# Operations Management in Hospitals: A Literature Review

[1]JAYASHREE SAMANTARAY,
*Gandhi Institute of Excellent Technocrats, Bhubaneswar*
[2]SHEETAL RANI HANSDAH,
*Sanjay Memorial Institute of Technology, Ganjam, Odisha, India*

## Abstract
Researcher and academics have been using operation management methods and tools, as continuous improvementprojects,toaddressproblemsrelatedtoprocessefficiencyandfinancialpressureinhospitals. Although there are literature reviews related to continuous improvement projects in hospitals, to authors' knowledge,thereisalackofinformationaboutthecontributionsthatotheroperationmanagementmethods and tools have been applied and/or investigated in hospitals, such as supply chain management, logistics, human resources, and performance measurement. Therefore, the purposes of this research are (i) define if hospitals'problemsandsolutionsisatopicofinterestinanoveralloperationsmanagementfieldand(ii)to characterize the literature available. In order to achieve this aim, a literature review limited to the International Journal of Operation and Production Management was conducted. This research shows that hospitalproblemsandsolutionshavebeenincreasingovertimeinanoperationsmanagementfieldoverall, author collaboration has been increasing in recent years, and the topics most commonly addressed are related to performance, quality and process improvement. The limitation of this research is the use of a single journal; therefore, future work should be conducted a systematic literature review to validate some of thesefindings.

## Keywords
Operations management, hospital, literature review

## 1. Introduction
Hospital services are very different than manufacturing and other service organizations (Berry &Seltman, 2008) in thattheservicerepresentsanecessity,patients(orcustomers)areusuallysick,andhospitalsarecomplexorganizations wherehumaninteractionisconstantlypresentthroughouttheprocesses,withlimitedresources(Harper,2002).Patient safety problems showed some of the inefficiency of the organizational processes that hospitals have (Institute of Medicine, 2000; Institute of Medicine, 2001). Researchers and academics have been using operation management (OM) methods and tools as continuous improvement projects to address problems related to process efficiency (Herzlinger, 2006; Leape&Fromson, 2006; Baddour&Saleh, 2013) and financial pressure in hospitals (Stevenson, 2011).Althoughtherearerecentsystematicliteraturereviewsrelatedtocontinuousimprovementprojectsinhospitals (Gonzalez Aleu, Van Aken, &Keathley, 2016; Gonzalez Aleu& Van Aken, in press), to author knowledge, there is a lack of information about the contributions that other operations management methods and tools have been applied and/or investigated in hospitals, such as supply chain management, logistics, human resources, and performance measurement.
The purposes of this research are (i) define if hospitals problems and solutions is a topic of interest in an operations management field overall and (ii) to characterize the literature available on OM in hospitals using the dimensions of publication characteristics, author characteristics, and content characteristics (Keathley-Herring et. al, 2016). This investigationseekstoanswerthefollowingresearchquestions:whattrends(positiveornegative)existinthefrequency ofpublicationsinajournalspecializedinoperationmanagementaddressingtopicsrelatedtohospitals? whicharethe formalandinformalgroupofauthorsworking(researchersandpractitioners)inoperationsmanagementinhospitals? which are the main focus (research or applications) of the publications in operation management in hospitals? which are the main topics related to operation management addressed in thepublications?
In order to achieve theses aims, a literature review using a single journal was conducted as follow.

## 2. Methodology
A systematic literature review is a well-organized procedure to collect and analyze data extracted from a set of publicationsusingsixsteps:problemdefinition,scopingstudy,searchstrategy,exclusioncriteria,datacollection,and analysis and synthesis (Trandfield, Denyer, & Smart, 2003; Keathley-Herring et al., 2016). Considering that this literature review is limited to a single journal (International Journal of Operation and Production Management - IJOPM) and does not include other types of publications such as books, practitioners' publications, theses and dissertations,theauthorsconsiderthisresearchasascopingstudy.Inascopingstudy,thesecondstepofthesystematic literature review (see Figure 1), the author or research team are focused to identify an initial set of publications to conduct in the

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future an extended investigation (futurework).

