

# BIBLIOMETRIC ANALYSIS OF THE 100 MOST CITED ARTICLES ON COVID-19 IN THE INTENSIVE CARE FIELD

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## ABSTRACT

**Introduction:** The COVID-19 pandemic affects the whole world and many studies were published about intensive care. Our aim is to assess the characteristics of 103 publications with most citations among literature related to COVID-19 in the intensive care field.

**Methods:** This descriptive cross-sectional study used suitable key words like “COVID-19”, “COVID-2019”, “SARS-CoV-2” and “pandemic” in the “Institute for Scientific Information Web of Science” database to determine the top 103 publications with most citations. Comparison of groups used the Kruskal Wallis and Mann Whitney U tests.

**Results:** Analysis of intensive care literature about COVID-19 up to October 2020 determined 1413 publications. The most-cited study had 1004 citations, while 7 was the minimum citations within the top 103 studies. The mean total citation number for these publications was  $49.58 \pm 117.63$ . The most-cited study was by Xu, Zhe et al. in the April 2020 issue of Lancet Respiratory Medicine entitled “Pathological findings of COVID-19 associated with acute respiratory distress syndrome”. When the areas of focus of the top studies are investigated, they were COVID-19 treatment (26.21%), experience and recommendations about COVID-19 (23.30%) and COVID-19 physiopathology (13.59%).

**Conclusions:** Our study is the first to analyze the top 103 studies with most citations related to COVID-19 in the intensive care literature. With the spread of the pandemic, academic articles continue to be published with great speed. Bibliographic studies provide critical information to assess the citation profile and determine the areas of focus. Future intensive care publications about COVID-19 will focus on diagnosis, treatment and physiopathology.

**Keywords:** Covid 19, Intensive Care, Citations, Top 103

## INTRODUCTION

The new acute infectious disease of coronavirus disease 2019 (COVID-19) was first reported in December 2019 in Wuhan and then spread to all provinces in China (1). COVID-19, caused by the novel coronavirus 2019, was declared a pandemic by the World Health Organization on 9 March 2020 (2). Up to the 2 November 2020, a total of 46,403,652 confirmed cases were reported in more than 200 countries with 1,198,569 mortalities (3) and this situation continues to cause concern around the

world. COVID-19 is associated with high disease load and 10% of confirmed cases progress to critical disease (4). Additionally, predictors for disease progression and mortality in critical patients are not fully understood. Since the first case was reported, intensivists have published a range of explanatory research about the clinical features of COVID-19. As the pathophysiology began to be understood, research focused on the pathology and clinical features of disease. Up to the beginning of October this year, more than a thousand articles have been

published related to intensive care units (ICU) and intensivists continue to share their experiences of the pandemic.

Bibliometric analyses assess the articles with most citations in a certain research field to show the most active journals, authors, countries, organizations and specializations (5). The Web of Science (WOS) online database includes nearly all of the important research articles with embedded analysis tools to produce representative numbers (6).

Performing bibliometric analysis is an important requirement in order for clinicians who spend a significant portion of time in intensive care with the continuation of the COVID-19 pandemic to benefit from these studies. According to the authors' knowledge and screening results of the English literature, there is no bibliometric analysis associated with the ICU during the COVID-19 pandemic. As a result, the aim of this study is to analyze the current scientific production in this field and to provide a purview. Our study will provide a broad perspective about research in a period during the COVID-19 pandemic when doctors have to produce emergency solutions and we think will provide an understanding about the direction studies will take in the future.

The aim of the study is to investigate and perform bibliometric analysis about the authors, journals of publication, countries and topics of the most cited articles at international level in the intensive care field related to COVID-19 pandemic screened via the Institute for Scientific Information (ISI) Web of Science search engine.

## MATERIAL AND METHODS

Planned as a descriptive cross-sectional study, after receiving ethics committee permission, the study was completed using the "advanced mode" of the ISI and WOS search engine (Decision no: 2020/26-18). Suitable key words were used (these key words are given in supplemental appendix 1). Our screening determined and listed the 103 articles with most citations among articles about COVID-19 in the intensive care field published internationally on 01.10.2020. The content of the articles was reviewed singly by the first author. Topics related to COVID-19 pandemic, specializations of the authors and journals were recorded. For each publication, the total number of citations, authors, information related to the study and journal were determined using the WOS. This method was previously used by the authors in another study (7).

## Statistical Analysis

Data obtained in the research were analyzed by entering data into the Statistical Package for Social Sciences (SPSS, Chicago, IL, USA) 20.0 program. Comparison of groups used the Kruskal Wallis test, Mann Whitney U test and student t test. p values below 0.05 were accepted as significant difference.

## RESULTS

Analysis of the intensive care literature until October 2020 determined a total of 1413 publications related to COVID-19.

The most cited study had 1004 citations, while within the top 103 studies with most citations, the minimum citation number was determined as 7. There were nine studies ranked in ninety-fifth place with minimum citation number of 7, so the study included a total of 103 articles. The mean total number of citations for the 103 studies with most citations was determined as  $49.58 \pm 117.63$ .

Luciano Gattinoni (8), who ranks first with three articles among the 103 most cited articles on covid-19, is also the scientist who invented the "Extracorporeal CO2 Removal" and promoted the "baby lung" (Table 1).

The institutions where 103 most cited articles in the field of intensive care related to the Covid-19 pandemic were written and the number of publications were respectively University of California, USA (4), University of Gottingen Germany (3), Huazhong Univ Sci & Technol, China (3) (Table 2). The respective top 103 articles related to COVID-19 in intensive care field are shown in table 3.

When the areas of focus for the top 103 studies with most citations related to COVID-19 in the intensive care field are investigated, the top three areas were COVID-19 treatment (26.21%), experience and recommendations about COVID-19 (23.30%) and COVID-19 physiopathology (13.59%) (Table 4).

The top three journals where the top 103 articles with most citations were published were determined as "Lancet Respiratory Medicine" (31.06%), "Critical Care" (21.35%), and "Intensive Care Medicine" (16.50%) (Table 4).

