

**Thesis**

**SOCIAL MEDIA IN MEDICINE**

**Comparison of the impact of new media on the dissemination of  
landmark studies in critical care and sepsis 2001 – 2015**

submitted by:

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Graz, 28.11.2015

### *Declaration*

*I hereby declare that this thesis is my own original work and that I have fully acknowledged by name all of those individuals and organizations that have contributed to the research for this thesis. Due acknowledgment has been made in the text to all other material used. Throughout this thesis and in all related publications I followed the guidelines of “Good Scientific Practice”.*

*Graz, am 28.11.2015*

Anika Konstantiniuk eh.

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# Zusammenfassung

## Hintergrund

Seit 2004 sind soziale Medien wie Twitter und Facebook eine neue wichtige Quelle für alle Arten von Informationen. Neueste Studien zeigen, dass es einen Trend weg von traditionellen Medien hin zu Online Medien zur Informationssuche gibt. Dieser Trend findet sich mehr und mehr auch unter WissenschaftlerInnen. Diese nutzen Online Medien nicht nur, um nach den Arbeiten anderer WissenschaftlerInnen zu suchen, sondern auch um auf ihre Arbeit aufmerksam zu machen. Die sozialen Medien spielen dabei mittlerweile eine wichtige und vernetzende Rolle und bieten den WissenschaftlerInnen eine interaktive Möglichkeit, ihre Arbeit zu präsentieren und sogar direkt Fragen zu diesen zu beantworten. Inwieweit dieser Trend die Wissenschaft in der Intensivmedizin erreicht hat, sollte im Rahmen dieser Arbeit untersucht werden.

## Methoden

Mittels quantitativer Erhebung wurden Daten zu zwölf wichtigen intensivmedizinischen Studien und deren ErstautorInnen mittels neuen und traditionellen Publikationsstatistiken erhoben. Dabei wurde das Augenmerk auf vier Studien gesetzt, die sich mit Early-Goal Directed Therapy bei Sepsis beschäftigen. Diese wurden mit anderen großen intensivmedizinischen Studien verglichen. Die Online Plattformen inkludierten Twitter, Altmetrics, ResearchGate, Google Scholar und Web of Science.

## Resultate

Die Erhebung zeigte, dass die Sepsis-Studien im Vergleich zu anderen intensivmedizinischen Studien in den sozialen Medien besser vertreten sind. Die proCESS Studie (2014) hatte den höchsten Altmetric Score von allen untersuchten Studien. Die ARISE Studie führt als einzige Studie einen Twitter Account. Obwohl die Rivers Studie schon 14 Jahre zurück liegt, hat sie einen überdurchschnittlichen hohen Altmetric Score (Rivers=176 vs Mittelwert=80). Zwischen dem Altmetric Score, Google Citations ( $r=-0.001$ ,  $p=0.998$ ) und dem Publikationsdatum ( $r=0.022$ ,  $p=0.945$ ) bestand keine Korrelation.

## Schlussfolgerung

Mittels der Erhebung konnte gezeigt werden, dass Sepsis-Studien überdurchschnittlich gut innerhalb des wissenschaftlichen Feldes der Intensivmedizin in den sozialen Medien vertreten sind. Die Resultate zeigen keinen signifikanten Zusammenhang zwischen dem Zeitraum seit der ersten Publikation und dem Erfolg in den sozialen Medien. Diese neuen Methoden eröffnen

wesentliche neue Forschungsfelder und Möglichkeiten des Wissenstransfers von WissenschaftlerInnen an KlinikerInnen.

## **Abstract**

### **Background**

Since 2004, social media have become an increasingly important source of information. This trend now reaches scientists of all disciplines, who use the online media to collect news and to disseminate information and awareness about their work. The social media play a connecting role and provide scientists an interactive way to promote their work and answer questions. The purpose of this thesis is to examine if this is the case in the field of intensive care as well.

### **Methods**

Quantitative data about twelve important studies was collected. We compared four studies about early-goal directed therapy (EGDT) in sepsis with eight alternative major ICU studies analyzing Twitter, Altmetrics, ResearchGate, Google Scholar, Web of Science and other traditional publication statistics.

### **Results**

Sepsis studies had a higher social media representation in comparison to the other ICU studies. The ProCESS study (2014) had the highest Altmetric score of all examined studies. The ARISE study (2014) even has a Twitter Account. Although the original EGDT trial has been published fourteen years ago, it had a very high Altmetric score (original EGDT=176 vs arithmetic mean=80 in all studies). Interestingly, the Altmetric Score neither correlated with Google Citations ( $r=-0.001$ ,  $p=0.998$ ) nor publishing date ( $r=0.022$ ,  $p=0.945$ ).

### **Conclusion**

We show that major sepsis studies have a high impact in the social media. The results suggest no significant correlation between publishing date and the impact in the social media. However, these recent developments open up many new possibilities for research and clinical practice.

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## Introduction

Before Web 2.0, the mass media was the original source of news and information. The individual would gather information relating their common interests by buying newspapers, watching TV or reading books. But in 2004 the internet changed. Without expert knowledge, before this time, everyone was a consumer of mostly single webpages. Search engines often led to unrelated websites and broken links.

With Web 2.0, the user became the “creator” and had the ability to create content fast and in a simple way. By that time, social media sites like MySpace and Facebook arose, allowing the users to share personal information and interact with other platform users. Search engines like Google or Yahoo improved their search-algorithms substantially. By now, they are updating the algorithms every day, making it even easier to access required information and news. However, it is still unclear how these algorithms are built, as some topics are easier to find than others – this elicits the question if these algorithms can help gain access to unpopular topics or if the algorithms rather exclude some topics (Brossard D. S., 2013).

The scientific world always relied on paper based journals to spread information about new studies. With the internet, new possibilities arose to get the attention and awareness of the public and scientists. To date, papers can be easily accessed electronically and can be found by search engines.

60% of the U.S. public seeks information about scientific topics via the internet (Board, 2012). Researchers and their institutes, who picked up the trend are now using blogs, podcasts and social media to promote their studies.

Whereas in the past the success and impact of scientific papers was measured by the journal they appeared in and how often they were cited, there are now new metrics measuring the impact of certain papers on the internet. Methods like analyzing the Twitter-activity of a study’s account or measuring the number of mentions of a paper within the social media opens up new possibilities to raise awareness for one’s study.

Severe sepsis is a phenomenon in many clinical fields like obstetrics, pediatrics and above all intensive care. Many patients from the intensive care unit were admitted by the emergency department and have a higher in-hospital mortality rate than other intensive care unit patients. In 2001, Emanuel Rivers published a landmark study on early goal-directed therapy (EGDT) which profoundly changed the way sepsis was treated. His protocol led to a new guideline by the Survive Sepsis Campaign, which was used all over the world. His study had enormous scientific impact in his research field and was cited many times.

Although his protocol of the early goal-directed resuscitation therapy became the new gold standard, many scientists questioned his therapy and started new trials varying certain aspects of the protocol. These scientists already used social media to promote their work. They are being cited on webpages or retweeted on Twitter. This leads to the main question of the paper: How are the scientists of the sepsis studies using the social media to raise awareness about their work.

Using twitter is very popular in the U.S., even among scientists. The popular use of Twitter led to the “K – Index”, or “Kardashian-Index”, which increased the ambition to share information and opinions to gather an audience - for scientists and others. (You, 2014). Because scientists are active on various social media sites, it is hard to measure their whole impact. Altmetric.com gathers data about a given study found on various online and social media sites to present a new rating measurement, the *Altmetric score*.

This thesis will collect data about the popularity of the main sepsis studies and their impact in the social media as well as in the traditional measurements like data from “Web of Science”, “Google Scholar” and “H-Index”. It can therefore be compared within one and a half decades of internet development.

## **1.1. Social Media**

### **1.1.1. The beginning of social media with the Web 2.0**

The change from Web 1.0 to 2.0 did not happen overnight. It was a slow procedure that took place in the years 2003 and 2004. Web 2.0 is a word for many phenomena differing from the internet as it was known before. The main changing factor was the interaction of the user and the content. During Web 1.0 there were hardly any content creators. This was based on the fact that to create websites, a high-level knowledge of HTML (Hypertext Markup Language) was required. Furthermore, websites consisted of many single, unconnected pages. With Web 2.0, it was now possible for the consumer to become the creator of content and to connect the content via links. So the Web 2.0 is both a platform for innovative technologies and a space where users are the primary object. These new factors led to the innovation of social networks as Facebook (founded 2004) or MySpace (founded 2003). In these systems, the participants of the social network are as important as the content they create and share with others (Cormode, 2008).

As anticipated, internet use increased rapidly in the last decade. A study by Facebook Germany showed that the number of Facebook users increased by more than 200 % in the year 2010 from 4,5 million to 10 million (Cleffmann, Feuerabend, & Howald, 2010).

The ACTA Study of the Institute of Allensbach published their results of internet use in October 2009. They found that the percentage of internet users increased by 51% from 2008 to 2009. 68% of teenagers stated that they interact with at least one friend via internet on a daily basis (Cleffmann, Feuerabend, & Howald, 2010).

91.3% of questioned young people between the age of 14 and 29 use the internet on a daily basis. For them the internet is the first place to look up information. Increasingly, men and women in their 60s or 70s use the internet and have been named, the „Silver Surfers“ (Hettler, 2010).

These numbers lead to the interpretation that social platforms not only hold the option to share personal information, but to gather and share news about common interests such as science.

### **1.1.2. The development of information-dissemination via social media**

Social media opened up new possibilities to send and receive information. The first piece of information about a certain event is often relayed by and gathered from eyewitnesses. This occurred also before social media was introduced in the communications industry via print or

TV. However, in social media the breaking news not only appears faster, but can be distributed by other users within an instant. For example, during the Haiti earthquake in 2010, social media played a key role in distributing information about the event (Bunz, 2010) and organizing targeted search for survivors.

Increasingly, lay people and experts also use social media to search health information. A national survey conducted in the U.S. in 2010, found that 80% of internet users have looked online for information about healthcare topics. Concerning social media they found out that *„23% of the social network users, or 11% of adults, have followed their friend’s personal health care experiences or updates on their site“* (Fox, 2011).

McNab (2009) suggests that people use the social media to gather and give information due to the anonymity it provides. They can access or send the information without disclosing their own personal information but these facts also question the credibility of information given via social media.

### **1.1.3. Scientific topics in the social media**

With the increasing impact of social media, the dissemination of scientific research via the social platforms developed as well.

*„The keyword ,science’ produces two billion Google search results in 0.16 seconds, and the ScienceAlert Facebook page has three million ,likes.’“* (Brossard D., 2013)

In the last years, it became easier to find scientific papers with the use of search engines and accessing them by downloading an electronic version of the original paper.

Many scientists now share their scientific knowledge via videos on Youtube, posts on Facebook or interviews in podcasts. The audience can not only consume this information, but interact with it by reposting, retweeting or simply commenting on it. Through this interaction the information is shared from one user to their network and thus to the next possible information-sharer (Brossard D. , 2013).

However, scientific information dissemination faces a problem that occurs with other information shared via social media as well: platforms, blogs or other online information sources often do not differentiate between opinion and facts. The option for anyone to comment or post one’s opinion below the information can profoundly affect the reader’s interpretation and lead to false conclusions (Anderson AA, 2013).

More and more, scientists become active social media users themselves (Allgaier J, 2013). To date, approximately one in four physicians uses social media to stay up-to-date on medical innovations and information (McGowan BS, 2012).

Whether a piece of information becomes “viral” or not depends mostly on the content and the interest of the consumer. Google News and Yahoo News are looking for trends and update their algorithms depending on the user`s interests. Because of this they can feature popular stories on their own aggregators (Owen, 2011). While some scientists can use this to their advantage, unpopular research fields fail to gain interest and therefore are at a disadvantage.

#### **1.1.4. „Ärztchamber Steiermark“ and the social media**

In January 2015 the Austrian medical chamber Styria published guidelines for Austrian doctors and their usage of social media. The medical chamber Styria itself runs a Twitter account (@AERZTE\_NEWS) and a Youtube-Channel (AERZTE\_NEWS). The guidelines suggest orientation and usage. They are divided into main recommendations and specific advice for doctors and medical officials.

The main recommendations include advice to create content by considering that the data can be hacked by a third party and used against the creator. Furthermore, the content should be classified into opinion or official information. It is recommended to avoid conflicts and insults on social media platforms.

The key aspect of the specific advices for doctors can be listed as follows:

It should always be considered that social media actions can be read and observed by colleagues and employers, and there could be consequences.

The medical confidentiality needs to be preserved in social media content. Images of patients should only be published with the patients` consent. It should also be kept in mind that patients use social media platforms and are able to comment content, and the comment could be emotional.

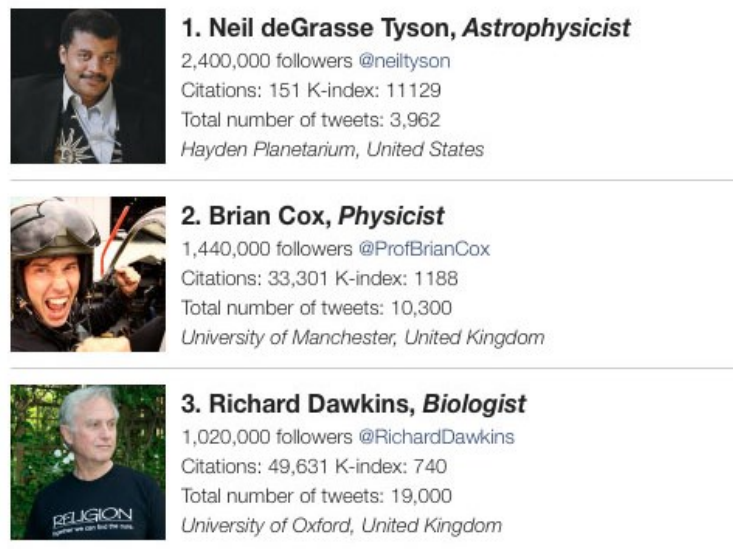
In summary, the guidelines suggest transparent and clear content in a respectful and fair language. The creator should always consider the consequences of patients, colleagues and employers being able to read the content (Ärztchamber Steiermark, 2015).

## 1.2. *Methods to measure scientific social media impact*

### 1.2.1. Twitter

Twitter is a social platform to spread information and awareness. It is called a microblog as the user can publish content that contains up to 140 characters. This content is called a tweet. In most cases, the microblog is used to introduce the news and lead to further information via an included link. The writer of these „tweets“ cannot choose his/her audience, but is chosen by people that are interested in his/her tweets.

(Based on followers)



**Fig. 1** The top three science stars on Twitter (adapted from news.sciencemag.org, 2014)

A further symbol of recognition of twitter is the hashtag, bundling different topics behind the sign „#“ and thus making them accessible more easily (Pick, 2013).

