorax: ***e***erste 2 dagen nog negatief, specificiteit 25%.

TAKE HOME MESSAGES

COVID -19

5.1.2e

Can also be done with fast-MRI