In terms of journal index, for the 103 articles with most citations related to COVID-19 in the intensive care literature, 93.20% were Q1, 2.91% were Q2 and 3.88% were Q3 index. There was no significant correlation determined between the index of the journal and the total citation numbers ( $p > 0.05$ ) (Table 4).

**Table 1.** First-name authors of the 103 most cited articles on Covid-19 in intensive care literature

| Author name  | Frequency | Percent % |
|--|-----------|-----------|
| Gattinoni, Luciano;  | 3         | 2,9       |
| Fang, Lei;   | 2         | 1,9       |
| Henry, Brandon Michael   | 2         | 1,9       |
| Liew, Mei Fong;  | 2         | 1,9       |
| Alhazzani, Waleed, Arabi Yaseen M, Ayebare, Rodgers R Buonsenso, Danilo; Busse, Laurence W. Cai, Hua Calabro, Luana Cao, Jianlei; Carr, Anitra C Chen, Ruchon G Cheung, Jonathan Chua, Felix Colombo, Carla Copin, Marie-Christine Cortegiani, Andrea; Couper, Keith; Cunningham, Anne Catherine Deng, Guangtong; Di Saverio, Salomone; Du, Yingzhen Feng, Shuo Feng, Yun Fox, Sharon E. Peters, Michael C ,Phua, Jason;Piva, Simone; Radbel, Jared; Ramanathan, Kollengode Ronco, Claudio Ruan Q Rubin, Geoffrey D. Shang, You Shao, Fei; Shi, Yu; Sinha, Ian P. Sodhi, Mohit Spagnolo, Paolo; Sun, Qin; Sward, Per; Taccone, Fabio S. Tang, Xia Tignanelli, Christopher J Tobin, Martin Vergano, Marco; Vincent, Jean-Louis Volpicelli, Giovanni Wang, Dawei; Wang, Hongliang Wang, Ke Wang, Yang; xie, Jianfeng; Xing, Changyang; Xu, Zhe Fraisse, Megan George, Peter M. Griffin, Kelly M.; Helms, Julie; Huang, Ian Huang, Lishan Hui, Kenrie P. Y. Hull, James H Ingraham, Nicholas E. Joly, Berangere S Jose, Ricardo J. Keith, Philip; Kirby, Tony Koffis, Katarzyn Leisman, Daniel E. Li, Lei; Li, Li; Li, Xu Liu, Xiaoqing; Martino, Francesca Matthay, Michael A. McGrath, Brendan A. Moore, Hunter B. Namendys-Silva, Silvio A. Needham, Edward J Niederman, Michael S. Ong, Jacqueline S. M Pan, Chun; Pan, Xiu-wu Peng, Qian-Y Perkins, G. D. Zangrillo, Alberto Zeng, Jie Zeng, Yingchun Zhang, Jinjun; Zhang, Yi; Ziehr, David R, Yu, Xia;, Rello, Jordi; Zhang, Wei | 1         | 94,1      |
| <b>Total</b>   | 103       | 100       |

When the distribution of researchers according to continent is investigated, Asia (39.80%), Europe (37.86%), America (19.41%) and other (2.91%) were determined (Table 4). There were no significant correlations determined between the authors' continent, journal continent and total citation numbers ( $p>0.05$ ) (Table 4).

When author characteristics are analyzed, articles with group authorship were found to have significantly more citations compared to studies that were not this type ( $p<0.05$ ) (Table 4). Additionally, articles with pathology as the area of employment among author characteristics were found to have significantly higher citation rates compared to other articles ( $p<0.05$ ) (Table 4). The total number of citations for publications related to the pathophysiology field were significantly higher than the total number of citations for publications not related to pathophysiology ( $p<0.05$ ) (Table 4).

There was no significant correlation found between the authors being pediatricists or adult clinicians; and the authors being preclinicians or clinicians with total citation numbers ( $p>0.05$ ) (Table 4).

There was no correlation between the type of article (letter, case report, case series), the journal of publication, and the country the journal with total citation numbers ( $p>0.05$ ) (Table 4).

**DISCUSSION**

In our study bibliographic analysis was performed for 103 articles with most citations found by screening the Web of Science collection database of the global literature about COVID-19 published in the intensive care field. The most commonly cited article was entitled "Pathological findings of COVID-19 associated with acute respiratory distress syndrome" and the top three journals publishing the 103 most cited articles were Lancet Respiratory Medicine, Critical Care and Intensive Care Medicine. Articles written by group authors, articles related to pathophysiology and articles written by authors in the pathology branch were determined to receive more citations.

Scientific studies play an important role in prevention and control of disease by updating our knowledge about the correlation between pandemics and history (9). All scientists around the world struggle for a

**Table 2.** The institutes of the 103 most cited articles on Covid-19 in intensive care literature.

| <i>The institutes</i>   | <i>paper</i> |
|---|--------------|
| University of California, USA                                 | 4            |
| University of Gottingen Germany                               | 3            |
| Huazhong Univ Sci & Technol, China                            | 3            |
| Zhejiang Univ, China  | 3            |
| Royal Brompton Hospital, London                               | 3            |
| Wuhan University, China                                       | 3            |
| Southeast University, China.                                  | 2            |
| Univ Hosp Basel, Switzerland                                  | 2            |
| Guangzhou Med Univ, China                                     | 2            |
| Univ Minnesota, USA   | 2            |
| IRCCS San Raffaele Scientific Institute, Italy                | 2            |
| Sanghai Jiao Tong University, R China                         | 2            |
| National University, Singapore                                | 2            |
| Rutgers-Robert Wood Johnson Medical School, NewBrunswick, USA | 2            |
| Beijing Chaoyang Hospital, China                              | 2            |
| Padua University, Italy                                       | 2            |
| University of Hong Kong, Hong Kong                            | 2            |
| The Fifth Medical Center of PLA General Hospital, China       | 1            |
| Central South University, China.                              | 1            |
| North District Hospital, China                                | 1            |
| Chinese People's Liberation Army General Hospital R, China.   | 1            |
| Second Mil Med Univ, China.                                   | 1            |
| Nanjing University China.                                     | 1            |
| Guangdong Second Provincial General Hospital, China           | 1            |
| Fourth Mil Med Univ, China.                                   | 1            |
| Shandong Univ, China.   | 1            |
| Central South University, China.                              | 1            |
| China Japan Friendship Hosp, Beijing, China                   | 1            |
| Shanghai Jiao Tong University China.                          | 1            |
| China Med Univ China  | 1            |
| Capital Medical University, Beijing                           | 1            |
| State Key Laboratory of Respiratory Diseases Guangzhou, China | 1            |
| Zunyi Medical University, China                               | 1            |
| Cincinnati Children's Hospital USA                            | 1            |
| Louisiana State University USA                                | 1            |
| Massachusetts General Hospital, USA                           | 1            |
| Lexington Medical Center, USA                                 | 1            |
| Loyola University of Chicago USA                              | 1            |
| Univ Colorado, USA  | 1            |
| Emory Univ, USA   | 1            |
| Weill Cornell Medicine New York, USA                          | 1            |