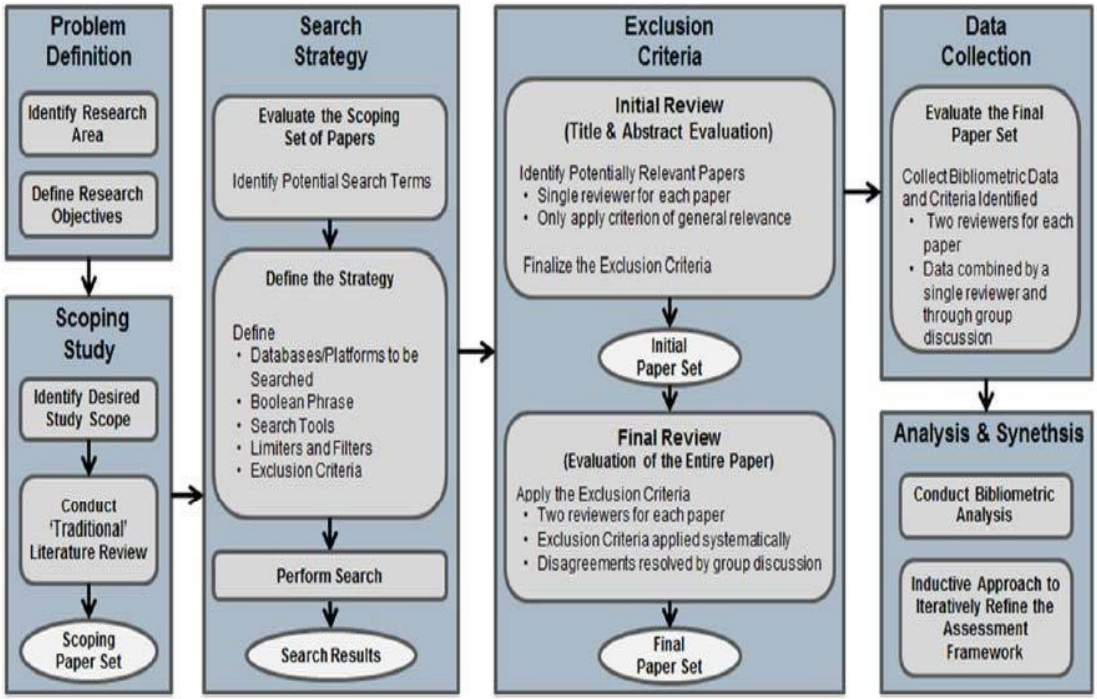


Figure 1. Systematic literature review approach (Keathley-Herring et al., 2016, p. 931)

The choice of the IJOPM was determined due to its academic relevance, with an h-index of 94, placing it among the top 50 journals in the subject area of Business, Management and Accounting (Scimago, 2017). It is also an academic journalthathasageneralapproachtoOperationsManagement(researchpurpose)andthiswillprovideanideaabout the relevance of research in hospitals regarding OM in general. A total of 2014 publications were extracted from IJOPM during the period between 1980 to 2016; however, only 44 papers were fully focused on hospitals (research interest). Using this set of papers, each of the research questions mentioned in the introduction were answered as follows.

## 3. Results

**What trends (positive or negative) exist in the frequency of publications in a journal specialized in operation management addressing topics related to hospitals?(RQ1)**

TheIJOPMstarteditspublicationsin1980,however,thefirsttwoarticlesthatfocusedinhospitalsappearedin1985. Since this year, the amount of publications increased gradually, and the application of operations management in hospitalsseemstogrowinrelevanceforthejournal(seeFigure2).Theoutstandingnumberofpublicationsintheyear 2002 should be produced by the impact that *To Err is Human* (Institute of Medicine, 2000) and *Crossing thequality*


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*chasm: a new health system for the 21st century* (Institute of Medicine, 2001) had in the practitioner and research communities, exposing severe organizational problems in hospitals.