The popularity of twitter is resembled by its use over the years. In 2007, 5,000 tweets were sent on average per day, while only 7 years later, in 2014 astonishing 500 million tweets were sent each day (Internet Live Stats - Twitter Usage Statistics, 2014). Even among scientists it is popular to use twitter. This led to the K-Index, or Kardashian-Index, which was derived from Kim Kardashian, an U.S. celebrity. Scientists with a high K-Index have a high impact on twitter (You, 2014).

### 1.2.2. Altmetrics

Altmetric.com is a website that tries to visualize an immediate response of interest to a certain topic; for our research purposes to a certain publication. It was developed because of the many critics on the Journal Impact Factor. The website approaches the influence of a single article, excluding the journal it was published in and the number of citations it gathers. The influence focuses on the article's appearance and indications on social media platforms as Twitter, Bookmarks on Mendely or Facebook. Furthermore, the website doesn't focus on the influence in the scientific community, but on the broader public (Hirschmann, 2013).

According to Luther (2012) their „*approach is to present totals of multiple data points including:*

- *Data use (HTML views and PDF downloads)*
- *Citations (PubMed Central, Scopus, Crossref, Web of Science)*
- *Social networks (CiteULike, Connotea, Facebook, Mendeley)*
- *Blogs and media coverage (Nature, Research blogging, Trackbacks)*
- *Discussion activity on PLoS (reader's comments, notes and ratings)*“

(Luther, 2012)

The Website takes an approach to gather different appearances of a study in the social media and summarize it to a new rating measurement. For example, the top 3 research studies that caught the greatest public interest in 2014 were published in three different scientific fields and differ greatly in their social media appearance.

The Altmetric score however does not show which of the numbers include information-sharing by the researchers themselves and which pieces of information are disseminated by the audience. Furthermore it is discussed whether open access papers are more likely to get shared than others papers that are accessible only via institutional accounts or payments. Moreover, even Altmetric.com states that a high Altmetric score does not reflect the quality of a paper but rather the popularity of it (Chimes, 2014).

The use of this concept is still on the rise and by January 2015, over 20 world-leading research institutes including the University of Manchester, ETH Zurich or University of South Australia have adapted Altmetrics to track the impact of their output. It will allow the institutes to monitor their performance in „*non-traditional sources including public policy documents, mainstream and social media, post-publication peer-review and online reference managers*“ (Altmetrics Press Releases, 2015).

	1. Experimental evidence of massive-scale emotional contagion through social networks (Psychology and Cognitive Science )	2. Variation in Melanism and Female Preference in Proximate but Ecologically Distinct Environments (Biological Sciences)	3. Artificial sweeteners induce glucose intolerance by altering the gut microbiota (Medical and Health Sciences)
<b>news stories</b>	301	4	127
<b>blog posts</b>	130	11	34
<b>peer reviews</b>	10	1	0
<b>weibo posts</b>	4	4	37
<b>Facebook posts</b>	342	50	200
<b>Google+ posts</b>	115	15	46
<b>Reddit posts</b>	14	0	0
<b>Videos</b>	4	0	2
<b>Tweets</b>	3801	6669	3303

Fig. 2 Top 3 academic research on Altmetric.com (2014)

The Altmetric score still is in its' developmental stage and suffers various problems, such as setting wrong key words or ignoring certain websites, although it follows an unique idea to „quantify the response to research and ultimately its influence across a global community“ (Luther, 2012).

### 1.2.3. ResearchGate

ResearchGate (RG) is a social media platform developed especially for scientists. In 2008, Dr. Ijad Madisch, Dr. Sören Hofmayer and computer scientist Horst Fickenscher founded the website with the aim to connect scientists and their work. (Research Gate, 2015) In 2015, the website already had more than five million members and two million paper uploads per month (Vicari, 2014).

A ResearchGate user can easily keep track of how often his/her publications are viewed. These statistics can also be downloaded with one click. The website also keeps track of citations in publications and automatically links the citations with the mentioned scientist's profile (Kintisch, 2014).

The RG Score provides further statistical data that measures “reputation” or activity based on how one scientist's research is received and reviewed by his peers. The reputation is put together by how the scientist contributes to the website with online reviews, questions and

answers and uploading data. The peers then review these contributions and this leads to the final RG score.

Another traditional displayed measurement is provided via impact points. These sum up each published article's impact factor into one number.

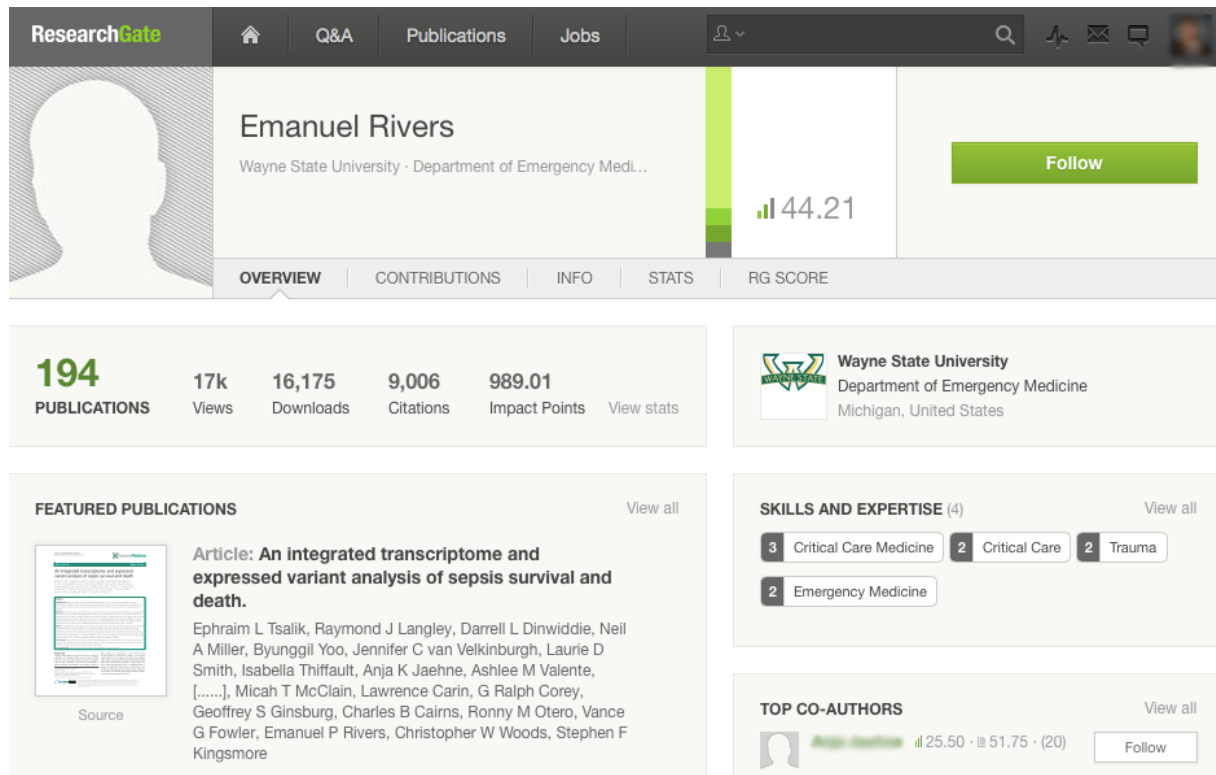


Fig. 3 Example of a ResearchGate profile based on Emanuel Rivers

If archiving is allowed by the respective publishers, users of the platform have the possibility to upload their publications and keep track on who cites their work. They are also able to interact with readers of their work, answering questions and making suggestions themselves. The open review option makes it possible to publicly review published articles and preprints of scientists (Vicari, 2014). „12,000 [...] users have reviewed papers, ResearchGate says.“ (Kintisch, 2014) Although the platform has more than five million members, ResearchGate acknowledged that only one third of their users actually visit the site at least once a month (Kintisch, 2014).

## 1.3. Methods to measure traditional Metrics

### 1.3.1. Google Scholar

Google Scholar was introduced in 2004 by the company Google Inc. The website aims to give better and free access to scientific papers and summarizes all electronic references on these papers (Falagas, 2008). A survey conducted by the journal *Nature* found that currently 60% of the scientists use Google Scholar's services on a regular basis (Van Noorden, 2014).

The website not only provides the option to search for published articles, but also gives access to some which may not be open access. The legality of this is not clear, and the accesses to the papers are not controlled. The website is updated each month, which is a long time period compared to other scientific data search engines such as Scopus, Web of Science or PubMed (Falagas, 2008).

Google Scholar however provides a quick search and an advanced search option, offering to filter results, i.e. by words, authors and date of publications. The results can also be filtered for specific languages that can be chosen. Each result is represented by author, title and source. There either is a link to an abstract or to a free full text, which is not provided by Google Scholar (Falagas, 2008).

Below each result, there is the number of citing articles, and details can be retrieved by being clicked on. In a study carried out by Falagas ME., it was shown that Google Scholar only sums up electronically accessible papers in this number and duplicate references also occurred frequently. An additional link to the number of cited articles on Web of Science is provided but can only be retrieved by being logged in via an institutional internet connection.



The screenshot shows a Google Scholar search interface. At the top, the Google logo is on the left, and a search bar contains the text "rivers early goal directed" with a search button on the right. Below the search bar, the word "Scholar" is displayed in red, followed by the text "Ungefähr 285.000 Ergebnisse (0,14 Sek.)".

On the left side, there is a sidebar with the following options: "Artikel", "Meine Bibliothek", "Beliebige Zeit", "Seit 2015", "Seit 2014", "Seit 2011", and "Zeitraum wählen...".

The main content area displays a search result. At the top of the result is a tip: "Tipp: Suchen Sie nur nach Ergebnissen auf **Deutsch**. Sie können Ihre Sprache in den **Scholar-Einstellungen** festlegen." Below this is the article title: "Early goal-directed therapy in the treatment of severe sepsis and septic shock". The authors listed are "E Rivers, B Nguyen, S Havstad, J Ressler...". The source is "England Journal of ..., 2001 - Mass Medical Soc". The abstract text begins with "Background **Goal-directed** therapy has been used for severe sepsis and septic shock in the intensive care unit. This approach involves adjustments of cardiac preload, afterload, and **contractility to balance oxygen delivery with oxygen demand. The purpose of this study ...**". Below the abstract, there are two red-bordered boxes: "Zitiert von: 7599" and "Web of Science: 3743". To the right of these boxes are links for "Ähnliche Artikel", "Alle 156 Versionen", "Zitieren", and "Speichern".

Below the first result is a second result titled "Early goal-directed therapy in severe sepsis and septic shock revisited: concepts, controversies, and contemporary findings". The authors listed are "CV Holthaus, T Osborn, FP Rivers - CHEST". The source is "2006 - journal publications.chestnet.org".

Fig. 4 Google Scholar and Web of Science Data

Furthermore it is often not comprehensible what information sources Google Scholar uses. The advantages are free and easy use, but it has been criticized as being overall inadequate and less often updated than other scientific search engines (Falagas, 2008).

### **1.3.2. Science Citation Index and the Impact Factor**

The Science Citation Index is a data index collecting journals of different disciplines since 1964. It led to the larger version, the Science Citation Index Expanded, adding citations and online-versions of the journals. Both are the foundation of the Impact Factor, which is a number representing a journals' influence. This number does not give any information about the quality or impact of an individual paper, but about the average number of citations of the journal in other publications (Wikipedia, 2014). Logically, this is highly specific to the field of science. The higher the Impact Factor, the more notable the journal, but the impact factor can be greatly influenced by a small number of highly cited papers.

The Impact Factor experiences a lot of criticism, especially with the introduction of Web 2.0. Firstly the Impact Factor does not allow a valid comparison between disciplines. The journal *Nature* stated already in 2003 that disciplines like immunology or cancer may receive 50 – 200 citations per paper, whereas disciplines like physics, climatology or palaeontology achieve fewer than 50 citations. *“These reflect differences in disciplinary dynamics, not quality.”* (Nature, 2005)

To gain more awareness and popularity, researchers aim to publish their papers in journals with a high impact factor, even though the impact factor is based on the mean number of citations per paper – not including the influence over time. For example in 2004, *the Nature's* Impact Factor is 90% based on a quarter of its publications, therefore not well representing the current impact *The Nature* has on both readers and researchers (Nature, 2005).

The Impact Factor may be manipulated *„by journal editors via skewed submission policies (such as inclusion of review articles) in order to increase the impact factor, which in turn, becomes an instrument used by publishers to market their journals to libraries worldwide“* (Yin, 2011).

Lastly, with the arrival of Web 2.0, scientific articles became digitally available and therefore made scientists more independent from journals and their reputation or their Impact Factor. A study by Lozano et al. (2012) stated that since the digital age the relation between paper citations

and the IF has been weakened (Lozano, Larivière, & Gingras, 2012). Nevertheless the impact factor remains a valuable tool in scientometrics.

### **1.3.3. H-Index and M-Quotient**

The H-Hirsch-Index represents the  $n$ -number of publications with at least an  $n$ -number of citations for a journal or an individual. This index is meant to compare scientists (or journals) of the same research field, dealing with the problem of the varying citation-behavior related of different disciplines. It was invented in 2005 and thus is a modern addition to the traditional Impact Factor (Wikipedia, 2014).

Currently, *The New England Journal of Medicine* holds the highest rank on the H-Index in the Category “Health & Medicine” with a number of 329. Second is *The Lancet* with a value of 248 (Google Scholar Metrics, 2014).

The H-Index rewards researchers with a long list of publications, which could have accumulated citations. Because of this, young and promising scientists cannot be identified easily. The M-Quotient, also called HY-Index, divides „*the h-index by the number of years the academic has been active (measured as the number of years since the first published paper)*“ (Harzing, 2008). It is used for pre-selection and to predict the further achievements of participating scientists (Halbach, 2011). However the M-quotient disadvantages part-time scientists or researchers with career interruptions (Harzing, 2008).

## 1.4. Sepsis and its treatments

### 1.4.1. Definition of sepsis and its impact in the hospital

„At an international consensus conference in 1991, sepsis was defined as the systemic inflammatory response syndrome (SIRS) with a suspected source of infection.“ (Daniels, 2010)

ACCP/SCCM named condition	Defining criteria
SIRS	Core body temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$ HR $\geq 90$ bpm Respirations $\geq 20/\text{min}$ (or PaCO <sub>2</sub> $< 32$ mmHg) WBC $\geq 12,000/\mu\text{l}$ or $\leq 4000/\mu\text{l}$ or $>10\%$ immature forms
Sepsis	At least two SIRS criteria caused by known or suspected infection
Severe sepsis	Sepsis with acute organ dysfunction (including hypoperfusion and hypotension) caused by sepsis
Septic shock	Sepsis with persistent or refractory hypotension or tissue hypoperfusion despite adequate fluid resuscitation

**Tab. 1** Defining criteria for Sepsis – Adapted by Martin, G.: 2012 Defining criteria of ACCP/SCCM named conditions. Expert Rev Anti Infect Ther.; 10(6): 701-706

SIRS resulting from infection can progress to severe sepsis or septic shock with multiorgan dysfunction syndrome (Cheung, 2012).