**Table 2.** Continue

| <i>The institutes</i>  | <i>paper</i> |
|--|--------------|
| New York Presbyterian Hospital, New York, USA                  | 1            |
| McMaster University Canada                                     | 1            |
| University of Palermo Italy                                    | 1            |
| Gemelli UnivItaly  | 1            |
| San Luigi Gonzaga Univ Hosp, Italy                             | 1            |
| Univ Milan, Italy  | 1            |
| Viale Univ, Italy  | 1            |
| Brescia Univ, Brescia, Italy                                   | 1            |
| San Bortolo Hosp, Italy.                                       | 1            |
| University of Insubria, It Italy.                              | 1            |
| CHU Strasbourg Serv Med, France                                | 1            |
| University of Oxford, UK                                       | 1            |
| Univ Brunei Darussalam, Brunei                                 | 1            |
| University Hospital of Siena, Italy                            | 1            |
| Erasme University Hospital, Bruxelles Belgium                  | 1            |
| Univ Libre Bruxelles, Belgium                                  | 1            |
| Minist Natl Guard Hlth Affairs, Saudi Arabia                   | 1            |
| Univ Lille, France   | 1            |
| Duke University, Canada  | 1            |
| Hospital Medica Sur, Mexico City                               | 1            |
| Pomeranian Medical University, Polonia                         | 1            |
| Alder Hey Childrens Hosp, England                              | 1            |
| University of Otago, New Zealand                               | 1            |
| University of Warwick, Coventry, UK                            | 1            |
| Manchester University, UK                                      | 1            |
| The UK's Intensive Care National Audit and Research Centre, UK | 1            |
| Makerere Univ, Uganda  | 1            |
| Univ Nottingham, England                                       | 1            |
| Khoo Teck Puat Natl Univ, Singapore                            | 1            |
| Univ Cambridge, England.                                       | 1            |
| Univ Pelita Harapan, EIndonesia                                | 1            |
| Univ British Columbia, Canada                                  | 1            |
| Saint Louis, Université, Belgium                               | 1            |
| Lund University, Sweden  | 1            |
| Centre Hospitalier Victor Dupouy, France.                      | 1            |
| Int Liaison Comm Resuscitat, Emile Vanderveldelaan Belgium     | 1            |
| Autonomous University of Barcelona                             | 1            |

**Table 3.** The 103 most cited articles on Covid-19 in critical care literature and citations rate

|    | <b>Article</b>   | <b>Authors</b>   | <b>Citation number</b> |
|----|--|--|------------------------|
| 1  | Pathological findings of COVID-19 associated with acute respiratory distress syndrome LANCET RESPIRATORY MEDICINE 2020;8(4):420-22   | Xu Z, Shi L, Wang Y et al.                                   | 1004                   |
| 2  | Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan. INTENSIVE CARE MEDICINE 2020;46(5):846-48.   | Ruan Q, Yang K, Wang W et al                                 | 479                    |
| 3  | Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection? LANCET RESPIRATORY MEDICINE 2020;8(4):404   | Fang L, Karakiulakis G, Roth M,                              | 404                    |
| 4  | Surviving Sepsis Campaign: Guidelines on the Management of Critically Ill Adults with Coronavirus Disease 2019 (COVID-19) CRITICAL CARE MEDICINE 2020;48(6): E440-E469   | Alhazzani W, Moller MH, Arabi Y M et al.                     | 280                    |
| 5  | A systematic review on the efficacy and safety of chloroquine for the treatment of COVID-19 JOURNAL OF CRITICAL CARE 2020;5:279-83 .   | Cortegiani A, Ingoglia G, Ippolito M et al.                  | 154                    |
| 6  | COVID-19 pneumonia: different respiratory treatments for different phenotypes? INTENSIVE CARE MEDICINE 2020;46(6):1099-102.  | Gattinoni L, Chiumello D, Caironi P et al                    | 145                    |
| 7  | COVID-19 Does Not Lead to a "Typical" Acute Respiratory Distress Syndrome By: Gattinoni, Luciano; Coppola, Silvia; Cressoni, Massimo; et al. AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE 2020;201(10):1299-1300 | Gattinoni L, Coppola S, Cressoni M et al                     | 133                    |
| 8  | High risk of thrombosis in patients with severe SARS-CoV-2 infection: a multicenter prospective cohort study INTENSIVE CARE MEDICINE 2020;46(6):1089-98  | Helms J, Tacquard C, Severac F et al. ( <b>grup author</b> ) | 125                    |
| 9  | Intensive care management of coronavirus disease 2019 (COVID-19): challenges and recommendations - LANCET RESPIRATORY MEDICINE 2020;8(5):506-17.   | Phua J, Weng L, Ling L et al. ( <b>grup author</b> )         | 113                    |
| 10 | Findings of lung ultrasonography of novel corona virus pneumonia during the 2019-2020 epidemic INTENSIVE CARE MEDICINE 2020;46(5):849-50.  | Peng QY, Wang, XT, Zhang ( <b>grup author</b> )              | 114                    |
| 11 | Staff safety during emergency airway management for COVID-19 in Hong Kong LANCET RESPIRATORY MEDICINE 2020;8(4): E19-  | Cheung JCH, Ho L T, Cheng JV et al                           | 82                     |
| 12 | Rational use of face masks in the COVID-19 pandemic LANCET RESPIRATORY MEDICINE 2020;8(5): 434-36  | Feng S, Shen C, Xia, N et al                                 | 80                     |
| 13 | Clinical Features of 85 Fatal Cases of COVID-19 from Wuhan A Retrospective Observational Study AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE 2020;201(11): 1372-79  | Du Y, Tu L, Zhu, P et al                                     | 73                     |
| 14 | Critical care crisis and some recommendations during the COVID-19 epidemic in China INTENSIVE CARE MEDICINE 2020;46(5): 837-40   | Xie J, Tong Z, Guan X et al.                                 | 73                     |
| 15 | Sex difference and smoking predisposition in patients with COVID-19 LANCET RESPIRATORY MEDICINE 2020;8(4): E20-  | Cai H.   | 71                     |
| 16 | Planning and provision of ECMO services for severe ARDS during the COVID-19 pandemic and other outbreaks of emerging infectious diseases LANCET RESPIRATORY MEDICINE 2020;8(5):518-26  | Ramanathan K, Antognini, D, Combes A et al.                  | 64                     |
| 17 | COVID-19 pneumonia: ARDS or not? CRITICAL CARE 2020;24(1):154  | Gattinoni L, Chiumello D, Rossi S                            | 62                     |