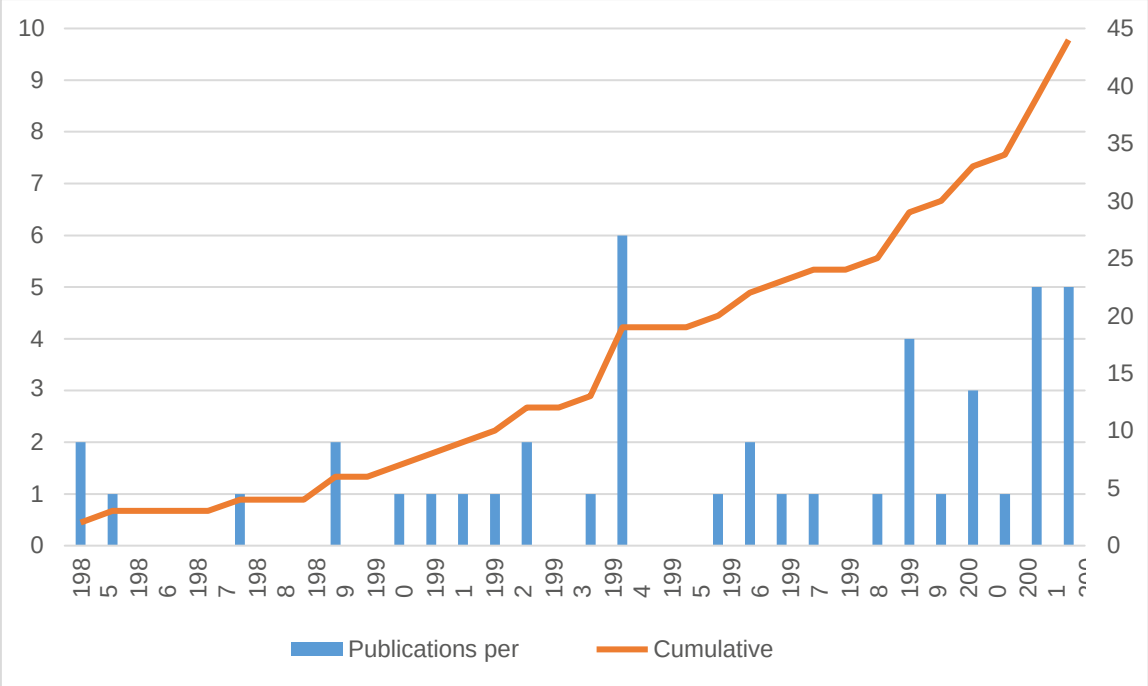


Figure 2. Cumulative frequency of publications focused in hospitals

It has been demonstrated through investigation that the publications of these reports had an impact on the literature andresearchinhealthcare(Stelfox,2006).AccordingtoStelfox(2006),theperiodafterthepublicationssawresearch addressinginagreaterwaytopicsrelatedtoorganizationalstructure,patientsafetyandquality.Thepresenceofthese two publications in the beginning of the decade drew interest into the applying OM in hospitals, since OM is an area that is focused on designing, controlling and improving systems and operations to produce goods and services (Stevenson, 2011, p. 4). The information from the sample in our study supports this conclusion. However, it is important to note that, from the 44 articles in the sample, only one made a direct citation to these publications (McFadden, 2006).

Product Life Cycle or Knowledge Life Cycle is composed on four stages: introduction, growth, maturity and decline (Rink & Swan, 1979). For this research field, the introduction stage covers from 1985 to 2009 and the growth phase startsinthemostrecent years,startingfrom2010.Thisisasignofearlydevelopmentofthisresearchareaandofthe initial adoption. However, to complement the characterization of the literature, RQ2 was addressed in the following subsection.

### Whicharetheformalandinformalgroupsofauthorsworking(researchersandpractitioners)in operations management in hospitals?(RQ2)

Thesecondstageofthisresearchinvolvestheanalysisoftheauthordimensionsintheliteratureavailable.Thisphase is aimed to identify the formal or informal groups of authors working in this area, and further detail the information obtained in the initial stage regarding publication characteristics. This section is divided into three levels: authors' name, authors' institution of affiliation, and authors' country of affiliations. First, a total of 101 authors contributed to the 44 publications found for this study. The number of new authors per year publishing on OM in hospitals has been increasing over the last years (see Figure 3), supporting the finding from RQ1: OM in hospitals have been increasingbetweenpractitionersandresearchers.Mostpublicationswerethesultofthecontributionoftwoorthree different authors and, in the great majority of the cases, they published onlyonce.

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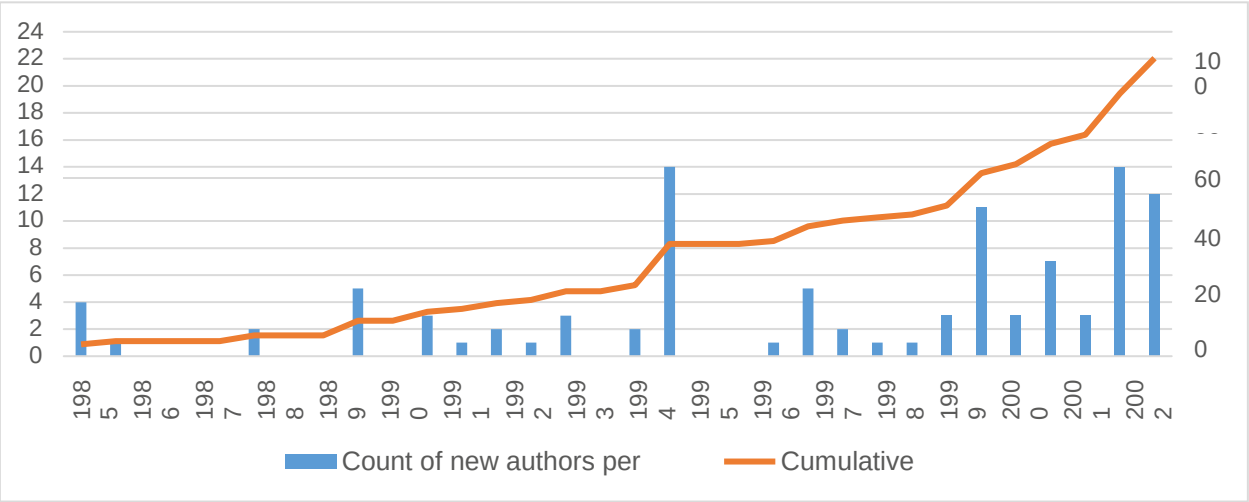