Besides the SIRS, there is severe sepsis and the septic shock. Severe sepsis includes organ dysfunction and hypofusion abnormalities. Septic shock shows criteria for sepsis and hypotension despite adequate fluid resuscitation.

The pathophysiology of sepsis begins with an infection affecting the host's immune system. A non-specific response is triggered via toll-like receptors (TLR's) found in immune cells' membranes. Humoral and cell-mediated immunity is activated and a number of pro- and anti-inflammatory cytokines are released. The production of both types of cytokines is excessively increased in patients with severe sepsis (Daniels, 2010).

An inflammatory cascade unfolds, leading to cell death and a state of relative immunosuppression. Apoptosis and pro-inflammatory mediators may be reduced at a late stage, but organ dysfunction continues, and any organ can be affected. Myocardial depression may decrease cardiac output. Capillary leak leads to pulmonary and peripheral edema that may progress to lung injury and acute respiratory distress syndrome (ARDS). Furthermore, acute kidney injury may develop. The coagulation cascade is often disturbed, which may progress

into fibrin deposition and microvascular thromboses, which threaten end organs (Daniels, 2010).

Despite the fact that sepsis is such a frequent disease and has such a high mortality rate (Fig.5), the pathophysiology still is only partly understood, and the diagnosis is not always clear. Therefore, improvements in sepsis criteria are currently being developed.

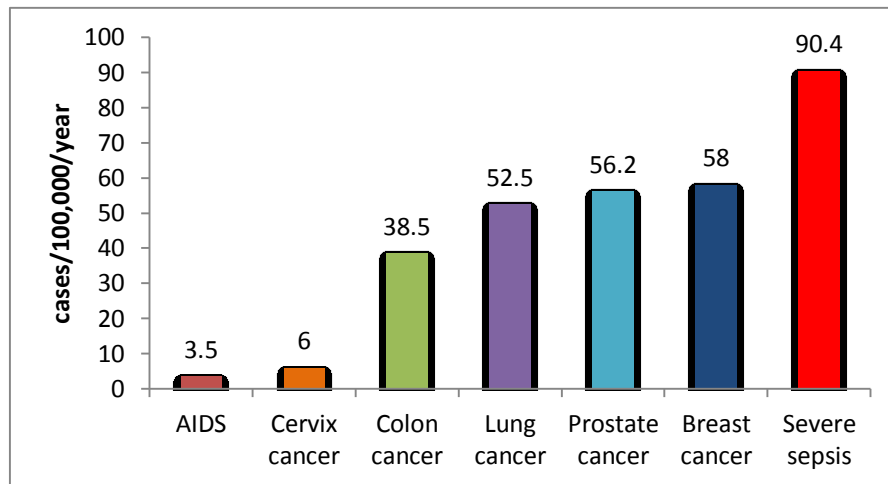


Fig. 5 Incidence of severe sepsis in Europe compared to other severe diseases. From Davies A. OECD health data 2001. *Intensive Care Medicine* 2001; 27 (suppl): 581.

The patient's immune system may compensate the effect of sepsis until a very late stage, when treatment may be too late. „*The resultant tissue hypoperfusion, which characterizes severe sepsis and septic shock, can occur despite normal clinical parameters including vital signs and urine output, and may continue following initial resuscitation.*“ (Daniels, 2010)

An important subgroup is patients presenting to the emergency department and intensive care units. The ICNARC (Intensive Care National Audit & Research Centre) data base indicates in the UK approximately 6,500 patients per year arrive in the ED suffering from severe sepsis. These patients have a 35% rate of in-hospital mortality (Power et al. 2013).

Therefore, an extremely important question is how to treat patients with severe sepsis and decrease their mortality rate.

#### 1.4.2. The history of sepsis treatments of patients in the ED

Septic patients transferred from the ED to the intensive care unit (ICU) have a high incidence of multi-organ dysfunction and high mortality. Before 2001, these patients were often treated only **after** admission to the intensive care unit (so often many hours after their first presentation to the hospital), i.e. with antibiotics or hemodynamic resuscitation (Hayes, 1994).

Emanuel Rivers and his research group were the first to treat septic patients **before** being admitted to the ICU in a randomized controlled trial using a bundle of different treatments summarized with the new term “early goal directed therapy”, EGDT (see chapter 1.3.4.1). The trial investigated the impact of EGDT within the first 6 hours after presentation. EGDT compared with standard care reduced hospital mortality significantly from 46.5% to 30.5%,  $p=0.009$  (E. Rivers, 2001).

The study is one of the most cited ICU studies in history and led to an impressive increase in awareness regarding patients with severe sepsis or septic shock in the ED, and the concept of rapid, aggressive goal-directed fluid and blood product-oriented resuscitation and antibiotic treatment was termed the „Golden Hour“ (Rello, 2012).

The combination of the Rivers protocol with several observational studies led to the professionally endorsed Surviving Sepsis Campaign (SSC), which publishes guidelines for resuscitation and management of sepsis. These guidelines are free to download on the website [survivingsepsis.org/guidelines](http://survivingsepsis.org/guidelines).

A survey by Levy in the year 2004 in 173 EDs showed problems in clinical practice using EGDT. Only 19% of EDs used the full protocol, further 10% were in some phase of planning to use it (Levy M., 2004). A more recent study suggested that compliance correlates with hospital mortality rate. *„Every 10% increase in compliance and additional quarter of participation in the SSC initiative was associated with a significant decrease in the odds ratio for hospital mortality.“* (Levy M., 2015)

Other studies addressing these questions showed correlations between successful early goal-directed resuscitation and *„leadership (local champion); communication, education and training; buy-in to the protocol; provision for protocol transition from ED to the critical care unit; and locally determined delivery“* (Power et al., 2013).

The Rivers trial fundamentally changed clinical practice of how patients with severe sepsis were treated. In the last years, three large randomized international multicenter studies have worked in detail with the original Rivers protocol:

List of studies referring to sepsis treatment of patients in the ED				
Name	Year	No. of patients	No. of centers	Location
Rivers trial	2001	288	monocenter	U.S.
ARISE	2014	1.600	multicenter (51)	Australia
proCESS	2014	1.341	multicenter (31)	U.K.
ProMISe	2015	1.260	multicenter (56)	U.S.

Tab. 2 List of sepsis studies

All three studies have been published in the last months in the New England Journal of Medicine, one of the most important journals for clinical medicine.

### 1.4.3. Sepsis and critical care in the online media today

There are 12,600.000 results for the keyword „sepsis“ on Google (date of access: 12.02.2015). Most articles revolve around the definition and practical approach to sepsis. On Facebook there are several closed groups for sepsis survivors. These groups often contain hundreds of persons and are available in many languages.

A website called *analytics.followthehashtag.com* allows the user to track a hashtag and visualize its metrics for free. For example, for the hashtag #sepsis there are 807 tweets in total and a total audience of 664.057 persons tracked during one week (18th February 2015 until 26<sup>th</sup> of February 2015).



Fig. 6 Example of Sepsis Groups on Facebook



There are many websites dedicated to intensive care that are greatly contributing to the FOAM (free open access medical education) movement.

The following three are outstanding in their relation to social media:

- [emcrit.org](http://emcrit.org)
- [intensivecarenetwork.com](http://intensivecarenetwork.com)
- [world-sepsis-day.org](http://world-sepsis-day.org)

***emcrit.org*** is both a blog and a podcast hosted by Scott Weingart, an emergency-physician - intensivist from New York. The website focuses on the early phase of acute illness, including topics like resuscitation, trauma or critical care. Every two weeks, a 20-minute podcast is uploaded and in between blog-updates miniature podcasts called EMCrit Wees are available (Weingart, 2013).

The second website ***intensivecarenetwork.com (ICN)*** has been launched in 2008 by an Australian team and since then the website provides free educational podcasts. It „*has been developed to educate, link and stimulate healthcare professionals involved in critical care, based on [...] key characteristics of Intensive Care: the teamwork and collegiality that occurs when like-minded professionals share a common purpose.*“ (SMACC, 2015) The ICN team also has a key role in organizing the social media and critical care conference (SMACC) ([intensivecarenetwork.com](http://intensivecarenetwork.com), 2015) that will in 2016 be held the third time, the first time in Europe (Dublin). This novel and innovative conference has been initiated in 2014. The number of attendees has doubled from the first to the second conference (n=1.300). (SMACC, 2015).

The third website is called ***world-sepsis-day.org*** and is available in the languages English, German and Spanish. The website provides the option to donate and gather information about sepsis in general, press releases and events. World-Sepsis-Day can also be found on Facebook and on Twitter (@WorldSepsisDay). The World-Sepsis-Day 2015 will take place on 13<sup>th</sup> September 2015 ([world-sepsis-day.org](http://world-sepsis-day.org), 2015).

#### **1.4.4. Major sepsis studies in intensive care in the years 2001-2015**

##### **1.4.4.1. Early Goal-Directed Therapy In Severe Sepsis And Septic Shock by E.Rivers et al. 2001**

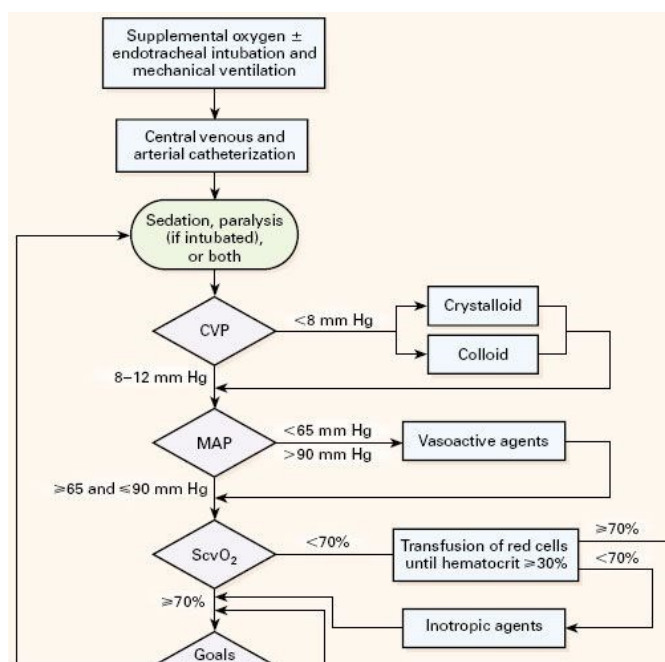
The Rivers trial focused on patients in the emergency department presenting with suspected sepsis.

The study explored the impact of early goal-directed therapy (EGDT) before admitting patients to intensive care units (ICU). The study took place in a tertiary center in Detroit, U.S and included 1.341 patients that were randomized to either receive standard therapy or EGDT before ICU admission. EGDT targets five key parameters (temperature, heart rate, urine output, blood pressure, and central venous pressure) to optimize oxygen delivery to tissues. To improve these parameters, Rivers suggested four interventions:

1. *Reduce work of breathing by early use of mechanical ventilation*
2. *Fluid resuscitation*
3. *Use of vasoactive agents: noradrenaline, dobutamine*
4. *Transfusions*

Patients with SIRS criteria, serum lactate  $\geq 4$  mmol/L or a systolic blood pressure  $\leq 90$  mmHg were included in the trial. After the initial six-hour period, patients on standard therapy had higher levels of organ dysfunction and higher rates in in-hospital mortality (RR 0.58; 95%CI 0.38-0.87), 28-day mortality (RR 0.58; 95%CI 0.39-0.87), and 60-day mortality (RR 0.67; 95%CI 0.46-0.96).

Results of the study were implemented in the next SSC guidelines and led to a new standard therapy with a more aggressive treatment focused on central venous catheterization to monitor central venous pressure and central venous oxygen saturation. The interventions (e.g. use of intravenous fluids or vasopressors) were meant to achieve a prespecified status (“goal-directed”) in the hope to lower chances of mortality (Rivers, 2001).



**Fig. 8** Early goal-directed resuscitation protocol used in the Rivers *et al.* trial

The study got criticized for several aspects, among them the use of blinded ICU professionals, but non-blinded ED staff and the impossibility to identify the most important intervention of the bundle. It was therefore unknown if the whole EGDT protocol is required or only one single component. Furthermore the control group had an above-average mortality and the study was single-centered. (Wiki Journal Club, 2014).

#### 1.4.4.2. ProCESS by Yealy DM. et al. 2014

Since the publication of the Rivers trial, the management of sepsis has changed many times and the question arose whether all elements of the EGDT protocol are still necessary to prevent excess mortality.

The proCESS study is a multicenter trial in North America and compared alternative resuscitation strategies in 1,341 patients with septic shock in the years 2008 to 2013. The patients were randomized to protocol-based resuscitation, usual treatment or „*a protocol with central hemodynamic monitoring to guide the use of fluids, vasopressors, blood transfusions, and dobutamine*“ (Yealy, Kellum , & Huang, 2014). The proCESS Investigators questioned, whether the protocol with central hemodynamic monitoring is superior to simpler protocols.

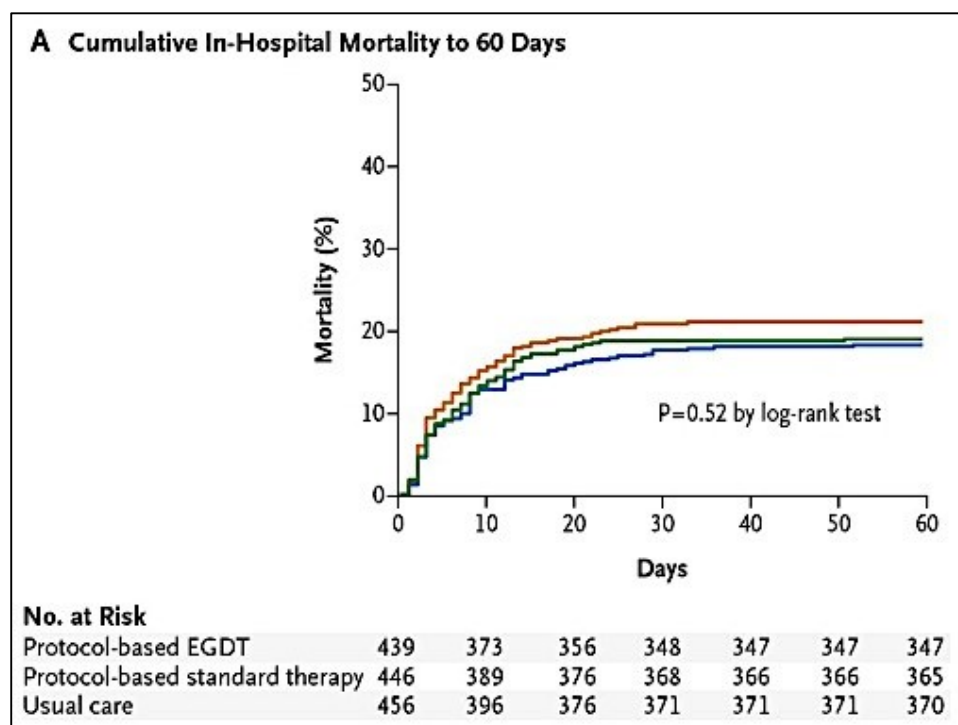


Fig. 9 Cumulative Mortality truncated at 60 days in Yealy et al. (2014)

The primary focus was the rate of in-hospital death to any cause at 60 days. Secondly they looked at 90-day and 1-year mortality. There was no difference found between the three

treatments. („By day 60, a total of 92 patients in the protocol-based EGDT group (21.0%), 81 in the protocol-based standard-therapy group (18.2%), and 86 in the usual-care group (18.9%) had died in the hospital“ (Yealy, Kellum , & Huang, 2014)) There was also no significant benefit for the „mandated use of central venous catheterization and central hemodynamic monitoring in all patients“ (Yealy, Kellum , & Huang, 2014).