**Table 3.** Continue

|    |  |  |    |
|----|--|--|----|
| 18 | COVID-19 cytokine storm: the interplay between inflammation and coagulation<br>LANCET RESPIRATORY MEDICINE 2020;8(6): E46-E47  | Jose RJ,<br>Manuel A.  | 56 |
| 19 | COVID-19 with Different Severities: A Multicenter Study of Clinical Features<br>AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE<br>2020;201(11): 1380-88  | Feng Y, Ling Y,<br>Bai T et al.                                | 51 |
| 20 | Host susceptibility to severe COVID-19 and establishment of a host risk score: findings<br>of 487 cases outside Wuhan CRITICAL CARE 2020;24(1): 108  | Shi Y, Yu X<br>Zhao H et al                                    | 50 |
| 21 | Treatment of COVID-19: old tricks for new challenges CRITICAL CARE 2020;24(1):91   | Cunningham A<br>C, Goh HP,<br>Koh, D.                          | 49 |
| 22 | COVID-19 outbreak: less stethoscope, more ultrasound LANCET RESPIRATORY<br>MEDICINE 2020;8(5): E27-E27   | Buonsenso D,<br>Pata D,<br>Chiaretti A.                        | 48 |
| 23 | Identification of a potential mechanism of acute kidney injury during the COVID-19<br>outbreak: a study based on single-cell transcriptome analysis INTENSIVE CARE<br>MEDICINE 2020;46(6):114-16.          | Pan X, Xu D,<br>Zhang H. et al                                 | 47 |
| 24 | Treatment for severe acute respiratory distress syndrome from COVID-19 LANCET<br>RESPIRATORY MEDICINE 2020;8(5):433-34.  | Matthay M A,<br>Aldrich JM,<br>Gotts J E.                      | 46 |
| 25 | How to balance acute myocardial infarction and COVID-19: the protocols from Sichuan<br>Provincial People's Hospital INTENSIVE CARE MEDICINE 2020;46(6):1111-13.  | Zeng J, Huang,<br>J, Pan L.                                    | 44 |
| 26 | COVID-19, ECMO, and lymphopenia: a word of caution LANCET RESPIRATORY<br>MEDICINE 2020;8(4):E24-E24  | Henry BM   | 40 |
| 27 | Lung Recruitability in COVID-19-associated Acute Respiratory Distress Syndrome: A<br>Single-Center Observational Study AMERICAN JOURNAL OF RESPIRATORY AND<br>CRITICAL CARE MEDICINE 2020;201(10):1294-97. | Pan C, Chen L,<br>Lu C et al                                   | 36 |
| 28 | Lower mortality of COVID-19 by early recognition and intervention: experience from<br>Jiangsu Province BANNALS OF INTENSIVE CARE 2020;10(1):33.  | Sun Q, Qiu H,<br>Huang M. et al                                | 36 |
| 29 | Pulmonary and cardiac pathology in African American patients with COVID-19: an<br>autopsy series from New Orleans LANCET RESPIRATORY MEDICINE<br>2020;8(7):681-86.   | Fox SE,<br>Akmatbekov A,<br>Harbert J L. et<br>al.             | 34 |
| 30 | Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150<br>patients from Wuhan, China INTENSIVE CARE MEDICINE 2020;46(6):1294-97.   | Ruan Q, Yang<br>K, Wang W et al                                | 32 |
| 31 | Preparing for COVID-19: early experience from an intensive care unit in CRITICAL<br>CARE 2020;24(1):83.  | Liew MF, Siow<br>WT, MacLaren<br>G et al                       | 31 |
| 32 | Clinical Course and Outcomes of 344 Intensive Care Patients with COVID-19<br>AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE<br>2020;201(11):1430-34.   | Wang Y, Lu X,<br>Li Y. et al                                   | 29 |
| 33 | Understanding pathways to death in patients with COVID-19 LANCET RESPIRATORY<br>MEDICINE 2020;8(5):430-32. Article From Repository Times Cited: 29   | Vincent JL,<br>Taccone FS.                                     | 29 |
| 34 | Risk Factors of Fatal Outcome in Hospitalized Subjects With Coronavirus Disease 2019<br>From a Nationwide Analysis in China CHEST 2020;158(1):97-105.  | Chen R, Liang<br>W, Jiang M. et<br>al. <b>Group<br/>Author</b> | 28 |
| 35 | Hydroxychloroquine in the management of critically ill patients with COVID-19: the need<br>for an evidence base LANCET RESPIRATORY MEDICINE 2020;8(6):539-41.  | Taccone FS,<br>Gorham J,<br>Vincent JL.                        | 28 |
| 36 | COVID-19: a novel coronavirus and a novel challenge for critical care INTENSIVE<br>CARE MEDICINE 2020;46(5):833-36.  | Arabi YM,<br>Murthy S,<br>Webb S.                              | 28 |
| 37 | Time to consider histologic pattern of lung injury to treat critically ill patients with<br>COVID-19 infection INTENSIVE CARE MEDICINE 2020;46(6):1124-26.   | Copin MC,<br>Parmentier E,<br>Duburcq T et al                  | 27 |