Figure 3. Count of new authors per year

Thereare6authorsthatmademultiplepublicationsinthearea,theirnamespresentedinthefollowingTable1.These authors have published in the last 10-11 years, this information can suggest that there is an active group of authors thatisbecomingthereferencegroupwithinthisareaandcanguidethefutureresearch.Thisinitialstageintheauthor communitiesandcollaborationcanbelinkedtotheinitialstageofgrowthidentifiedinthepublicationcharacteristics. It is important to note the participations of Dirk Pieter van Donk, Justin Drupsteen, and Taco van der Vaart from the Netherlands,theypublishedtogetherin2013and2016,becomingtheonlygrouptohavemultiplepublicationsinthe sample.

Table 1. Authors with multiple publications

| Authors with multiple publications | No. of publications | Country of work |
|---|---|---|
| Dirk Pieter van Donk (2011, 2013, 2016) | 3 | Netherlands |
| Justin Drupsteen (2013, 2016) | 2 | Netherlands |
| Taco van der Vaart (2013, 2016) | 2 | Netherlands |
| Gregory N. Stock (2006, 2007) | 2 | USA |
| Kathleen L. McFadden (1996, 2006) | 2 | USA |
| Teresa S. Waring (2002, 2015) | 2 | UK |

AnotherwaytoanalyzecontributionsbetweenauthorsisthroughtheSocialNetworkAnalysis,whichhasbeenapplied to this sample of publications through the software *Gephi*(version 0.9.1). The result is shown in Figure 4. It is important to note that the size of the nodes corresponds to the number of publications by that author, and the color refers to the number of collaborations with different authors in different papers. To form the graph, an algorithm of Force Atlas was used and different parameters were tried for the best layout to provide visual explanation. Four authorsthatpublishedasinglearticleanddidn'thavecontributionsareinthecenter(Al-Shammari,Buchanan,Pegels, andRamanathan).InthecaseofMcFadden(1996),sinceshepublishedagainlaterincollaborationwithotherauthors (2006), is present in another part of the graph linked to them and is not seen as a singleauthor.


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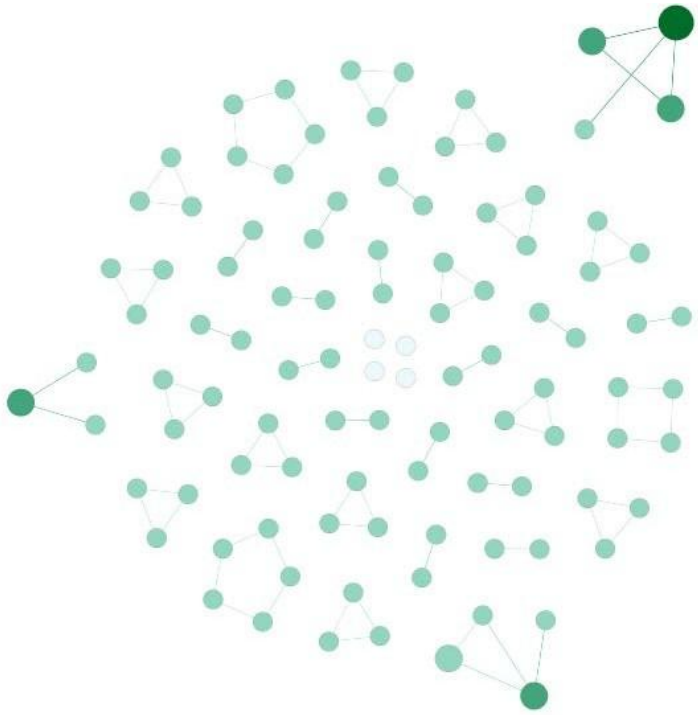

Figure 4. Social Network Analysis of author contributions

Second, 21 out of 44 papers were made through cooperation of different institutions (66.7% were made by representatives from different universities and 33.3% between universities and others institutions as hospitals). The dissemination of knowledge flows mainly from the academic area of business administration and operation managementinuniversitiestothehospitalsandhealthcareunits.Aninterestingfindinginthisanalysis,isthepresence of an author from the Civil Engineering department. In a publication about patient satisfaction, managers' climate orientation and organizational climate, the team of authors studied a model for manager's orientation and its impact ontherestoftheorganizationandinpatientsatisfaction.Thepaperfeaturescollaborationfromtwodifferentareasof knowledge: Civil Engineering and Social, Political and Institutional science. The result is a study with a strong theoreticalbaseinsocialandinstitutionalstudies,aresearchmethodologyproperforthisarea,andanequationmodel totesttheresults.Thisisanexampleofsuccessfulcollaborationbetweendifferentknowledgeareasandapplicability of external practices into hospital and healthcareresearch.

