CWTS BIBLIOMETRIC REPORT

Meaningful metrics

Research performance analysis for the STZ-hospitals 2009-2018

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1. Introduction

The study on the hospitals organized under the umbrella of STZ relates to 26 research intensive non-academic hospitals. The current report provides bibliometric evidence to assess the performance of those 26 hospitals. By advanced bibliometric methods and tools, CWTS assesses and characterizes their scientific output, citation impact, research and collaboration profiles. It is a quantitative analysis using the oeuvre as far as covered by Web of Science (WoS), a bibliographic database covering international peer refereed journals in all fields of science. This database discloses bibliographic data (including citations) of all articles in journals and is processed by CWTS for bibliometric analysis.

Back in 2015, CWTS conducted the last full bibliometric performance analysis of the STZ hospitals. A regular update of this analysis is valuable for evaluation and management purposes of the STZ. This report is in line with the structure of the previous report but uses newer methods and tools developed at CWTS during the past 10 years. In this report, we have also generated collaborative network maps that show the collaboration between the STZ hospitals and their partners. For each hospital the collaboration network map consists of the STZ hospital analyzed linked to the institutions to whom this hospital is co-publishing with. The network analysis is made for the 26 STZ hospitals.

In the next section, we describe the data collection and methods used. In the third section, we present the results. Final conclusion of our findings is in the fourth section. In the Annexes, we provide more details on data, methods and results.

2. Database and methods

In this section, we discuss the methods underlying the bibliometric analysis presented in the report. Additional discussion about these topics can be found in Annex A.

It is important to highlight that the Web of Science, produced by Clarivate Analytics, and Scopus, produced by Elsevier, are the two most commonly worldwide used bibliometric data sources, because the allow for large scale analyses which is the case for the 26 STZ hospitals. Both are multidisciplinary databases. CWTS works with the Web of Science because of our long history working with these data. Furthermore, Web of Science offers a good coverage of the international scientific literature and generally provides high quality data. It provides a homogeneous set of publications in the international scholarly communication which allows for a comparative perspective. These bibliometric databases do show a limited coverage in certain fields , e.g. social science and humanities. Furthermore, not all forms of scholarly outputs are captured by these databases. One should be aware of these limitations when looking at the results of a bibliometric study. For example, it does not reveal contributions to clinical guidelines or publications serving the national professional community, e.g. publications Nederlands Tijdschrift voor Geneeskunde.

2.1 Database Structure

At CWTS, we calculate bibliometric indicators based on an in-house version of the Web of Science (WoS) online database, which shall be referred to as CI-system. The WoS is a bibliographic database that covers publications of about 12,000 journals and each of these journals are assigned to one or more Journal Subject Categories (JSC). Each publication in the CI-system has a document type. The most frequently occurring document types are 'articles', 'reviews', 'book reviews', 'corrections', 'editorial material', 'letters', 'meeting abstracts' and 'news items'. For the sake of this report, we only take into account document types 'articles' and 'reviews'. In general, the idea behind limiting the analysis to these two types of publications is that these documents are considered to reflect most of the original scientific output of a field.

The CI-system is an improved version of the WoS database versions of the Science Citation Index (SCI), Social Science Citation Index (SSCI), and Arts & Humanities Citation Index (A&HCI). Improvements concern the systematic verification of publication-based addresses for a more accurate match of organization names (e.g. unification of university names). Another enhancement concerns the improved matching of cited references to targeted articles. Additionally, the CI-system implements a publication-based field classification which clusters publications into research areas based solely on citation relations (Waltman & van Eck, 2012). One important advantage of this classification system is that it allows for taxonomy of science that is more detailed and better matches the current structure of scientific research (Ibid). This not only reduces classification bias but is also essential for calculating field-normalized indicators (Ruiz-Castillo & Waltman, 2014).

The Conference Proceedings Citation Index-Science (CPCI-S) and the Emerging Sources Citation Index (ESCI) databases within the WoS are not included in this study. Although these citation indexes contain very valuable information that also reflect the scientific output of a research unit, conference literature, emerging literature and journal literature cannot be easily combined in just one bibliometric study.

A brief description of the indicators used in this report is shown in the table below.

INDICATOR	DIMENSION	DEFINITION
P	Output	Total number of publications of a unit.
MCS	Impact	The average number of citations of the publications of a unit (self-citations not included).
TCS	Overall	Total number of citations of the publications of a unit.
MNCS	Impact	The average normalized number of citations of the publications of a unit (self-citations not included).
MNJS	Journal Impact	The average normalized citation score of the journals in which a research group has published.
PP (TOP 10%)	Impact	The proportion of a unit's publications that, compared with other publications in the same field and in the same year, belong to the top 10% most frequently cited.
PNC	Overall	Percentage of publications not cited by others (in the given time period)

INT COV	Output	Internal coverage: Proxy of oeuvre being covered by Web of Science. Measured by the proportion of cited references in the oeuvre linked to (other) CI publications.

Moreover, in this study we include citation data until 2019 as retrieved from the CI-system database updated version.