**Table 3.** Continue

|    |   |  |    |
|----|---|--|----|
| 38 | The Role of Chest Imaging in Patient Management During the COVID-19 Pandemic A Multinational Consensus Statement From the Fleischner Society CHEST 2020;158(1):106-16.  | Rubin GD, Ryerson CJ, Haramati LB. et al.                    | 26 |
| 39 | In-hospital cardiac arrest outcomes among patients with COVID-19 pneumonia in Wuhan, China RESUSCITATION 2020;151:18-23.  | Shao FX, Shuang M, Xuedi; et al                              | 25 |
| 40 | Respiratory support for patients with COVID-19 infection LANCET RESPIRATORY MEDICINE 2020;8(49): E18-E18  | Namendys-Silva SA.   | 25 |
| 41 | Respiratory Pathophysiology of Mechanically Ventilated Patients with COVID-19: A Cohort Study AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE 2020;201(12): 1560-64  | Ziehr DR, Alladina J, Petri CR et al.                        | 24 |
| 42 | COVID-19: ICU delirium management during SARS-CoV-2 pandemic CRITICAL CARE 2020;24(1):176.  | Kotfis K, Williams R, Shawniqua W, Jo E. et al               | 24 |
| 43 | Special attention to nurses' protection during the COVID-19 epidemic CRITICAL CARE 2020;24(1):120.  | Huang L, Lin G, Tang L et al.                                | 23 |
| 44 | Clinical course and outcome of 107 patients infected with the novel coronavirus, SARS-CoV-2, discharged from two hospitals in Wuhan, CRITICAL CARE 2020;24(1)   | Wang D, Yin Y, Hu C. et al                                   | 21 |
| 45 | A novel treatment approach to the novel coronavirus: an argument for the use of therapeutic plasma exchange for fulminant COVID-19 CRITICAL CARE 2020;24(1):128.  | Keith P, Day M, Perkins L et al.                             | 21 |
| 46 | COVID-19 infection in children LANCET RESPIRATORY MEDICINE 2020;885):446-47.  | Sinha IP, Harwood R, Semple MG. et al.                       | 20 |
| 47 | Management of acute kidney injury in patients with COVID-19 LANCET RESPIRATORY MEDICINE 2020;8(7):738-42  | Ronco C, Reis T, Husain-Syed F.                              | 19 |
| 48 | Basing Respiratory Management of COVID-19 on Physiological Principles AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE 2020;201(11): 1319-20  | Tobin M.   | 19 |
| 49 | Facing COVID-19 in the ICU: vascular dysfunction, thrombosis, and dysregulated inflammation INTENSIVE CARE MEDICINE 2020;46(6):1105-08.   | Leisman DE, Deutschman CS, Legrand M.                        | 19 |
| 50 | COVID-19-related Genes in Sputum Cells in Asthma Relationship to Demographic Features and Corticosteroids AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE 2020;202(1):83-90.   | Peters MC, Sajuthi S, Deford P. et al<br><b>Group Author</b> | 18 |
| 51 | A new clinical trial to test high-dose vitamin C in patients with COVID-19 CRITICAL CARE 2020;24(1):133   | Carr AC.   | 18 |
| 52 | Safe patient transport for COVID-19 CRITICAL CARE 2020;24(1):94.  | Liew MF, Siow WT, Yau YW. et al                              | 18 |
| 53 | Clinical features and short-term outcomes of 18 patients with corona virus disease 2019 in intensive care unit INTENSIVE CARE MEDICINE 2020;46(5):851-53.   | Cao J,Hu X, ; Cheng W. et al                                 | 18 |
| 54 | Tropism, replication competence, and innate immune responses of the coronavirus SARS-CoV-2 in human respiratory tract and conjunctiva: an analysis in ex-vivo and in-vitro cultures LANCET RESPIRATORY MEDICINE 2020;8(7):687-95. | Hui KPY, Cheung MC, Perera RAPM. et al.                      | 17 |

**Table 3. Continue**

|    |   |   |    |
|----|---|---|----|
| 55 | COVID-19 in cardiac arrest and infection risk to rescuers: A systematic review<br>RESUSCITATION 2020;151:59-66.   | Couper K, Taylor-Phillips S, Grove A. et al.                    | 17 |
| 56 | Tracheostomy in the COVID-19 era: global and multidisciplinary guidance LANCET<br>RESPIRATORY MEDICINE 2020;8(7):717-25   | McGrath BA, Brenner MJ, Warrillow SJ. et al                     | 16 |
| 57 | Use of Tocilizumab for COVID-19-Induced Cytokine Release Syndrome A Cautionary<br>Case Report J. CHEST 2020;158(1): E15-E19   | Radbel J, Narayanan N, Bhatt PJ.                                | 16 |
| 58 | Comparison of Hospitalized Patients With ARDS Caused by COVID-19 and H1N1<br>CHEST 2020;158(1):195-205  | Tang X, Du, RW, Wang R. et al                                   | 16 |
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| 62 | COVID-19 and the RAAS-a potential role for angiotensin II? CRITICAL CARE<br>2020;24(1):136.   | Busse LW, JH, McCurdy MT. et al.                                | 16 |
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| 71 | A Novel Coronavirus (COVID-19) Outbreak A Call for Action CHEST 2020;157(4):<br>E99-E101  | Zhang Y, Xu J, Li H. et al.                                     | 12 |
| 72 | Coronavirus Disease 2019 in Critically Ill Children: A Narrative Review of the Literature*<br>PEDIATRIC CRITICAL CARE MEDICINE 2020;21(7):662-66 Published: JUL 2020<br>Free Full Text from Publisher View Abstract Times Cited: 11 | Ong JSM, Tosoni A, Kim Y. et al                                 | 11 |