Third,toanalyzetheinternationalaspectofthissample,authorswereclassifiedbytheircountryofaffiliation,resulting in 14 different countries of origin for the 101 authors included in the study. The country that groups the most authors isUSA,andwiththeUKandtheNetherlandstheyconcentratemorethan65%ofthetotalauthorsinthesepublications. Another aspect within international cooperation stands out is that, even if USA is clearly the biggest contributor in numberofauthors,thereareonlytwoauthorsthatpublishedmorethanonearticle,whileauthorsfromtheNetherlands seem to have more cooperation and presence, as seen in Table 1. Also, out of the 44 articles, 6 featured international cooperation between the researchers and their institutions (see Table2).

Table 2. International cooperation between authors and their institutions

| Year | Name of paper | Authors | Country of work |
|---|---|---|---|
| 1985 | Discovering Local Logics in the Hospital World | P. S. Agrell<br>J-C. Moisdon | Sweden<br>France |
| 1993 | A Simulation Model for Scheduling in the Emergency Room | Masood A. Badri<br>John Hollingsworth | UAE<br>USA |
| 2012 | | VedranCapkun | France |


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| | | | |
|---|---|---|---|
| | Service specialization and operational performance in hospitals | Martin Messner<br>Clemens Rissbacher | France<br>Austria |
| 2006 | Measuring the operational performance of intensive care units using the analytic hierarchy process approach | Prasanta Kumar Dey<br>SeetharamanHariharan<br>Benjamin T. Clegg | UK<br>Trinidad and Tobago<br>UK |
| 2016 | Behavioural operations in healthcare: a knowledge sharing perspective | Matteo Mura<br>EmanueleLettieri<br>Giovanni Radaelli<br>Nicola Spiller | Italy<br>Italy<br>UK<br>Italy |
| 2002 | Hybrid stockless: a case study | Hugo Rivard-Royer<br>Sylvain Landry<br>Martin Beaulieu | Canada<br>Canada/France<br>Canada |

The small number of collaborations between authors from different institutions and between authors from different countries of affiliations is an evidence of the less mature research field (Keathley et al, 2016). Other relevant information in this research is to identify the main purpose of these papers, such as research and application of OM tools.

### 3.3. Which are the main focus (research or applications) of the publications in operations management in hospitals? (RQ3)

Each paper was revised to define if the document's purpose was to present an investigation (the document presents a research question and hypotheses, through a theoretical approach) or an application (document that presents applied theorytosolvearealproblemthroughmethodologiesandtoolsofOM):86.4%(38outof44papers)werefocusedon investigation, 9.1% (four out of 44 papers) were focused on applications, and 4.5% (two out of 44 papers) included investigation and application. This information shows a greater presence of theoretical approach in the sample. The research seems to be focused on building up theory, in many occasions the articles study practices used in other industriesorsectorsandhowcantheybeappliedinthehospitalandhealthcaresector,stayingwithinthetheory.This can be linked to the development phase of the research area, because, as described before, it is currently in an early stage.

The 44 papers documented the utilization of 86 research methods, this indicate an average of 1.9 research methods per paper; a paper could use a single or multiple research methods (e.g. literature review and survey). The most frequently used research methods were literature review (45.5%), survey (29.6%), case study (27.3%), and primary data (27.3%). On the other hand, a paper could use also a single or multiple analysis tools. In the 44 papers were identified only 8 different analysis tools out of 26 identified by (Gonzalez Aleu and Van Aken, 2017): modeling (45.5%),descriptivestatistics(18.2%),regression(13.6%),simulation(13.6%),processmapping(11.4%),correlation (4.5%), design of experiments (4.5%) and brainstorming (2.3%). The high concentration in the utilization of a small set of research methods and the small number of analysis tools used is a indicative of low maturity of the research field (OM in hospitals) (Keathley et al.,2016).

Awordanalysisisusedtoidentifythemainideasdiscussedinthepublications;thegoalistoidentifymainconcepts, keywords and ideas that are part of the academic discussion in this research area. A keyword analysis was used to address this analysis. A total of 34 out of 44 publications included keywords, producing a list of 164 keywords. The keywords were grouped by general concepts and stemmed words, and this generated a list of 68 unique terms. The topfourkeywords(healthcare,hospitals,performance,OM)represent5.9%ofthetotaluniquekeywords,butaccount for 37.2% of the 164 keywords collected. From these four terms, three are strictly related to the research subject (healthcare, hospitals, OM), so the frequency of the term performance suggests that it is one of the most important subjects in the currentliterature.