Critiques about the proCESS study include the limitation that only academic hospitals participated, the change of EGDT's original elements and that the actual mortality rates were substantially lower compared to estimations used for the sample size calculation (Jähne, 2014).

#### **1.4.4.3. ARISE - Study by The ARISE Investigators and the ANZICS Clinical Trials Group 2014**

Although the ARISE-study also evaluated the EGDT protocol of the Rivers trial, it took a different approach. The study took place in 41 centers in Australia and New Zealand. 1,600 patients with early septic shock were randomly assigned to receive either EGDT or the usual care in the emergency departments. Patients in the EGDT group got a different amount of intravenous fluids in the first six hours than the control group. Furthermore they were more likely to receive vasopressor infusions, red-cell transfusions and dobutamine. 90-day all-cause mortality of the 1,600 patients was not different between groups (EGDT group 147 deaths/18.6%, control group 150 deaths/18.8%). The authors concluded that EGDT for patients presenting to the ED with an early septic shock syndrome did not reduce all-cause mortality at 90 days in comparison to those who received standard treatment (Peake, 2014).

In summary, the ARISE and proCESS-trial failed to show any benefit between EGDT and groups, although these results led to new questions about SSC bundles and whether the SSC guidelines would need to be updated and developed anew (Surviving Sepsis Campaign, 2014).

#### **1.4.4.4. ProMISe by Mouncey PR. et al. 2015**

The ProMISe study took place in 56 UK hospitals and compared the two treatments in different aspects than the study conducted in the US. In total, 1260 patients were included in the study, 630 received EGDT and 630 the usual treatment. 29% of each group died within 90 days, although the usual treatment group had a lower absolute mortality risk reduction (29.2%) than the EGDT group (29.5%). Therefore there were no significant differences in the primary and also in the secondary outcomes. However, Mouncey concludes that the EGDT increased costs with a cost-effectiveness below 20% (Mouncey, 2015).

# Methods & research-leading questions

## 1.5. Research questions

1. *What differences can be measured in the dissemination of major sepsis studies in the social media in the years 2001-2014?*
2. *Are there characteristics about the first author of a study and his/her use of online and social media in relation to his/her scientific work?*
3. *Do major sepsis studies have an equal impact in the social media compared to other studies in the intensive care unit?*

## 1.6. Research hypotheses

RQ1: What differences can be measured in the dissemination of major sepsis studies in the social media in the years 2001-2015?

→ **H1: The more recent a study has been published, the greater is its impact through dissemination in the social media**

→ **H2: The higher the impact of a study in the traditional measurements is, the higher is its impact in the social media**

RQ2: 2. *Are there characteristics about the first author of a study and his use of online and social media in relation to his scientific work?*

→ **H3: The more recent an author published his first paper, the more impact he has on the online and social media.**

RQ3: Do major sepsis studies have an equal impact in the social media as other major studies in the intensive care unit?

→ **H4: Major sepsis studies have a smaller impact in the social media in comparison to other studies in critical care.**

## 1.7. **Research leading research categories**

Categories and definitions to H1 – H4:

**→ H1: The more recent a study has been published, the greater is its impact through dissemination in the social media**

### Dimension 1: Impact through dissemination in the social media

The impact of the studies is measured by their appearance on *Twitter*, ResearchGate and on *Altmetric.com*. Furthermore, *Google Scholar* and *Web of Science* data will be included to complement the research.

### Dimension 2: Limitation of the publishing date

The date of publication is defined as the day of the official journal's release (not the epub).

**→ H2: The higher the impact of a study in the traditional measurements is, the higher is its impact in the social media**

### Dimension 1: Impact in the social media

The impact of the studies is measured by their appearance on *Twitter*, ResearchGate and on *Altmetric.com*. Furthermore, *Google Scholar* and *Web of Science* data will be included to complement the research.

### Dimension 2: Traditional measuring methods

Traditional metrics rely on traditional media, such as printed papers, journals and magazines. They specialize on data that connect the traditional media with each other, often via citations of papers published in journals.

The **Impact Factor** represents the impact of an academic journal in the year the paper was published. It measures the average number of citations to recent articles published in the same journal. Frequently it is used to reflect the relative importance of a journal within its field. Google Scholar provides comparable data about cited articles amounts found on Google Scholar itself and Web of Science. The H-Index and the M-Quotient is documented by Google Scholar.

**→ H3: The more recent an author published his first paper, the more impact he/she has on the online and social media.**

### Dimension 1: First author

Interactive media includes every platform that revolves around the user creating content which is consumed and can be disseminated by other users, thus transforming users into both, sender and receiver of news and information.

### Dimension 2: Impact in the social media

The impact of the studies is measured by their appearance on *Twitter*, *ResearchGate* and on *Altmetric.com*. Furthermore, *Google Scholar* and *Web of Science* data will be included to complement the research.

**→ H4: Major sepsis studies have a lower impact in the social media in comparison to other major studies in critical care.**

#### Dimension 1: Impact of major sepsis studies

The major sepsis studies include the monocenter Rivers trial in year 2001 and the large multicenter trials studies ARISE (2014), proCESS (2014) and ProMISe (2015) that research a similar group of patients under similar circumstances but with different treatment approaches and in different regions.

#### Dimension 2: Impact of other major studies in critical illness

Other major studies in intensive care are measured by their view-account in the last year on the website cforum.com of the top journal „*Critical Care*“, with an Impact Factor of 5.04. Data from the 11<sup>th</sup> of February 2015 is being used for the purpose of this paper.

1. Management of bleeding and coagulopathy following major trauma: an updated European guideline by Spahn, D. et al. (2013) – 60,663 accesses
2. Ventilator-associated pneumonia in the ICU by Kalanuria, AA. et al. (2014) – 31,940 accesses
3. Acute renal failure – definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group by Bellomo R. et al. (2004) – 28,450 accesses (Critical Care, 2015)

Furthermore the major sepsis studies will be compared with the most discussed studies of the Hot Topics Session of the ESICM (European Society Of Intensive Care Medicine) Annual congress from Autumn 2014 in Barcelona. These involve five studies (excluding the ARISE study), however one of these is not yet published (Cariou A et al).

1. The effects of decontamination of the oropharynx and intestinal tract on antibiotic resistance in ICUs by Oostdijk E.
2. The VITdAL-ICU trial: Correction of vitamin D deficiency in critically ill patients by Amrein K.
3. Transfusion threshold in septic shock: The TRISS trial by Holst LB.
4. Calories: A phase III multicenter RCT comparing early nutritional support with parenteral versus enteral routes by Harvey SE.

(ESICM Hot Topics, 2014)

## **1.8. Methods**

The leading research questions are analyzed in the following chapters by verifying or falsifying the related research hypothesis to each question. All twelve studies on intensive care have been examined with the following variables:

1. Publishing date
2. Twitter (hashtag appearance, account availability)
3. Altmetrics (score and listed individual categories)
4. Google Scholar (cited articles and Web of Science data)
5. Impact Factor
6. Published journal
7. First author
8. First published paper of the first author
9. H-Index & M-Quotient of the first author
10. ResearchGate account of the first author (RG score, downloads, citations, impact points)

With the program SPSS a simple correlation analyses was performed. With the program SPSS a simple correlation analysies was performed. Correlation coefficients and level of significance is stated.

## Results

Four sepsis studies addressing the early-goal directed therapy in EDs transferred to the ICU have been examined and compared to other major studies in the intensive care. At first, it appeared there was no data about the sepsis studies on the internet at all. There were no results for hashtag searches on Twitter (only in relation with the hashtag #sepsis). There was no search option on the Altmetric.com website itself. When searched for on Google, there was no Altmetric data found as well. Even the H-Index could not be identified for all studies on one website and thus making it incomparable.

However, after thorough research I found the website *readcube.com*, which provides a link to the Altmetric data of a study. Unfortunately not each examined study was listed on *readcube.com*. I took the few data samples from Twitter as a result for the under-representation of the studies, and I solved the problem of the inhomogeneous results for the H-Index by installing an Add-On for Google Scholar, which provided the opportunity to look up several indexes for one author. Each examined author was found by this Add-On and therefore it provided additional comparable data.

## 1.1. Discussion of the research questions and illustration of the results

1. What differences can be measured in the dissemination of major sepsis studies in the social media in the years 2001-2015?

**H1: The more recent a study has been published, the greater is its impact through dissemination in the social media.**

Simple statistics were used to examine the correlation between the publishing date and the Altmetric score.

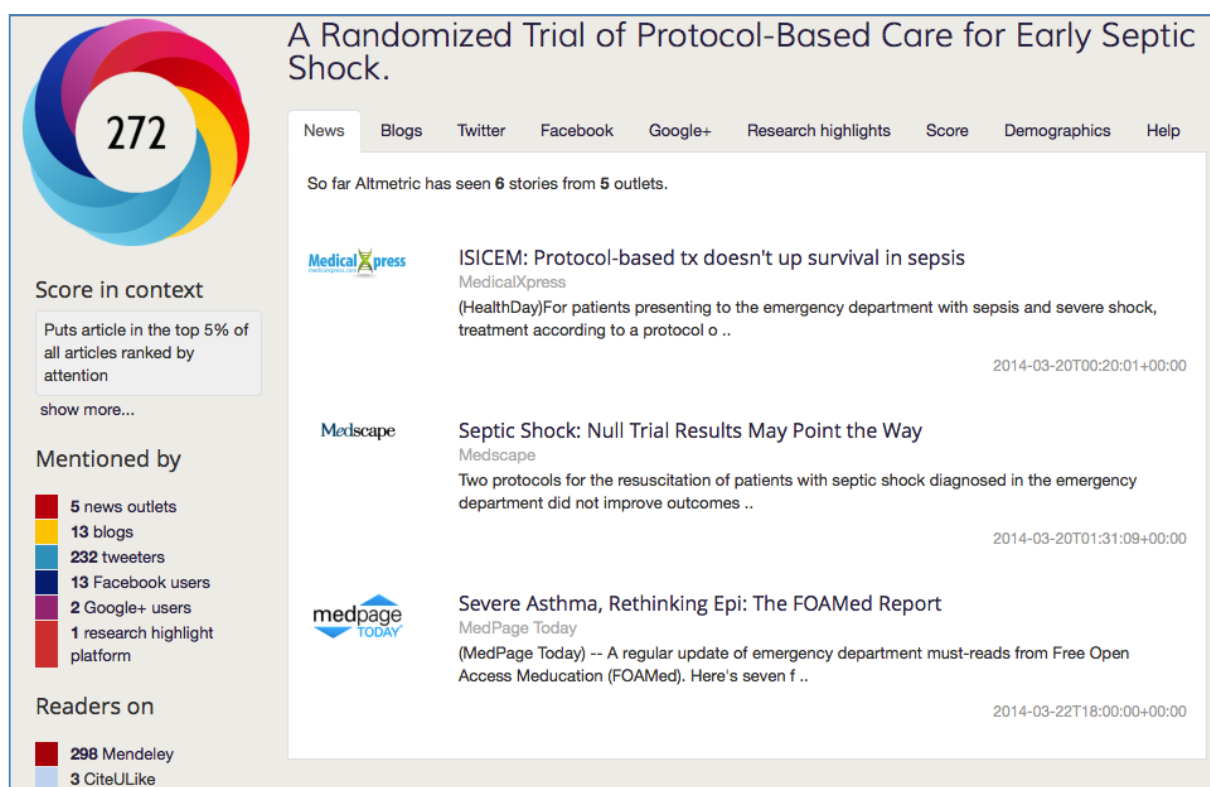


Fig. 10 Example of Altmetric.com data based on the proCESS study (date: 22th February, 2015)

Interestingly, there was no significant correlation between publishing date and Altmetric Score ( $p=0.945$ ), which is true for the sepsis studies as well (Fig.11: red=sepsis studies, blue=alternative studies; arithmetic mean =80).

