









ASST Spedali Civili

Session GTTI "Solutions against

pandemic"

BrixIA-Net: end-to-end multi-network solution for the assessment of COVID-19 pneumonia severity on Chest X-rays



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Chest X-rays (CXR) for COVID-19

Diagnosis Stratification Prognosis

Image processing/ Medical image analysis

CONTEXT	TASKS	Number of scientific works (preprint/ already published)	Dimension of the datasets
Diagnosis	Given a CXR is it COVID-19 or not?	>>100	Hundreds of CXR (early public availab.)
Stratification	Given a CXR assess the severity of COVID-19 pneumonia	3 1 (ours)	Hundreds of CXR Thousands of CXR
Prognosis	Given a CXR which is the patient deterioration risk?	1	Thousands of CXR + other data from clinical exams

COVID-19 Pneumonia Severity assessment: where&how?

Admisssion Triage (facility management) Monitoring (patient management) Retrospective (pathology understanding)





ALLO →



	Bedside	X-ray dose	Infection risk	Triage	Monitoring
Chest X-Ray	yes	low	low	<u>.</u>	<u>.</u>
Chest CT	no	high	high	<u></u>	

COVID-19 Pneumonia Severity assessment on CXR

Qualitative \rightarrow for case reporting Quantitative \rightarrow not suitable for CXR (possible on CT) Semi-quantitative \rightarrow scoring system \rightarrow Brixia-score \rightarrow

> Radiol Med. 2020 May;125(5):509-513. doi: 10.1007/s11547-020-01200-3. Epub 2020 May 1.

COVID-19 outbreak in Italy: experimental chest Xray scoring system for quantifying and monitoring disease progression





Andrea Borghesi ¹, Roberto Maroldi ²

- Score 0: no lung abnormalities
- Score 1: interstitial infiltrates
- Score 2: interstitial and alveolar infiltrates (interstitial predominance)
- Score 3: interstitial and alveolar infiltrates (alveolar predominance)





The BrixIA-Net

https://github.com/BrixIA/Brixia-score-COVID-19



- 2. Normalization
- 3. Score estimation

https://arxiv.org/abs/2006.04603



The BrixIA-Net

https://github.com/BrixIA/Brixia-score-COVID-19

- 1. Segmentation
- 2. Normalization
- 3. Score estimation

https://arxiv.org/abs/2006.04603





http://www.tg1.rai.it/dl/RaiTV/programmi/media/ContentItem-1f81a00c-d957-45c1-8417-a265835fa9f7-tg1.html#p=0

The BrixIA Dataset

https://brixia.github.io https://osf.io

Main CXR Dataset (4703 CXR) Consensus Gold Standard (150 CXR) Public Covid-19 Dataset (194 CXR)



Results

Single-cell and Global score Inter-rater agreement Qualitative (error analysis)







BS-Net Mean Absolute Error

	Regional score	Global score	
BS-Net-Ens	0.441	1.728	

Human Mean Absolute Error

	Regional score	Global score
Average on all pairs of radiologists	0.528	2.592

Performance of B5-Net exceeds those of radiologists in the Brixia-score annotation of CXR

Results

Single-cell and Global score Inter-rater agreement Qualitative (error analysis)





Deployment (in progress)

Second Opinion (explainability) **Worklist Prioritization** Deterioration Tracking (single reader)

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Thanks to the BrixIA Team...

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...and thanks for your attention!