Aco-keywordnetworkisthevisualrepresentationofthekeywordsinasampleandtheirrelationshipswitheachother. Eachkeywordandtheirconnectionswiththeotherkeywordsinthesamepublicationareinputtedintothedata,sothe final diagram shows every connection and their frequency. Figure 5 has been generated using Gephi version 0.9.1, using the layout algorithm of Force Atlas combined with additional criteria for layout enhancement. The size of the nodesrepresentsthefrequencyofeachterminthefullkeywordsample.Additionally,thethicknessoftheedges


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represents the frequency that two different terms appear in the same publication. Finally, node color relates to the number of relationships that the term has in the sample.

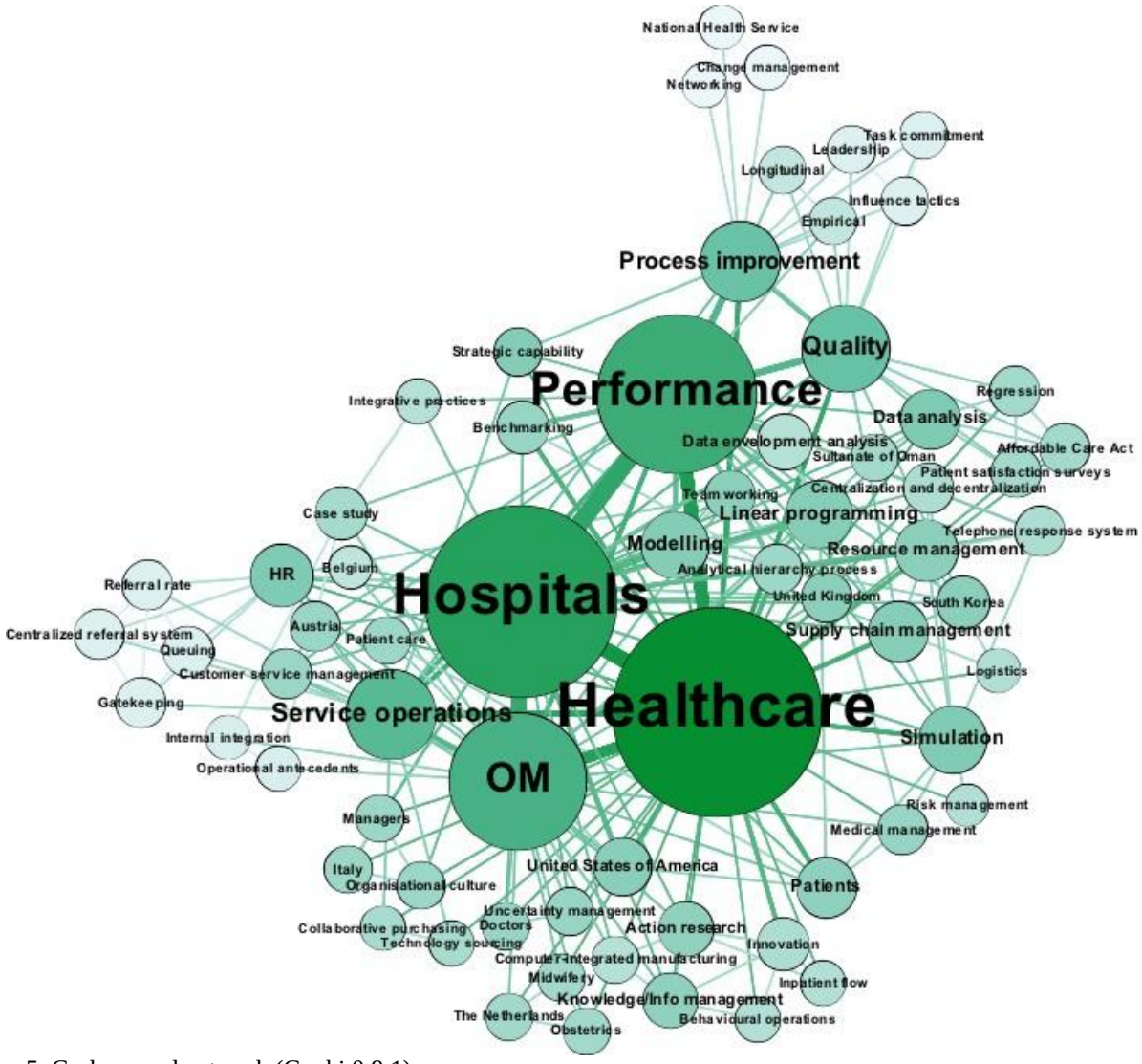


Figure 5. Co-keyword network (Gephi 0.9.1)

Themostrelevantkeywordsareevidentsincethepreviousanalysis,wherehospitals,OM,healthcareandperformance havebeenmentioned.Additionally,inthekeywordnetwork,arelativelylargegroupoftermswasformedintheright- center area. Terms as modelling, linear programming, data analysis, resource management and simulation are highly linked and related with the most frequent keywords. This suggests that researchers are currently investigating a mathematical and more structured approach for problem-solving into thisarea.