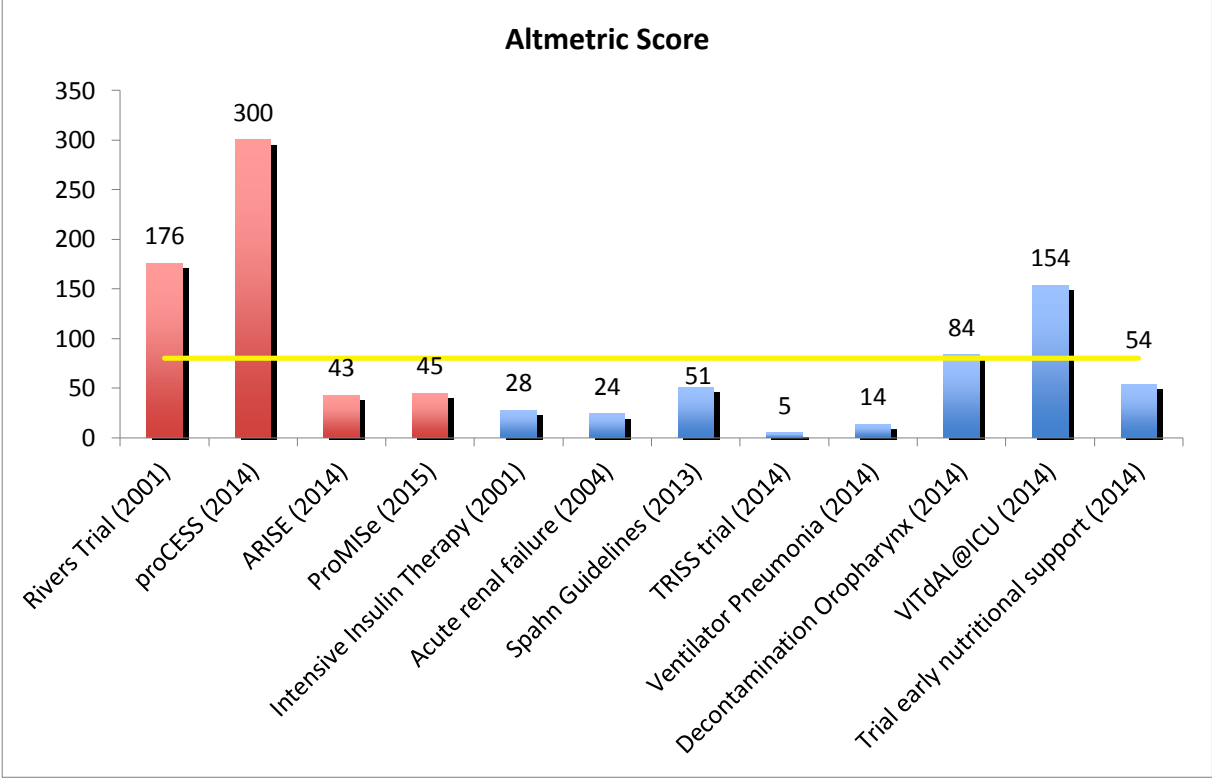
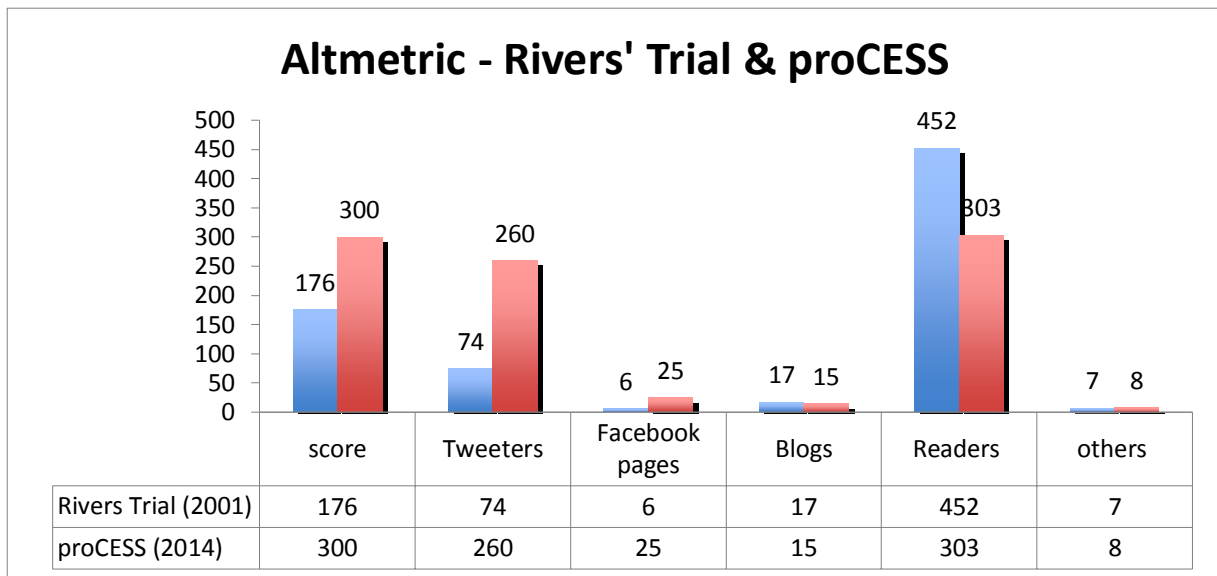


Fig. 11 Altmetric Score of all investigated studies

A further striking result is that the composition of the Altmetric scores differ between the older and the more recent studies. The data suggests that more recent studies have more impact in social media platforms as Twitter, Facebook or blogs, whereas older studies establish a higher Altmetric score because of passive reading platforms such as Mendeley (Fig. 12).



**Fig. 12** Altmetric data on Rivers trial & proCESS

Fig. 12 shows that the Altmetric Score of the Rivers trial is shaped mostly by readers of the paper on websites like Mendeley, CiteULike or Connotea. There are as many blogs mentioning the Rivers trial, but almost four times more Tweeters mentioning the proCESS trial.

In summary, the hypothesis that the more recent a study is, the more impact it has in social media can be falsified. The Rivers trial which has been published fourteen years ago has had similar impact as the proCESS study and a higher impact than the ARISE and the Promise studies.

**H2: The higher the impact of a study in the traditional measurements is, the higher its impact in the social media**

The analysis suggests that the longer a paper has been published, the greater the amount of citations and therefore the higher the traditional impact of a study is. The publishing date correlated with traditional metric indicators as the Google Scholar citation - ( $p=0.01$ ) and Web of Science citation number ( $p=0.01$ ).

The Impact Factor was another traditional index in comparison to the social media data. All four major sepsis studies appeared in the New England Journal of Medicine (NEJM) and therefore would have the same Impact Factor today (54.4). It can be added that at the time of the Rivers publication in 2001, the NEJM had a lower Impact Factor of 29.1 (Selected Scientific Journals, 2003). However, the journal was also then in the leading position in the Impact Factor ranking among the medical scientific journals.

Interestingly, there was no significant correlation between the Altmetric score and the Impact Factor ( $p=0.382$ ) or the number of Google Scholar citations ( $p=0.998$ ). Therefore the data suggests, that the position of a journal does not necessarily have an impact on the popularity of a paper in the social media (Tab.3).

	Altmetric Score	No. of citations, Google	No of citations Web of Science
<b>Rivers Trial (2001)</b>	176	7472	3590
<b>Intensive Insulin Therapy (2001)</b>	25	9563	4333
<b>Acute renal failure (2004)</b>	24	2898	1813
<b>TRISS trial (2014)</b>	5	8	5
<b>Spahn Guidelines (2013)</b>	51	208	103
<b>proCESS (2014)</b>	300	52	49
<b>Ventilator Pneumonia (2014)</b>	14	6	-
<b>Decontamination Oropharynx (2014)</b>	84	11	9
<b>VITdAL@ICU (2014)</b>	154	5	3
<b>ARISE (2014)</b>	29	34	11
<b>Trial early nutritional support (2014)</b>	54	0	2
<b>ProMISe (2015)</b>	45	27	4

**Tab. 3** Correlation Altmetric score and Google Scholar data

Overall, the earlier a study is published, the more impact it has in traditional measurements and therefore the greater is its dissemination. The dissemination via the social media on the other hand does not correlate with time but rather with the author's commitment to social and online media. Websites like Mendeley provide easy access to papers and are able to track the readers and their demographics. The data also suggests that it takes time to gather impact in traditional indexes in spite of online and social media. Recent studies like ProMISe and proCESS have an expectedly low number of citing articles, whereas they show a rather great impact in the social and online media considering the amount of time they had to gather the impact (ProMISe = 4 months, proCESS = 20 months).

These results suggest that the hypothesis can be falsified.

2. Are there characteristics about the first author of a study and his use of online and social media in relation to his scientific work?

**H3: The more recent an author published his first paper, the more impact he has on the online and social media.**

The hypothesis focuses on the first author of the paper and measuring indicators including traditional indices as H-Index and M-Quotient in comparison to the data of the social media platform ResearchGate. ResearchGate.com provides a score, which represents the interactivity of scientists with other members of the platform and their online activity by publishing papers on the platform.

Google Scholar provides an add-on in Google Chrome showing the H-Index for a given author. It needs to be stated though that there were different results based on how the name was spelled and how the surname and last name were placed. For better comparison the version of last name and the first letter of the surname with a dot were chosen (e.g. Delany A.)

The screenshot shows a Google Scholar search for 'author = "van den berghe g."'. The search results include a list of co-authors clusters on the left and a table of impact indices in the center. Below the table is a search result for a PDF article titled 'Intensive insulin therapy in the medical ICU' by G Van den Berghe, A Wilmer, and G Hermans.

**Co-authors clusters:**

- [73] P Becx, N Berends, ...
- [7] J Aimi, BA Barshop, ...
- [4] J Calderon, JL Horswell, ...
- [4] P Aerssens, A Casneuf, ...
- [4] K Gosch, A Goyal, ...

**Impact indices (computed on displayed results only):**

Normalization	Citations	h-index	g-index	e-index	delta-h	delta-g
none	10585	40	>50	93	6	-
per co-authorship	4105.1	27	>50	54	1.7	-
per age	1113.1	16	32	24	0.6	54.5

Data on video might not be enough for computing indices values. Want to add 20, 100 or all results ?

**Search Result:**  
 [PDF] Intensive insulin therapy in the medical ICU  
 G Van den Berghe, A Wilmer, G Hermans - ... England Journal of ..., 2006 - biomedcentral.com  
 ... Competing interests The authors declare no competing interests. References 1. Van den Berghe G, Wilmer A, Hermans G, Meersseman W, Wouters PJ, Milants I, Van Wijngaerden E, Bobbaers H, Bouillon R: Intensive insulin therapy in the medical ICU. ...  
 Zitiert von: 3217 Ähnliche Artikel Alle 33 Versionen Web of Science: 1547 Zitieren Speichern Mehr

Fig. 13 Example of Google Scholar data based on the author Van Den Berghe Greet

A positive correlation between the first published paper of the first authors and the H-Index ( $p=0.002$ ) and a negative with the M-Quotient ( $p=0.004$ ) was found. It can be said that the longer an author has been publishing, the higher is his/her H-Index and the lower his/her M-Quotient, which also includes the amount of years since the first published paper.

The more surprising correlation is found between the first published paper and the ResearchGate score ( $p=0.013$ ). The correlation is negative, therefore the more recent an author has been publishing, the higher his/her ResearchGate score. This data suggests that members of the scientific community who published their first paper recently spend more time on the social media platform.

However, 50% of the first authors do not have a ResearchGate account and therefore no score. There is no correlation between the first published paper and the registration for an account.

	<b>First author</b>	<b>RG score</b>	<b>First published paper</b>
<b>Rivers Trial (2001)</b>	Rivers E.	44.20	1989
<b>VITdAL@ICU (2014)</b>	Amrein K.	33.17	2007
<b>ARISE (2014)</b>	Delaney A.	32.90	2005
<b>TRISS trial (2014)</b>	Holst LB.	20.77	2011
<b>Ventilator Pneumonia (2014)</b>	Kalanuria AA.	13.13	2012
<b>ProMISe (2015)</b>	Mouncey PR.	22.14	2013

**Tab. 4** Correlation between ResearchGate score and first published paper (red=sepsis papers)

*3. Do major sepsis studies have an equal impact in the social media compared to other major studies in intensive care?*

**H4: Major sepsis studies have a smaller impact in the social media in comparison to other major studies in the intensive care.**

For the purpose of this research question, eight major studies of intensive care were chosen from the „ccforum.com“ website of the “Critical Care” journal. The website provides a list of the most viewed papers of the last year. The first three on this page were chosen as three other major studies of the intensive care. Furthermore, „escim.org“, the website of the European Society of Intensive Care Medicine, provides news about intensive care in general, but also about scientific research. On one subpage they list the hot topics in the online media of the intensive care, including four further published studies, which have been presented at the ESICM annual congress in Autumn 2014 and were used for this analysis. Another major study called „Intensive Insulin Therapy in critically ill patients by Greet Van den Berghe from the year 2001 has been added to gain better comparative data between recent studies and studies, which have been published before 2005.

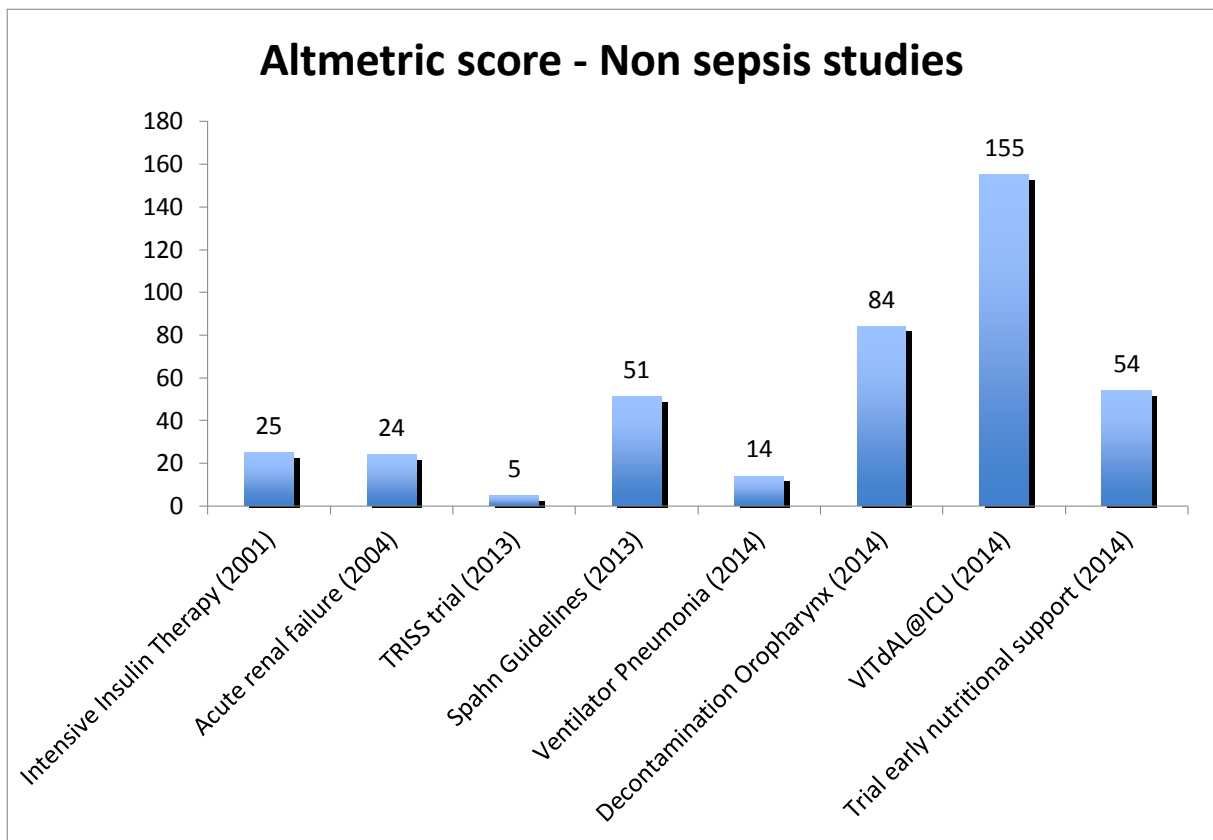


Fig. 14 Altmetric score of the non-sepsis ICU studies

### Altmetric and Twitter

The Altmetric score of each study was found (Fig 14.). The two studies from 2001 and 2004 have a similar score as studies from 2013 and 2014. In comparison to the data of the major sepsis studies, the other major studies show a similar behavior in the Altmetric score. The older general ICU studies do not show a similarly high Altmetric score as the Rivers trial (AS=176). None of the non-sepsis studies have a twitter account, but when searched for on twitter with the parts of the study's name as hashtags (e.g. #TRISS trial), six of the eight studies were found. These studies show a higher number of tweets than the sepsis studies (see Tab.5). This indicates that the sepsis studies have a smaller impact on Twitter than the non-sepsis studies.