**Table 3. Continue**

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|----|---|--|----|
| 73 | Lung ultrasound findings in patients with COVID-19 pneumonia CRITICAL CARE 2020;24(1):174.  | Xing C, Li Q, Du H. et al.                     | 11 |
| 74 | Familial cluster of COVID-19 infection from an asymptomatic CRITICAL CARE 2020;24(1):119.   | Zhang J Tian S, Lou J. et al                   | 11 |
| 75 | Pulmonary fibrosis secondary to COVID-19: a call to arms? LANCET RESPIRATORY MEDICINE 2020;8(8):750-52.   | Spagnolo P, Balestro E, Alibert S. et al;      | 10 |
| 76 | Immunomodulation in COVID-19 LANCET RESPIRATORY MEDICINE 2020;8(6): 544-46  | Ingraham NE, Lotfi-Emran S, Thielen BK. et al. | 10 |
| 77 | Acute respiratory failure in COVID-19: is it "typical" ARDS? CRITICAL CARE 2020;24(1)   | Li X, Ma X.                                    | 10 |
| 78 | Antihypertensive drugs and risk of COVID-19? LANCET RESPIRATORY MEDICINE 2020;8(5): E32-E33   | Fang L, Karakiulakis G, Roth M.                | 10 |
| 79 | Kidney transplant programmes during the COVID-19 pandemic LANCET RESPIRATORY MEDICINE 2020;8(5): E39-E39  | Martino F, Plebani M, Ronco C.                 | 10 |
| 80 | Antihypertensive drugs and risk of COVID-19? BLANCET RESPIRATORY MEDICINE 2020;8(5):E30-E31   | Tignanelli CJ, Ingraham NE, Sparks MA. et al   | 10 |
| 81 | Neurological Implications of COVID-19 Infections NEUROCRITICAL CARE 2020;32(3):667-71.  | Needham EJ, Chou SHY, Coles AJ. et al.         | 10 |
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| 88 | Respiratory health in athletes: facing the COVID-19 challenge LANCET RESPIRATORY MEDICINE 2020;8(6):557-58.   | Hull JH, Loosemore M, Schwellnus M.            | 8  |
| 89 | Understanding pathophysiology of hemostasis disorders in critically ill patients with COVID-19 INTENSIVE CARE MEDICINE 2020;46(8):1603-06.  | Joly BS, Siguret V, Veyradier A.               | 8  |
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**Table 3. Continue**

|     |  |   |   |
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| 91  | Rising to the Challenge of COVID-19: Advice for Pulmonary and Critical Care and an Agenda for Research AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE 2020;201(9): 1019-22   | Niederman MS, Richeldi L, Chotirmall, SH. et al | 8 |
| 92  | Clinical determinants for fatality of 44,672 patients with COVID-19 CRITICAL CARE 2020;24(1): 179  | Deng G, Yin M, Chen, X. et al.                  | 8 |
| 93  | COVID-19: the need for continuous medical education and training LANCET RESPIRATORY MEDICINE 2020;8(4): E23-E23  | Li L, Xv Q, Yan J.                              | 8 |
| 94  | COVID-19 infection epidemic: the medical management strategies in Heilongjiang Province, China CRITICAL CARE 2020;24(8):107  | Wang H, Wang, S Yu K.                           | 8 |
| 95  | Management of critically ill patients with COVID-19 in ICU: statement from front-line intensive care experts in Wuhan, China ANNALS OF INTENSIVE CARE 2020;10(1):73.   | Shang Y, Pan C, Yang X. et al.                  | 7 |
| 96  | Thrombotic and hemorrhagic events in critically ill COVID-19 patients: a French monocenter retrospective study CRITICAL CARE 2020;24(19):275.  | Fraisse M, Logre E, Pajot O. et al.             | 7 |
| 97  | Challenges in lung cancer therapy during the COVID-19 pandemic LANCET RESPIRATORY MEDICINE 2020;8(6):542-44.   | Calabro L, Peters S, Soria JC. et al.           | 7 |
| 98  | International Liaison Committee on Resuscitation: COVID-19 consensus on science, treatment recommendations and task force insights. RESUSCITATION 2020;151:145-147   | Perkins GD, Morley PT, Nolan JP. et a           | 7 |
| 99  | Ventilatory Ratio in Hypercapnic Mechanically Ventilated Patients with COVID-19-associated Acute Respiratory Distress Syndrome AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE 2020;201(10):1297-99. Pages: 1297-1299 | Liu X, Xuesong XY. et al.                       | 7 |
| 100 | 15-day mortality and associated risk factors for hospitalized patients with COVID-19 in Wuhan, China: an ambispective observational cohort study INTENSIVE CARE MEDICINE 2020;46(7):1472-74.                                     | Wang K, Zhang Z, Yu M. et al.                   | 7 |
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| 102 | Coronavirus Disease 2019 (COVID-19): A critical care perspective beyond China By: Rello, Jordi; Tejada, Sofia; Userovici, Caroline; et al. ANAESTHESIA CRITICAL CARE & PAIN MEDICINE 2020;39(2):167-69.                          | Rello J, Tejada S, Userovici C. et al           | 7 |
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**Table 4.** The characteristics of the 103 most cited articles on Covid-19 in intensive care literature