### 3.4 Which are the main topics related to operations management addressed in the publications? (RQ4)

This classification corresponds to the subject of OM that the paper studies. A list of topics was retrieved from the InternationalJournalofOperationsandProductionManagement'sonlineprofileportal,whichispresentedbyEmerald Group Publishing. The journal's profile lists most of the topics that it covers, accompanied by the quote "Thescope


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of the Journal covers all aspects of operations management: manufacturing and service, profit and non-for-profit, including, but not limited to, the topics listed below" (Emerald Publishing, 2017): capacity planning and control, e-businessandoperations,globaloperationsmanagement,humanresourcemanagementinoperations,informationand knowledgemanagement,lean/agileoperations,logistics,orderfulfilmentanddistribution,managementoftechnology for operations, managing technological customization change, mass customization, material and inventory management, new product and service design/development, operation planning – scheduling - control, operations strategy,performancemeasurementandmanagement,planlocation-design-layout,projectmanagementinoperations, quality management in operations, role of operations in sustainability, supplier/customer relationship management, andsupplychainmanagement.Eachpaper'scontentwasanalyzedtoclassifyitbyOMtopic.Eachpublicationcould refer to one or more topics. As some subjects are similar, some definitions were detailed to provide structure and can be found in the Appendix section (see Annex8.2).

Theresultsfromthe frequencyinformationinFigure6indicatesthat,inthesample,researchisfocusedonachieving an optimal level of operations in hospitals, managing the available resources as beds, doctors, equipment, nurses. Therefore, 5 main topics stand out: Operations planning, scheduling and control; Operations strategy; Performance measurementandmanagement;andCapacityplanningandcontrol.Thisindicatesthatmostoftheproblemsandareas of opportunity are currently in those areas, which are closely related with eachother.

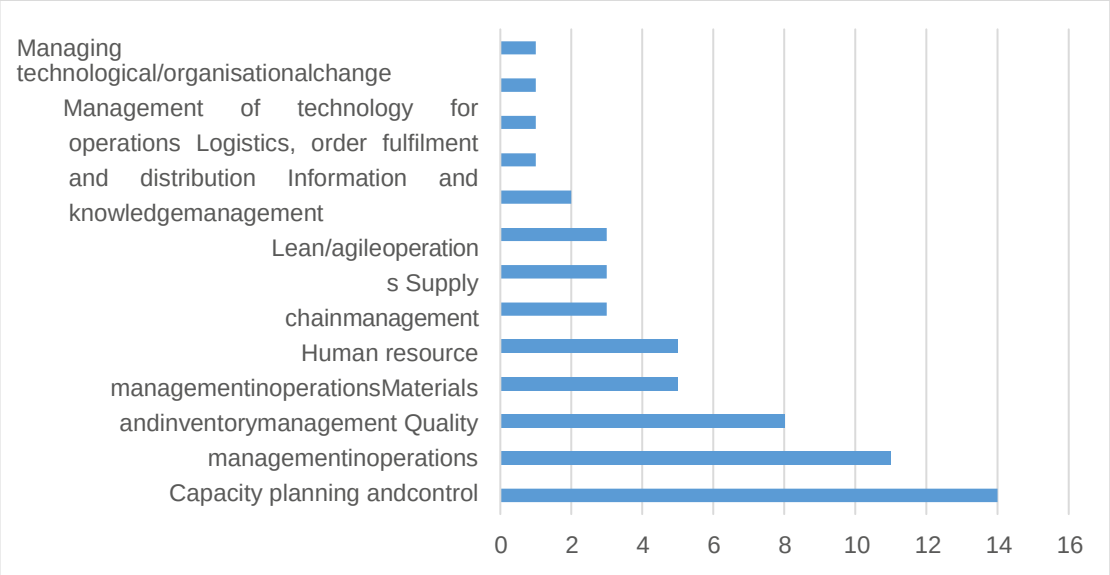


Figure 6. Frequency of topics studied in thesample

Itisalsoevidentaninterestinmeasuringandmanagingperformanceinhospitals,thiscouldberelatedtothefactthat they are service organizations and these aspects are underdeveloped in practice due to their complexity. This is a key aspect to optimize operations.

## 4. Conclusions

### Summary

As explained through the initial section, this study presents a characterization of the literature of OM in Hospitals through a sample of publications obtained from the IJOPM. The purpose is to analyze this sample and present a scopingstudythatisusefulforanextendedliteraryreviewwithadditionalsourcesinthefuture.Thisdocumentdetails the current state of this area ofresearch.