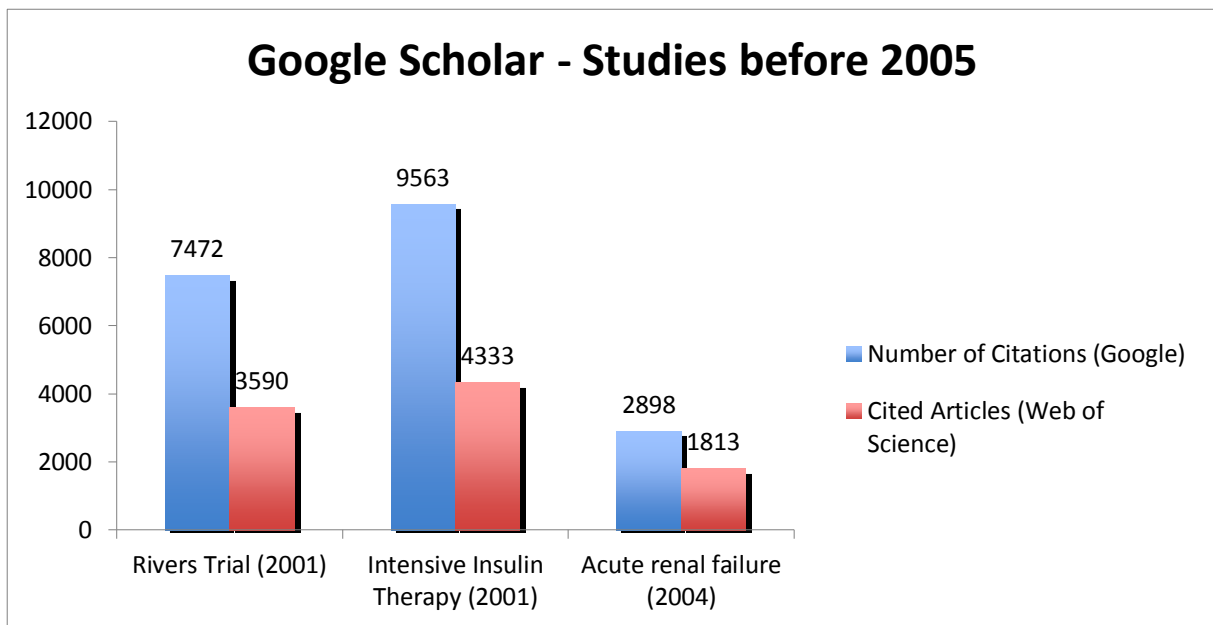
SEPSIS STUDIES	Tweets about the studies
<b>Rivers Trial (2001)</b>	4
<b>proCESS (2014)</b>	29
<b>ARISE (2014)</b>	16
<b>ProMISe (2015)</b>	9
Arithmetic mean	<b>14.5</b>
<b>NON-SEPSIS STUDIES</b>	
<b>Spahn Guidelines (2013)</b>	2
<b>Ventilator Pneumonia (2014)</b>	39
<b>Acute renal failure (2004)</b>	-
<b>Intensive Insulin Therapy (2001)</b>	46
<b>TRISS trial (2014)</b>	54
<b>Decontamination Oropharynx (2014)</b>	-
<b>VITdAL@ICU (2014)</b>	26
<b>Trial early nutritional support (2014)</b>	50
Arithmetic mean	<b>27.1</b>

**Tab. 5** Number of tweets found on Twitter of sepsis and non-sepsis studies

### Google Scholar and Web of Science

Data was found for each study, with the exception of the guidelines publication by Spahn DR. A significant correlation between the publishing date and the number of cited articles on Google Scholar ( $p=0.001$ ) and Web of Science ( $p=0.001$ ) was found. Indeed, studies published after 2013 are cited below the arithmetic mean (Google Scholar = 1653, Web of Science = 872). For example, the proCESS study has the highest number of citing articles on Google Scholar: 52.

Further analyses focusing on studies published before 2005 were conducted. As shown in Fig. 15 the Rivers trial shows exceptional results but still takes second place after the 2001 Intensive Insulin Therapy study by Van den Berghe G. in both Google Scholar data and the data from Web of Science. This is an interesting result, because both studies are considered practice changing landmark ICU trials. They have been released on the same day.



**Fig. 15** Google Scholar data on studies published before 2005

In summary, the sepsis studies do not have a smaller impact in the social media than other major ICU studies. The proCESS study has the highest Altmetric score among all studies. In traditional citation measurements, the Rivers trial scores exceptionally high and is second only to the Intensive Insulin Therapy trial. Twitter data however suggest that the other major studies have a larger impact on the micro-blogging platform as they have a arithmetic mean of 27 in comparison to the sepsis studies with a arithmetic mean of 15.

## **1.2. Data-Analysis**

### **1.2.1. Rivers trial**

Analysis of the Rivers trial shows that this study had a substantial impact in the scientific field and still has a great impact in social media nowadays.

On Altmetric.com, the Rivers trial had a score of 176 (highest proCESS = 300), therefore the study took second place among on all investigated studies, even though the study was published years before social and online media became popular. The score resulted mostly from a high impact in reading platforms like mendeley.com, which provide access to scientific papers and share demographic data about the readers with the publishers. Because of this, the high Altmetric score of the Rivers trial does not represent a high impact in social and therefore interactive media, but rather a high impact in newer, but passive reading platforms.

In further analyses, the first author Emanuel Rivers was examined. As Tab.6 shows River's H-Index is 32 and therefore above average (arithmetic mean = 25.8). The highest number was reached by Rinaldo Bellomo with an H-Index of 45. Among all studies Rivers E. takes fifth place on the H-Index. With his first published article 23 years ago his M-Quotient was low as well = 1.45 (mean = 2.67).

	H-Index
<b>Rivers Trial (2001)</b>	32
<b>proCESS (2014)</b>	25
<b>ARISE (2014)</b>	23
<b>ProMISe (2015)</b>	12
<b>Spahn Guidelines (2013)</b>	42
<b>Intensive Insulin Therapy (2001)</b>	40
<b>Acute renal failure (2004)</b>	45
<b>TRISS trial (2014)</b>	26
<b>Decontamination Oropharynx (2014)</b>	15
<b>VITdAL@ICU (2014)</b>	16
<b>Trial early nutritional support (2014)</b>	17
<b>Ventilator Pneumonia (2014)</b>	17
Arithmetic mean	<b>26</b>

Tab. 6 H-Index of first authors

Surprisingly, Emanuel Rivers is represented on ResearchGate and also has the highest RG score.

In summary, the Rivers trial has an excellent performance in the examined new media platforms. Although there was almost no representation on Twitter, the original EGDT trial takes second place on the Altmetric score. On Google Scholar and Web of Science the trial has the highest number of citing articles. Although Rivers E. has an average H-Index and M-Quotient compared to these outstanding studies' first authors, he is represented on ResearchGate and has the highest score of all.

### 1.2.2. Recent sepsis studies

The first of the recent sepsis studies was the proCESS study by Yealy DM, published in January 2014 in the New England Journal of Medicine. The study had the highest impact by far among all of the three recent sepsis studies in the online media, as well as in the traditional citation measurements. proCESS has the highest Altmetric Score resulting from a high impact on the interactive platform Twitter as well as on passive reading platforms. When searched for on

Twitter via hashtags, it showed the most tweets for proCESS in comparison to the other sepsis studies (proCESS = 29 tweets, ARISE = 16, ProMISe = 2 and Rivers trial = 4) On Google Scholar, it also takes first place of the recent sepsis studies. ProCESS was the first of three large sepsis studies and had the element of surprise as well as unexpected results that likely favored the interactive possibilities of rapidly sharing the long-expected results. Moreover it was published nine months before ARISE and 14 before ProMISe and therefore the paper had more time to be cited and promoted in the online media.

Surprisingly, Yealy DM. as the first author of the paper has both a low H-Index (25) and a low M-Quotient (0.96) in comparison to the other sepsis studies as well as the other examined major studies. Furthermore, Yealy DM. is not represented on ResearchGate. All in all, although the proCESS study had a very high impact on the examined platforms, its first author has not.

The second published study, ARISE, (October 2014) has a Twitter account, which makes it outstanding among all the other examined studies. The Twitter account has 693 followers and tweeted 927 tweets since February 2012. Of the 927 tweets, 113 have been retweeted. The account is still active, the last tweet was uploaded in September 2015. Otherwise, ARISE shows a relatively low performance. The Altmetric score is 29 and below average (mean = 80). On Google Scholar the ARISE study has 18 less cited articles than proCESS and 38 less cited articles on Web of Science, which may well be explained by later publishing date.

	1. Author	RG Score	Downloads	Citations	Impact Points
<b>Rivers Trial (2001)</b>	Rivers E.	44.20	15998	8944	989.01
<b>proCESS (2014)</b>	Yealy DM.	-	-	-	-
<b>ARISE (2014)</b>	Delany A.	32.90	2133	1189	268.19
<b>ProMISe (2015)</b>	Mouncey PR	22.14	148	104	181.07

**Tab. 7** ResearchGate data – recent sepsis studies

Delany A. is the first author of the ARISE study. He has a ResearchGate score of 32.9 and takes fourth place among all examined first authors. The other ResearchGate data of Delany A. suggests that he is very interactive with other users as well, although he does not have as many downloads, citations and impact points as Rivers E. (Tab.7) His behavior on ResearchGate could relate to the ambition of the ARISE team to use an interactive Twitter account to disseminate information about its work. The M-Quotient of Delany A. also is high with a number of 2.3 indicating a very active researcher and putting him in the first place among the sepsis studies (fifth place among all studies). However, the ARISE study itself has a rather low impact on the examined platforms, although it is outstanding by having a study Twitter account.

The ProMISe study was published four months ago in April 2015 and is therefore the most recent examined study. It already has an Altmetric score of 45 and hence outrun the ARISE study (AS = 43). In the four months the study has been cited 27 times on Google Scholar and 4 times of Web of Science. (ARISE, GS = 34, WoS = 11). It can therefore be stated that the ProMISe study already gained impact on both traditional and modern platforms. Mouncey PR. is the first author of ProMISe, he has a ResearchGate account and a RS score of 22 Although Mouncey's H-Index is below average (12 vs 26), his M-Quotient is 6 and thus high above average (arithmetic mean = 2.67). Overall, although the ProMISe study is the most recent study examined in this thesis, and it already shows impact on both traditional and online platforms. Its first author Mouncey PR. published his first paper two years ago and hence has a high M-Quotient. On ResearchGate he is below average (22 vs 28).

The data of the recent sepsis studies leads to the assumption that the more active the first author is on social media platforms, the higher is the study's impact in social and online media. A significant correlation between M-Quotient and the ResearchGate score was found ( $p=0.023$ ).

### **1.2.3. Other recent studies in intensive care**

The VITdAL-ICU study by Amrein K. has the highest Altmetric score among the major studies with a number of 154, resulting mostly from tweets. The study was released in October 2014 and does not have many citing articles on Google Scholar (Google Scholar = 5, Web of Science = 3). Amrein K. is represented on ResearchGate with an RG score of 33.17, putting her in third place among all examined authors. Her M-Quotient is 2.00 and thus close to average (arithmetic mean = 2.67).

Another successful author is Oostdijk EAN. with a M-Quotient of 3.00 (arithmetic mean = 2.23). Her study about Decontamination of the Oropharynx has an Altmetrics score of 84, though the study was published only in October 2014 in JAMA. The study takes fourth place among all examined studies in the Altmetric score data. Oostdijk EAN. is not represented on RG score and there were no tweets found about the study on Twitter.

The studies „Management of bleeding and coagulopathy, an updated European Guidelines“by Spahn DR., published in 2013 (AS = 51) and the trial plan about early nutritional support in ICU patients by Harvey SE., published in 2014 (AS = 54) have a similar Altmetric score. Interestingly, the Altmetric score of those two studies results from different sources. The Guidelines study has had a lot of impact in reader platforms, whereas the early nutritional support study has had its most impact on Twitter (see Tab. 8). It is surprising that the Guideline

study has more tweeters and more impact on reader platforms than the early nutritional support study, but still a lower Altmetric score.

	AS Score	Tweeters	Facebook	Blogs	Readers
<b>Trial early nutritional support (2014)</b>	54	46	27	3	2
<b>Spahn Guidelines (2013)</b>	51	63	4	1	145

**Tab. 8** Altmetric data about the study by Spahn DR. and by Harvey SE.

These results suggest that interactive platforms like Twitter, Facebook or Blogs are weighted higher in the Altmetric score than passive platforms like mendeley.com or CiteULike.com. The assumption cannot be validated, because the exact Altmetric algorithm is not publicly shared.

Similar results can be seen at the Intensive Insulin Therapy study by Van den Berghe G. The study's Altmetric score is 15, although there are 238 listed readers of the study (arithmetic mean = 148), but almost no Tweeters, Facebook posts or blogs.

The TRISS trial is mentioned 54 times on Twitter and can be found by entering the hashtag #TRISS trial. Therefore it takes first place among all examined studies relating tweets (arithmetic mean = 26.80). Nonetheless, the study has an Altmetric score of 5, which is the lowest among all studies found on Altmetrics. This suggests that Altmetrics, as well as Google Search, have non-transparent and non-comprehensible algorithms for analyzing a study. Holst L., the first author of the TRISS trial, is represented on ResearchGate with a RG score of 20.8 (arithmetic mean = 27.9). This and his M-Quotient of 6.5 suggest that Holst L. is a young and very active scientist.

## Discussion and Conclusion

This study set out to determine the impact of scientific papers related to critical care in the social media. We focused on landmark sepsis studies, including the original Rivers trial from 2001 which introduced the concept of early goal directed therapy in the treatment of early sepsis and the three large multicenter trials which were published in the last 18 months. We chose eight major non-sepsis studies to compare the four sepsis studies in their social media appearance and their traditional citations impact.

One interesting finding of this study is that the publishing date and the impact in the social media do not correlate in ICU studies. Therefore it does not depend on how long a paper is published and whether it is popular in the social media.

Surprisingly, no differences were found between the traditional scientometric indicators and the social media. Papers with many citations were not necessarily popular in the online and social platforms. This could depend on the age of the addressed audience of a paper. Older scientists may relate to traditional indicators, whereas younger scientists use the internet for reading and discussing papers.

The second question of this study focused on the first author of the papers. There was a significant correlation between the first published paper and their ResearchGate score, which represents their impact on the social platform.

Our findings are limited by the available data, for example it is likely that a study is also commented on without always using a certain hashtag. Sometimes, there were obviously missing data – for example, only 50% of the examined first authors had a ResearchGate account. Further, we concentrated on a relatively small number of large highly visible critical care trials, their first (and not additionally senior) authors who often are established international researchers. Therefore, our data may not relate to other settings.

Since 2004, the possibility for scientists to promote their work via online and social platforms has increased steadily. As a consequence, scientists may in the future be less dependent on traditional citations measures such as Web of Science or the Impact Factor.

But with the rise of the social media, the number of published papers has also increased. A recent study raised concerns regarding potential deliberate influencing of some scientometric indicators (e.g. journal impact factors) (Wilsdon, 2015). Similarly, Parolo (2015) report an increasing number of published papers since 1970, explainable by the “publish or perish” dogma in modern science. Since then, papers seem to be obsolete more rapidly, and scientists

easily lose the overview over the high number of published papers. Parolo also relates this increase to the new technologies.