|                             | <b>Subgroups</b>  | <b>N</b> | <b>Overall citation number mean ± SD</b> | <b>p value</b> |
|-----------------------------|-------------------|----------|--|----------------|
| <b>Authors' Nationality</b> | China             | 34       | 70,64±183,86                             | 0,529          |
|                             | USA               | 17       | 23,35±16,40                              |                |
|                             | Italy             | 13       | 26,46±39,68                              |                |
|                             | England           | 9        | 18,00±14,87                              |                |
|                             | Canada            | 4        | 82,50±131,87                             |                |
|                             | France            | 4        | 41,75±56,25                              |                |
|                             | Singapore         | 4        | 43,25±47,23                              |                |
|                             | Belgium           | 3        | 21,33±12,42                              |                |
|                             | Germany           | 3        | 113,33±44,85                             |                |
|                             | Sweetzerland      | 2        | 207,00±278,60                            |                |
|                             | Australia         | 2        | 41,00±32,52                              |                |
|                             | Hong kong         | 2        | 49,50±45,96                              |                |
|                             | Saudi Arabia      | 1        | 28,00                                    |                |
|                             | Brunei            | 1        | 49,00                                    |                |
|                             | Polond            | 1        | 24,00                                    |                |
|                             | Eindonesia        | 1        | 9,00                                     |                |
|                             | Uganda            | 1        | 15,00                                    |                |
| Sweden                      | 1                 | 8,00     |  |                |
| <b>Authors' country</b>     | Asia              | 41       | 40,87±75,30                              | 0,950          |
|                             | Europa            | 39       | 74,02±172,93                             |                |
|                             | USA               | 20       | 22,35±15,53                              |                |
|                             | Other             | 3        | 32,33±27,46                              |                |
| <b>Group Author</b>         | Group Author      | 10       | 95,50±82,18                              | <b>0,002</b>   |
|                             | Non-group Author  | 93       | 45,90±119,16                             |                |
| <b>Pediatric/Adult</b>      | Adult             | 97       | 50,44±121,05                             | 0,331          |
|                             | Pediatric         | 6        | 35,6±8,14                                |                |
| <b>Clinic/preclinic</b>     | Clinic            | 85       | 49,58±117,63                             | 0,392          |
|                             | Preclinic         | 18       | 98,00±251,07                             |                |
| <b>Q index</b>              | Q1                | 96       | 50,89±122,02                             | 0,335          |
|                             | Q2                | 3        | 11,00±2,00                               |                |
|                             | Q3                | 4        | 47,00±71,40                              |                |
| <b>Article Type</b>         | Letter            | 66       | 41,43±77,20                              | 0,801          |
|                             | Review            | 16       | 34,81±43,79                              |                |
|                             | Case /Case series | 6        | 181,83±402,89                            |                |
|                             | Retrospektive     | 5        | 38,60±23,15                              |                |
|                             | Guideline         | 4        | 82,50±131,87                             |                |
|                             | Prospective       | 3        | 51,66±63,57                              |                |
|                             | Other             | 3        | 15,33±1,52                               |                |
| <b>Author specialty</b>     | Intensivist       | 51       | 32,25±45,21                              | <b>0,018</b>   |
|                             | Other             | 31       | 36,51±74,29                              |                |
|                             | Anesthesist       | 8        | 63,12±51,57                              |                |
|                             | Pathology         | 7        | 230,14±380,83                            |                |
|                             | Pediatric         | 6        | 35,66±26,14                              |                |

**Table 4.** Continue

|                                   |   |    |              |       |
|-----------------------------------|---|----|--------------|-------|
| <b>Journals</b>                   | LANCET<br>RESPIRATORY<br>MEDICINE                                   | 32 | 73,21±184,07 | 0,225 |
|                                   | CRITICAL CARE   | 22 | 20,09±15,23  |       |
|                                   | INTENSIVE CARE<br>MEDICINE  | 17 | 86,41±123,40 |       |
|                                   | AMERICAN JOURNAL<br>OF RESPIRATORY<br>AND CRITICAL CARE<br>MEDICINE | 11 | 36,90±37,69  |       |
|                                   | CHEST   | 6  | 17,66±7,84   |       |
|                                   | JOURNAL OF<br>CRITICAL CARE   | 3  | 60,33±81,13  |       |
|                                   | ANNALS OF<br>INTENSIVE CARE   | 3  | 17,66±15,94  |       |
|                                   | RESUSCITATION   | 3  | 16,33±9,01   |       |
|                                   | JOURNAL OF<br>TRAUMA AND ACUTE<br>CARE SURGERY                      | 2  | 10,50±3,53   |       |
|                                   | PEDIATRIC<br>CRITICAL CARE<br>MEDICINE                              | 1  | 11,00        |       |
|                                   | NEUROCRITICAL<br>CARE   | 1  | 10,00        |       |
|                                   | JOURNAL OF<br>INTENSIVE CARE  | 1  | 9,00         |       |
|                                   | ANAESTHESIA<br>CRITICAL CARE &<br>PAIN MEDICINE                     | 1  | 7,00         |       |
| <b>Country of the<br/>journal</b> | England   | 59 | 48,79±137,55 | 0,118 |
|                                   | USA   | 35 | 59,94±93,71  |       |
|                                   | Holland   | 6  | 17,66±7,84   |       |
|                                   | Germany   | 2  | 8,50±2,12    |       |
|                                   | France  | 1  | 7            |       |
| <b>Study Interest</b>             | Treatment of Covid-19   | 27 | 33,18±34,55  | 0,013 |
|                                   | Experience,suggest  | 24 | 34,45±56,63  |       |
|                                   | Pathophysiology of<br>Covid-19                                      | 14 | 93,07±262,58 |       |
|                                   | Diagnosis of Covid-19   | 11 | 69,63±139,24 |       |
|                                   | Strategy of Covid-19  | 10 | 14,30±20,63  |       |
|                                   | Risk Factors of Covid-<br>19  | 10 | 79,60±120,03 |       |
|                                   | Protection of Covid-19  | 3  | 12,33±5,13   |       |
|                                   | Health worker<br>protection   | 2  | 52,50±41,71  |       |
|                                   | Chloroquine   | 1  | 154,00       |       |
|                                   | Mask  | 1  | 80,00        |       |

common aim during pandemics (10). The COVID-19 pandemic contributed to the “battlefield” in a short duration as intensivists in the front lines of the struggle with the disease shared their experiences and recommendations.