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This first stage of the research, about the dimension of publications, has demonstrated that the application of Operations Management in hospitals is in a phase of early growth and development, increasing in relevance during thelastdecade.Atotalof44publicationsonthesubjecthavebeenfoundamongthe2014publicationsfromthejournal since its foundation in 1980. Through the analysis of the publication trends to answer RQ1, it was found that of the publicationsinthesample,70.5percenthavebeenmadefrom2002-2016,and50percentofthetotalhavebeenmade inthelast10years.Thisgrowthinrelevanceseemstohavebeenstronglyinfluencedbythepublicationsoftheinstitute of Medicine in the beginning of the 2000s (2000, 2001). The data reflects that this development should continue in the following years and there are many areas of opportunity for development. The phase of this research area was definedbyusingthebusinessapproachoftheproduct'slifecycletheory.Theslowadoptioninpreviousyearsfollowed by an accelerated increase in frequency started in recent years suggests a phase of earlygrowth.

Later, the analysis for RQ2 showed that most of the publications have been made by groups of 2-to-3 authors that made a single publication. However, in recent years there has been a group of authors that is guiding the research: Dirk Pieter van Donk, Justin Drupsteen, and Taco van der Vaart from the Netherlands. They published together in 2013 and 2016, being the only group to have multiple publications in the sample. This also indicates a phase early development in the research area, and presents an opportunity for author collaboration and leadership, which can contribute to develop maturity (Keathley-Herring et al., 2016). Still in the author dimensions, the sample features representativesfrom14differentcountries,with65%oftheauthorsfromUSA,UK,andNetherlandsintherespective order of representation. This concentration suggests that there is room for further international collaboration and development. There is also a high cooperation between authors from different institutions, with nearly 50 per cent of the articles featuring authors from different organizations. This is positive and can benefit the quality in future publications. An interesting example of collaboration between different knowledge areas was found between Civil EngineeringandSocial,PoliticalandInstitutionalscience.Theresultisastudywithastrongtheoreticalbaseinsocial and institutional studies, a research methodology proper for this area, and an equation model to test the results. This is an example of successful collaboration between different knowledge areas and applicability of external practices into hospital and healthcare research. The area can benefit from more cases as this one in futureresearch.

Through the analysis for RQ3 and RQ4, key information was found to understand the development in this area and themaintopicspresentinthesample.Thefirstfindinginthecontentisthatmostofthepapers(38of44)inthesample presentexclusivelyaninvestigationresearch, whilethepresenceofapplicationisreduced.Thisfindingcanbelinked to the early development stage identified in the sample. The content analysis provided the most frequent topics and concepts, which are related to performance, resource management, quality management and operation improvement. Thisprovidesthecontextofwhatiscurrentlybeinginvestigatedandthemainareasofinterestof OMinhospitals.As stated in the introduction section, hospitals are complex organizations with limited resources, and the research is focusing on these issues to reach an optimal level of operations. Also, the constant human interaction present in hospitals an area of interest for the application of OM in theseorganizations.

## Discussion

This research provides a structured reference for researchers and practitioners to identify the state of research of OM inhospitals;itcanbeusedtoobtaininformationintheliterature.Inthecaseofpractitioners,thestudyidentifieswhat has been investigated already, the publications from previous applications are identified and can be followed for further development.

Forresearchers,itprovidesasimilaradvantage.Informationinthisstudycanbeusedasascopingstudyandastarting pointforanextensiveliteraturereview.Also,themainsubjectsofinterestcanbeusefuldatafornewauthorstoguide their research. The content analysis presents in a clear way the research lines that are being studied and which ones have opportunity for development. The different content characteristics are a clear image for thispurpose.

## Futureresearch

Asstatedpreviously,thisinvestigationshouldbeusedasascopingstudyandreferencepointtoperformanextensive systematic literature review. It can be extended with additional journals and databases to provide a general understanding. Additional journals focused on OM in hospitals should be considered for thispurpose.

The future research should consider the current stage of this area, accounting the stage of development and the areas of opportunities mentioned in this document. The research area can benefit for further personal and international collaborationbetweenauthors.ThehighernumberofresearchersfromUSA,UKandtheNetherlandscanpartnerwith authorsfromothercountriesforatransferofknowledgeandhelpinginthedevelopmentofthareaindifferentnations.

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Also,authorsworkingfull-timeinhospitalsorhealthcareorganizationsshouldbepartofthefuturecollaborations.In the aspect of content, the future research should address more applications of OM in hospitals, rather than investigation-onlypublications.Theareacanbenefitofmoredocumentationoftheoutcomesof OMframeworksand tools. It is also of high relevance, according to the results, that a clear performance measurement and management frameworkisestablishedandadoptedinthearea.Thiscanonlybeachievedbydefiningtheframeworkfirst,andthen several case studies should be performed in different hospitals or clinics to document the outcomes of itsuse.

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