These studies stress the importance for scientists to make their work known to a broad audience. Prior traditional indexes could not easily be manipulated to increase the number of citations. Nowadays, social media give a new opportunity to promote scientific papers. The Altmetric score is considered an official indicator for a paper's representation in the social media. However, similarly to traditional citation statistics the score does not necessarily represent the quality or clinical meaningfulness of a paper than rather its popularity in the online and social platforms. It must also be considered that the Altmetric Score often is largely driven by medical lay people and the lay press, but - in contrast to traditional scientometrics - not by the discipline-specific scientific community.

For example, among the list of the Top 100 Altmetric articles, top scoring papers cover topics like weight loss, sexuality or chocolate (Crotty D., 2014).

There are still many unanswered questions about the impact of the social media behaviour of the participating scientists in a paper and the impact of the paper itself on online and social platforms.

A further study could assess the impact of successful studies in the social media in their first weeks after publishing and whether the impact decreases with time.

In conclusion, we present novel data on the impact of critical care trials in the social media. Although these certainly improve and speed up the translation from clinical research to the bedside and encourage the discussion between researchers and clinicians, we must remain careful in interpreting new scoring systems too enthusiastically. Similar to traditional metrics, scientific output can hardly be measured in single numbers, in addition these can to a certain extent be manipulated, and large discipline specific differences exist.

However, these recent developments open up many new possibilities for the translation of research into clinical practice. Within the next years it will become evident how useful these new methods truly are and if they should be used in addition or even replace traditional measures of scientific success.

## References

- Allgaier J, D. S.-Y. (2013). Journalism and social media as means of neuroscientists' observation of contexts of science. *Biosciences* , 63 (4), 284–287.
- Altmetrics Press Releases*. (27. 01 2015). Access on date 07. 02 2015 on <http://www.altmetric.com/pressreleases/altmetric-for-institutions-adoption.php>
- Anderson AA, B. D. (2013). The “nasty effect”: Online incivility and risk perceptions of emerging technologies. *Journal of Computer-Mediated Communication* , 19 (3), 373–387.
- Ärzttekammer Steiermark. (01 2015). *Die Ärztekammer Steiermark*. Access on date 13. 07 2015 on <http://www.aekstmk.or.at/cms/cms.php?pageName=233&articleId=5357>
- Bunz, M. (14. 01 2010). *The Guardian*. Access on date 01. 02 2015 on <http://www.theguardian.com/media/pda/2010/jan/14/socialnetworking-haiti>
- Board, N. S. (2012). *Science and Engineering Indicators 2012* . Washington DC: National Science Foundation.
- Brossard, D. (11. 02 2013). *New media landscapes and the science information consumer*. Access on date 02. 02 2015 on [https://univpn.univie.ac.at/+CSCO+0h756767633A2F2F6A6A6A2E63616E662E626574++/content/110/Supplement\\_3/14096.full](https://univpn.univie.ac.at/+CSCO+0h756767633A2F2F6A6A6A2E63616E662E626574++/content/110/Supplement_3/14096.full)
- Brossard, D. S. (2013). Science, New Media, and the Public. *Science* , 330, 40-41.
- Cheung, A. (11 2012). *2 Minute Medicine*. Access on date 27. 12 2014 on <http://www.2minutemedicine.com/the-rivers-trial-early-goal-directed-therapy-prior-to-icu-admission-improves-outcomes-in-patients-with-severe-sepsis-and-septic-shock-classics-series/>
- Chimes, C. (09. 12 2014). *Altmetric Top 100 2014*. Access on date 02. 02 2015 on <http://www.altmetric.com/blog/altmetric-top-100-2014/>
- Cleffmann, L., Feuerabend, A., & Howald, F. (2010). *ECCO Social Media Report: Die Integration von Social Media in der Kommunikation*. London: ECCO International Public Relations Ltd.
- Cormode, G. K. (2008). Key differences between the Web 1.0 and Web 2.0. *Peer-reviewed Journal on the Internet* , 13 (6).
- Critical Care*. (2015). Access on date 11. 02 2015 on <http://ccforum.com/mostviewed/year>

Crotty D. (17. 12 2014). *Altmetric's Top 100: What Does It All Mean?* Access on date 17. 07 2015 on <http://scholarlykitchen.sspnet.org/2014/12/17/altmetrics-top-100-what-does-it-all-mean/>

E. Rivers, B. N. (2001). Early Goal-Directed Therapy in the Treatment of Severe Sepsis and Septic Shock. *The New England Journal of Medicine* , 345, 1368-1377.

*ESICM Hot Topics*. (2014). Access on date 18. 02 2015 on <http://www.esicm.org/news-article/lives2014hottopics>

Daniels, R. N. (2010). *ABC of Sepsis*. West Sussex: Blackwell Publishing Ltd.

Falagas, M. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. *The FASEB Journal* , 22, 338-342.

Fox, S. (2011). *The Social Life of Health Information*. Access on date 01. 02 2015 on [http://www.pewinternet.org/files/old-media//Files/Reports/2011/PIP\\_Social\\_Life\\_of\\_Health\\_Info.pdf](http://www.pewinternet.org/files/old-media//Files/Reports/2011/PIP_Social_Life_of_Health_Info.pdf)

*Google Scholar Metrics*. (06 2014). Access on date 27. 12 2014 on Health & Medical Science: [http://scholar.google.com/citations?view\\_op=top\\_venues&hl=en&vq=med](http://scholar.google.com/citations?view_op=top_venues&hl=en&vq=med)

*ICNARC*. (2014). Access on date 29. 12 2014 on Intensive Care National Audit & Research Centre : <https://www.icnarc.org/Our-Research/Studies/Promise/About>

*intensivecarenetwork.com*. (2015). Access on date 26. 02 2015 on <http://intensivecarenetwork.com/about/the-icn-story/>

*Internet Live Stats - Twitter Usage Statistics*. (2014). Access on date 26. 12 2014 von Internet Live Stats - Twitter Usage Statistics: <http://www.internetlivestats.com/twitter-statistics/>

Hayes MA., e. a. (1994). Elevation of systemic oxygen delivery in the treatment of critically ill patients. *N Engl J Med* , 330, 1717-1722.

Halbach, O. v. (2011). How to judge a book by its cover? How useful are bibliometric indices for the evaluation of “scientific quality” or “scientific productivity”? *Annals of Anatomy - Anatomischer Anzeiger* , 193, 191-196.

Harzing, A. (23. 04 2008). *Reflections on the h-index*. Access on date 27. 12 2014 on [http://www.harzing.com/pop\\_hindex.htm](http://www.harzing.com/pop_hindex.htm)

Hettler, U. (2010). *Social Media Marketing*. München: Oldenbourg Wissenschaftsverlag GmbH.

- Jähne, K. (22. 05 2014). *The New English Journal of Medicine*. Access on date 29. 12 2014 on <http://www.nejm.org/doi/citedby/10.1056/NEJMoa1401602#t=comments>
- Kintisch, E. (25. 08 2014). <http://sciencecareers.sciencemag.org>. Access on date 25. 02 2015 on [http://sciencecareers.sciencemag.org/career\\_magazine/previous\\_issues/articles/2014\\_08\\_25/career.a1400214](http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2014_08_25/career.a1400214)
- Luther, J. (2012). *The Scholarly Kitchen*. Access on date 26. 12 2014 on Altmetrics – Trying to Fill the Gap: <http://scholarlykitchen.sspnet.org/2012/07/25/altmetrics-trying-to-fill-the-gap/>
- Levy M., e. a. (2015). Surviving Sepsis Campaign: Association Between Performance Metrics and Outcomes in a 7.5-Year Study. *Critical Care Medicine* , 43 (1), 3-12.
- Levy, M. P. (2004). Sepsis change bundles: converting guidelines into meaningful change in behavior and clinical outcome. *Crit Care Med* , 32, S595-S597.
- Lozano, G. A., Larivière, V., & Gingras, Y. (2012). The weakening relationship between the impact factor and papers' citations in the digital age. *Journal of the American Society for Information Science and Technology* , 63, 2140–2145.
- Nature*. (23. 06 2005). Access on date 27. 12 2014 on Not-so-deep impact: <http://www.nature.com/nature/journal/v435/n7045/full/4351003b.html>
- Nierop, E. V. (2009). Why do statistics journals have low impact factors? *Statistica Neerlandica* , 63, 52-62.
- McGowan BS, e. a. (2012). Understanding the factors that influence the adoption and meaningful use of social media by physicians to share medical information. *J Med Internet Res* , 14 (5), 117.
- McNab, C. (2009). What social media offers to health professionals and citizens. *Bulletin of the World Health Organization* , 87, 566–566.
- Merten, K. (1995). *Inhaltsanalyse. Einführung in Theorie, Methode und Praxis* . Opladen: Westdeutscher Verlag .
- Mouncey PR, e. a. (2015). Trial of Early, Goal-Directed Resuscitation for Septic Shock. *The New England Journal of Medicine* , 2015 (07), 08.
- Owen, S. (2011). *The layered look: How Google News is integrating the social web*. Cambridge: Nieman Journalism Lab.
- Parolo P., e. a. (03 2015). Attention decay in science. *physics.soc-ph* , 1-12.

Peake, S. D. (2014). Goal-directed resuscitation for patients with early septic shock. *The New England Journal of Medicine* , 2014 (12), 27.

Power, G., Harrison, D., Mouncey , P., Osborn , T., Havey, S., & Rowan, K. (2013). The Protocolised Management in Sepsis (ProMISe) trial statistical analysis plan. *Critical Care and Resuscitation* , 15 (4), 311-317.

*Surviving Sepsis Campaign*. (01. 10 2014). Access on date 07. 02 2015 on <http://www.survivingsepsis.org/SiteCollectionDocuments/ProCESS-ARISE.pdf>

*Selected Scientific Journals*. (10. 03 2003). Access on date 21. 02 2015 on <http://www.genebee.msu.su/journals/if01n.html>

*SMACC*. (2015). Access on date 26. 02 2015 on <http://www.smacc.net.au/about-us/how-were-different/>

Rello, J. L. (2012). *Sepsis Management: PIRO and MODS*. Heidelberg: Springer Verlag.

*Research Gate*. (2015). Access on date 25. 02 2015 on <https://www.researchgate.net/about>

*researchgate.net*. (2015). Access on date 25. 02 2015 on <https://www.researchgate.net/publicprofile.RGScoreFAQ.html>

Rivers, E. N. (2001). Early Goal-Directed Therapy in the Treatment of Severe Sepsis and Septic Shock. *The New England Journal of Medicine* , 345, 1368-1377.

*Twitter analytic tool - Tweetchup*. (2014). Access on date 26. 12 2014 on <http://tweetchup.com/#/profiles>

Pick, Y. (2013). *Das Echo-Prinzip. Wie Online-Kommunikation Politik verändert*. Wien: Czernin Verlag.

Weingart, S. (2013). *emcrit.org*. Access on date 26. 02 2015 on <http://emcrit.org/about-me/>

*Wiki Journal Club*. (01. 10 2014). Access on date 27. 12 2014 on [http://www.wikijournalclub.org/wiki/Rivers\\_Trial](http://www.wikijournalclub.org/wiki/Rivers_Trial)

*Wikipedia*. (20. 12 2014). Access on date 26. 12 2014 on Impact Factor: [http://de.wikipedia.org/wiki/Impact\\_Factor](http://de.wikipedia.org/wiki/Impact_Factor)

*Wikipedia*. (18. 12 2014). Access on date 26. 12 2014 on H-Index: <http://en.wikipedia.org/wiki/H-index>

Wilsdon, J. e. (2015). *The Metric Tide: Report of the Independent Review of the Role of Metrics in Research Assessment and Management*. HEFCE.

*world-sepsis-day.org*. (2015). Access on date 08. 07 2015 on <http://www.world-sepsis-day.org/?MET=US&vPRIMNAVISELECT=2&vCONTAINERID=>

Yealy, D., Kellum, J., & Huang, D. (2014). A Randomized Trial of Protocol-Based Care for Early Septic Shock. *The New England Journal of Medicine*, 370, 1683-1693.

Yin, C. (2011). Do impact factor, h-index and Eigenfactor™ of chemical engineering journals correlate well with each other and indicate the journals' influence and prestige? *Current Science*, 100 (05), 648 -653.

You, J. (14. 09 2014). *The top 50 science stars of Twitter*. Access on date 02. 02 2015 on <http://news.sciencemag.org/scientific-community/2014/09/top-50-science-stars-twitter>

Van Noorden, R. (04. 11 2014). *nature.com*. Access on date 25. 02 2015 on <http://www.nature.com/news/google-scholar-pioneer-on-search-engine-s-future-1.16269>

Vicari, J. (2014). *wired.de*. Access on date 25. 02 2015 on <https://www.wired.de/collection/latest/ein-halbes-jahr-mit-researchgate-grunder-ijad-madisch>

# Appendix<sup>1</sup>

The four examined sepsis studies on the website of the New England Journal of Medicine ([nejm.org](http://nejm.org))

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**ORIGINAL ARTICLE**

## Early Goal-Directed Therapy in the Treatment of Severe Sepsis and Septic Shock

Emanuel Rivers, M.D., M.P.H., Bryant Nguyen, M.D., Suzanne Havstad, M.A., Julie Ressler, B.S., Alexandria Muzzin, B.S., Bernhard Knoblich, M.D., Edward Peterson, Ph.D., and Michael Tomlanovich, M.D. for the Early Goal-Directed Therapy Collaborative Group

N Engl J Med 2001; 345:1368-1377 | November 8, 2001 | DOI: 10.1056/NEJMoa010307

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**BACKGROUND**

Goal-directed therapy has been used for severe sepsis and septic shock in the intensive care unit. This approach involves adjustments of cardiac preload, afterload, and contractility to balance oxygen delivery with oxygen demand. The purpose of this study was to evaluate the efficacy of early goal-directed therapy before admission to the intensive care unit.

[Full Text of Background ...](#)

**MEDIA IN THIS ARTICLE**

**FIGURE 2**



Protocol for Early Goal-Directed

<sup>1</sup> accessed on date 15.07.2015

# A Randomized Trial of Protocol-Based Care for Early Septic Shock

The ProCESS Investigators  
N Engl J Med 2014; 370:1683-1693 | May 1, 2014 | DOI: 10.1056/NEJMoa1401602

Comments open through May 7, 2014

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## BACKGROUND

In a single-center study published more than a decade ago involving patients presenting to the emergency department with severe sepsis and septic shock, mortality was markedly lower among those who were treated according to a 6-hour protocol of early goal-directed therapy (EGDT), in which intravenous fluids, vasopressors, inotropes, and blood transfusions were adjusted to reach central hemodynamic targets, than among those receiving usual care. We conducted a trial to determine whether these findings were generalizable and whether all aspects of the protocol were necessary.