In our study, 1413 ICU publications related to COVID-19 indexed in the WOS database were analyzed. Analysis of the published literature shows studies focus on three areas: disease diagnosis, treatment and physiopathology. Topics with most citations in the section related to the ICU for the disease were mostly related to clinical presentation and pathophysiology of the disease. Understanding the basic physiological and immunological processes underlying the clinical symptoms of COVID-19 carries vital importance for rational design and identifying effective treatments so research related to the pathophysiology of the disease was completed (11). The study area with most citations in our study appeared to be COVID-19 physiopathology.

When the pandemic first emerged in Wuhan, Chinese scientists began to write articles and receive citations. In our analysis, the study with most citations was by Xu, Zhe et al. published in April 2020 in the *Lancet Respiratory Medicine* journal entitled “Pathological findings of COVID-19 associated with acute respiratory distress syndrome”. In parallel with the most cited research coming from China, when the continents of the authors of the top 103 articles receiving most citations are analyzed, first place was authors from Asia at 39.80%. This situation is thought to be related to the first publications about the pandemic beginning in China being from China and the Asian continent. However, though Chinese-sourced publication numbers were higher compared to publications from the European continent, the total citation numbers were more for publications sourced in Europe.

When the author characteristics are researched, articles by authors working in study groups received more citations. This situation is linked to the increase in the number of citations of publications developed via different cooperation types (12). Growth curves show that articles written by multinational or national multiorganizational cooperation have increased percentages. However, the percentages for within-organization cooperation and single author studies are reducing (13). From this aspect, publications related to COVID-19 are similar to other areas of science. Cooperation is at the fore of developing science.

Additionally, when the author features of the most cited articles are researched, it appears adult publications are in the majority. This situation may be connected to the confirmed case numbers among pediatric cases around the world (4 months to 17 years) comprising less than 0.02% of total case numbers and children who are severe cases comprising ~7.9% of cases (14). The low number of pediatric cases may have caused the COVID-19 pandemic to attract the attention of pediatric intensivists less compared to adult intensivists.

When author characteristics are investigated, 51% of authors of the most cited articles in the ICU field were intensivists, while the remaining authors were 31% other, 8% anesthesia and reanimation clinician group, 7% pathology and 6% pediatric branches.

When the 103 articles with most citations were analyzed according to topic, quinine studies appear to come to the fore in the treatment group. Additionally, antiviral treatment studies about remdesivir (15), arbidol (16) and lopinavir-ritonavir (17) were published in the literature. Additionally, conclusions are still debated due to the differences in severity of patients and the limited sampling size (18). Medical treatment will be a priority for research in the future.

Additionally, when the top 103 cited articles about the COVID-19 pandemic related to the ICU are analyzed according to type, the top three types were letters, reviews and case/case series. This situation is different to analysis of the most cited articles in other studies. When the top 100 cited articles in a journal published since 1920 are researched according to type, observational studies, reviews and randomized studies appeared to dominate, respectively (19). Another study performing bibliometric analysis of 100 articles with most citations about geriatric anesthesia, similarly found randomized controlled studies appeared to receive most citations (7). The different results in our study may be connected to COVID-19 being a new disease and the lack of sufficient time to perform observational and randomized studies and create guidelines and reviews. We think that if bibliometric studies about COVID-19 are repeated at certain time intervals, the citation trend will move from letters and case/case series toward reviews, meta-analysis and guidelines. As a result, bibliometric studies are important in terms of illuminating the direction of scientific development.

When journals publishing the most cited articles are analyzed, a significant portion appeared to be in

journals classified as Q1. The top three journals for most cited articles were Lancet Respiratory Medicine (32%), Critical Care (22%), and Intensive Care Medicine (17%), respectively. When the most cited journals are analyzed according to country, it appeared the United Kingdom was 1st place (58%). Second and third place were the United States of America and Holland. To intervene against the pandemic, medical journals with high impact like the Lancet, British Medical Journal and New England Journal of Medicine opened special columns for COVID-19, which led to advantages in terms of the number of articles published (20). The high citation rates for articles published in Q1 journals with high impact factor in the academic field and separation in special columns within these journals may be explained by the large interest in the COVID-19 pandemic around the world.

When publications about COVID-19 are investigated, it appears that some were accepted for publication more rapidly than predicted and some were later retracted (21). If this study is repeated in the future, we think that some publications included in our study may be retracted. However, our aim in this publication is not to pay attention to retracted publications about COVID-19. In the future, we think another study can be performed about articles published and receiving most citations about COVID-19 which were later retracted.

### Limitations

Publications related to COVID-19 were obtained from the WOS and data were analyzed objectively and comprehensively. Additionally, some limitations are still unavoidable. Firstly, many new research articles are added to the WOS every day, and citation numbers vary every day. As a result, our analysis reflects the situation on 1 October 2020. Citation numbers and rankings may vary after this date. Additionally, the key words included in the study are assigned by WOS and as a result, though a very small possibility, some publications may not have been included in the analysis due to reasons related to WOS. However, this rate is low and not only valid for this study. In fact, all studies dealing with this topic have the same limitation.

### CONCLUSION

Our study is the first to assess and analyze the most cited 103 publications related to COVID-19 in the intensive care literature. Current growth curves

predict a large increase in the number of global publications related to COVID-19. Currently, intensive care publications about COVID-19 focus on the topics of diagnosis, treatment and physiopathology. Bibliometric studies at certain intervals to be performed about COVID-19 will form a guide showing citation trends and the direction of scientific progress.

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**Author contributions:** The contribution of both authors was equal in designing the study, reviewing the literature, being prepared for the ethics committee, collecting, analyzing and reporting the data.

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**Peer-review:** Externally peer-reviewed.

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