[Full Text of Background...](#)

## METHODS

In 31 emergency departments in the United States, we randomly assigned patients with septic shock to one of three groups for 6 hours of resuscitation: protocol-based EGDT; protocol-based standard therapy that did not require the placement of a central venous catheter, administration of inotropes, or blood transfusions; or usual care. The primary end point was 60-day in-hospital mortality. We tested sequentially whether protocol-based care (EGDT and standard-therapy groups combined) was superior to usual care and whether protocol-based EGDT was superior to protocol-based

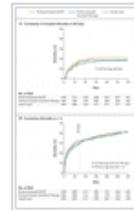
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#### FIGURE 1



Screening, Randomization, and Follow-up.

#### FIGURE 2



Cumulative Mortality.

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May 1, 2014 | C.M. Lilly

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May 1, 2014 | C. Rhee and Others

#### CORRESPONDENCE

Protocol-Based Care for Early Septic Shock

July 24, 2014

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# Goal-Directed Resuscitation for Patients with Early Septic Shock

The ARISE Investigators and the ANZICS Clinical Trials Group  
 N Engl J Med 2014; 371:1496-1506 | October 16, 2014 | DOI: 10.1056/NEJMoa1404380

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## BACKGROUND

Early goal-directed therapy (EGDT) has been endorsed in the guidelines of the Surviving Sepsis Campaign as a key strategy to decrease mortality among patients presenting to the emergency department with septic shock. However, its effectiveness is uncertain.

[Full Text of Background...](#)

## METHODS

In this trial conducted at 51 centers (mostly in Australia or New Zealand), we randomly assigned patients presenting to the emergency department with early septic shock to receive either EGDT or usual care. The primary outcome was all-cause mortality within 90 days after randomization.

[Full Text of Methods...](#)

## RESULTS

Of the 1600 enrolled patients, 796 were assigned to the EGDT group and 804 to the usual-care group. Primary outcome data were available for more than 99% of the patients. Patients in the EGDT group received a larger mean ( $\pm$ SD) volume of intravenous fluids in the first 6 hours after randomization than did those in the usual-care group ( $1964 \pm 1415$  ml vs.  $1713 \pm 1401$  ml) and were more likely to receive vasopressor infusions (66.6% vs. 57.8%), red-cell

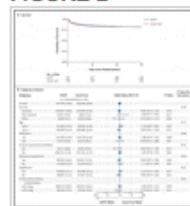
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#### FIGURE 1



Enrollment and Outcomes.

#### FIGURE 2



Probability of Survival and Subgroup Analyses of the Risk of Death at 90 Days.

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# Trial of Early, Goal-Directed Resuscitation for Septic Shock

Paul R. Mouncey, M.Sc., Tiffany M. Osborn, M.D., G. Sarah Power, M.Sc., David A. Harrison, Ph.D., M. Zia Sadique, Ph.D., Richard D. Grieve, Ph.D., Rahi Jahan, B.A., Sheila E. Harvey, Ph.D., Derek Bell, M.D., Julian F. Bion, M.D., Timothy J. Coats, M.D., Mervyn Singer, M.D., J. Duncan Young, D.M., and Kathryn M. Rowan, Ph.D. for the ProMiSe Trial Investigators

N Engl J Med 2015; 372:1301-1311 | April 2, 2015 | DOI: 10.1056/NEJMoa1500896

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## BACKGROUND

Early, goal-directed therapy (EGDT) is recommended in international guidelines for the resuscitation of patients presenting with early septic shock. However, adoption has been limited, and uncertainty about its effectiveness remains.

## METHODS

We conducted a pragmatic randomized trial with an integrated cost-effectiveness analysis in 56 hospitals in England. Patients were randomly assigned to receive either EGDT (a 6-hour resuscitation protocol) or usual care. The primary clinical outcome was all-cause mortality at 90 days.

## RESULTS

We enrolled 1260 patients, with 630 assigned to EGDT and 630 to usual care. By 90 days, 184 of 623 patients (29.5%) in the EGDT group and 181 of 620 patients (29.2%) in the usual-care group had died (relative risk in the EGDT group, 1.01; 95% confidence interval [CI], 0.85 to 1.20;  $P=0.90$ ), for an absolute risk reduction in the EGDT group of  $-0.3$  percentage points (95% CI,  $-5.4$  to  $4.7$ ). Increased treatment intensity in the EGDT group was indicated by increased use of intravenous fluids, vasoactive drugs, and red-cell transfusions and reflected by significantly worse organ-failure scores, more days receiving advanced cardiovascular support, and longer stays in the

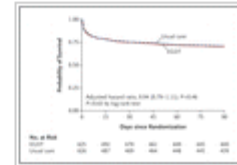
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#### FIGURE 1



Enrollment and Outcomes.

#### FIGURE 2






Kaplan–Meier Survival Estimates.

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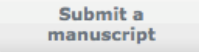
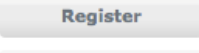
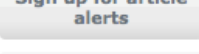
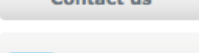

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**Passive Leg Raising (PLR): « primum non nocere »**  
Many thanks to the authors for this welcomed reminder about a not so easy to perform method, the PLR (1). However, in our opinion, going further on how to help realizing it is necessary to achieve its safe and efficient use. Firstly, as unexpected side observations from simulation  
Comment on: [Monnet et al.](#), *Critical Care* 2015, **19**:18

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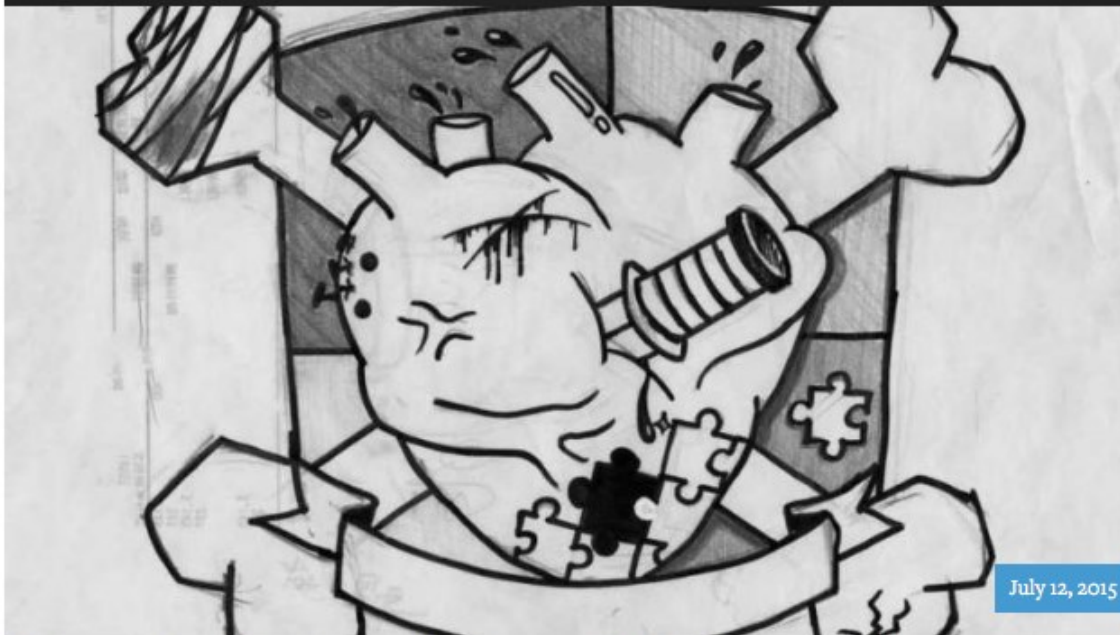
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Newsletter 1 · 2015 / Tue, 28 Apr 2015

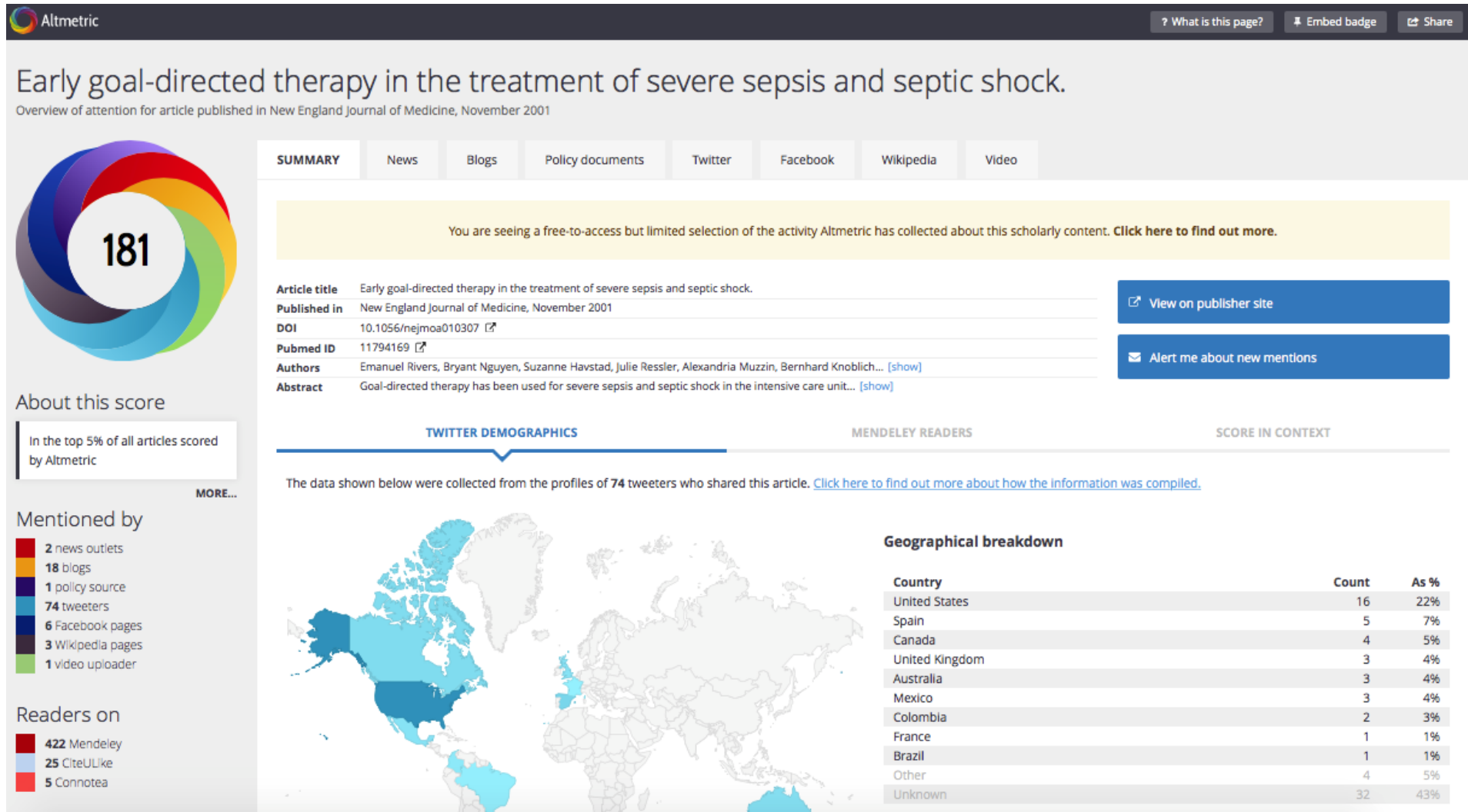
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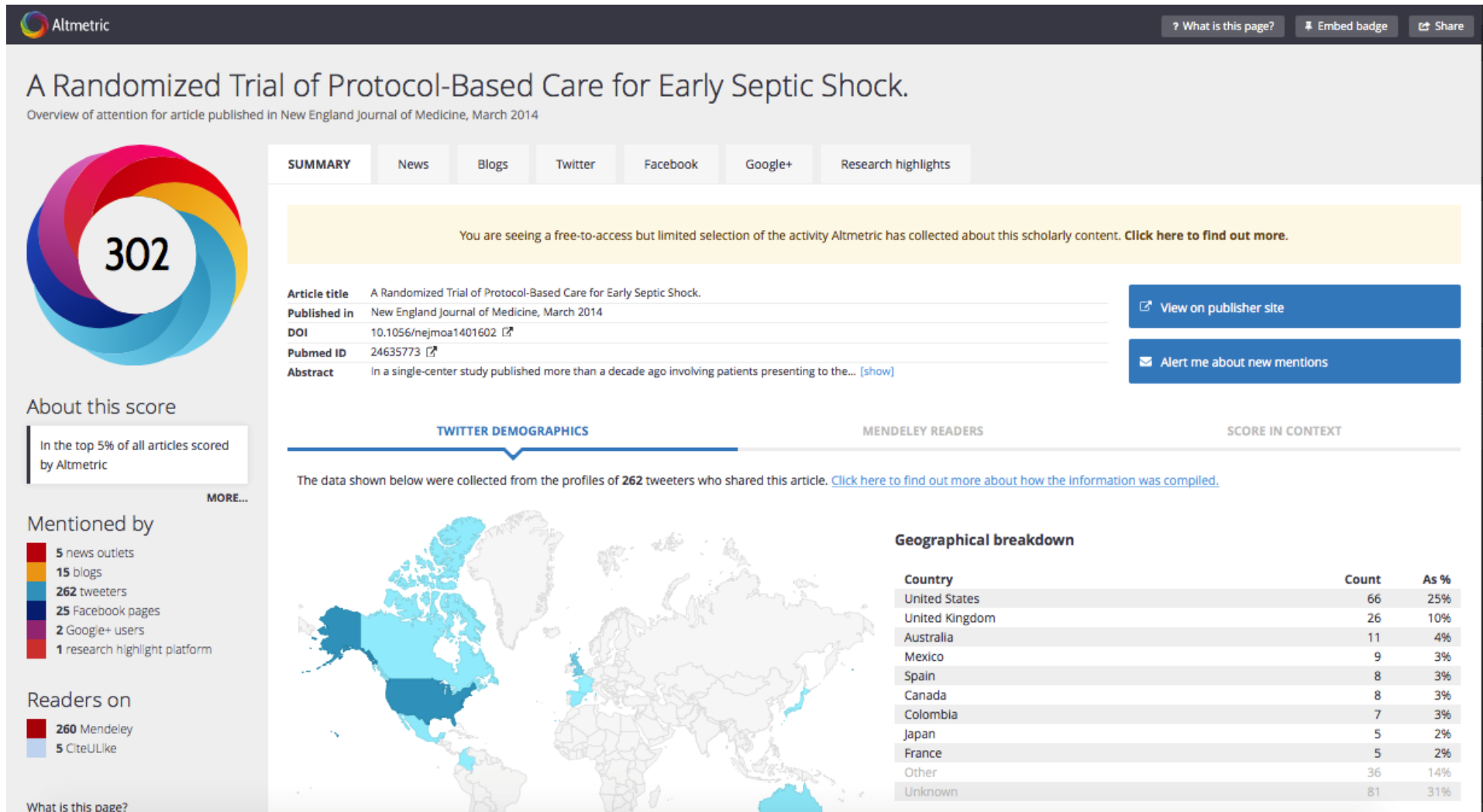
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