2.2 Counting Method and Field Normalization

Self-citations

In the calculation of impact indicators, we disregard self-citations. A citation is considered a self-citation if the cited publication and the citing publication have at least one author (i.e. last name and initials) in common. The main reason for excluding self-citations is that they often have a different purpose than ordinary citations. Specifically, self-citations may indicate how different publications of a researcher build one another or they may serve as a mechanism for self-promotion rather than for indicating relevant related work. Self-promotion activities can in turn be used to manipulate the impact of a publication in terms of the number of citations received. Excluding self-citations from the analysis effectively reduces the sensitivity of impact indicators to potential manipulation. In so doing, impact indicators can be interpreted as the impact of researchers' work on other members of the scientific community rather than on his or her own work.

Field Normalization

Field normalization is about the problem of correcting for differences in citations practices between scientific fields. The goal of field normalization is to develop citation-based indicators that allow for valid between-field comparisons. Traditionally, fields of science are defined by sets of related journals in the WoS. This approach is problematic, especially in the case of multidisciplinary journals such as Nature, PLOS ONE, PNAS, and Science, which do not belong to one specific scientific field. To counter these issues, all impact scores are normalized with respect to the most detailed field classification system created by CWTS.

In the CWTS approach, publications are assigned to about 4535 fields using an unbiased algorithmic method. The main reason to have such a classification system is that it allows for taxonomy of science that is more fine-grained and closely matches its dynamic structure (Waltman & Van Eck, 2012). The next paragraphs will give a brief explanation about the CWTS classification approach and the WoS approach, as well as the main problems underlining the use of field normalization indicators based on the Web of Science Journal Subject Categories (JSC). Further discussions on the CWTS publication-based classification system can be found in Waltman & Van Eck (2012) article and in Annex A.

WoS subject categories and journals scope

The most popular science classification system for bibliometric purposes is the WoS Journal Subject Categories (JSC) classification approach. The WoS classification scheme contains 250 elements and each journal is assigned to one or a few JSCs. This approach, however, is connected to a number of shortcomings. First, under this classification scheme, publications are not directly assigned to a research area. Instead, it is the journal in which publications appear that determines the scientific field to which they belong. Second, the WoS classification system works under the assumption that publications within a journal have a similar scope. However, this is often not the case. The JSC entitled 'Multidisciplinary Sciences' is a case in point, because it encompasses multidisciplinary journals that publish on a wide array of topics and because individual articles in those journals have a very different research focus. Although journals do not need to be comparable in terms of volume (i.e. number of articles published each year) for normalization purposes, they should have a similar specialization. In practice, however, some journals can be very broad (e.g. 'Science', 'Nature', 'PLOS One', etc.) while others can be very specialized (e.g. 'Scientometrics'). This not only poses problems for the interpretation of the impact indicators, but it may also significantly overestimate the impact scores of a research unit.

CWTS publication-based classification system

The CWTS publication-based classification system is an alternative to the WoS Subject Categories which works at the level of publications rather than at the level of journals. Within the CWTS framework, groups of publications are algorithmically clustered based on direct citation relations. This approach is meant as way to deal with the heterogeneity of publications within a research field. Clustering a relatively homogenous set of publications into a single field allows us to compare the impact of publications that belong to a similar scientific context, which is essential for normalization purposes.

The CWTS classification method can be subdivided into the following three steps:

(1) As a first step, the similarity between pairs of publications that are linked by direct citation relations is determined. Since the number of publications as well as the citation linkages among them increases over time, the CWTS updates its classification system at one-year intervals.

(2) Then, as a second step, a clustering technique is used to cluster publications into research areas and to organize research areas in a hierarchical structure. These clusters contain publications from multiple years and each publication is assigned to one cluster only. Furthermore, these clusters have been considered and, in many cases validated as representative for disciplines, research areas, fields or sub-fields.

Currently, the CWTS classification scheme has three levels of hierarchy:

I. A top level of 27 clusters (areas).

II. A second level of 783 clusters (meso-fields).

III. A third level of 4535 clusters (micro-fields).

(3) As a final step, labels are assigned to research areas. These labels are obtained by extracting frequently occurring terms from the titles and abstracts of publications.

In this study, we consider the third classification level for the calculation of field-normalized citation indicators.

Counting method

Counting methods are about the way in which co-authored publications are handled. For instance, if a publication is co-authored by two research organizations, should the publication be counted as a full publication for each organization or should it be counted as half a publication for each organization? In this study, we use the full counting approach. The full counting approach is used for the allocation of collaborative papers. This means that if a publication is co-authored by multiple institutions, that publication counts multiple times, once for every institution, regardless of the weight of their contribution. The full counting method is also used to compute the cumulative number of publications (P), the total number of citations (TCS), the mean citation score (MCS), and the rest of indicators and analysis.

2.3 Indicators of Output

In computing the indicators of output, we use the number of WoS publications (articles and reviews) produced by STZ hospitals between 2009 and 2018 and that were successfully matched to the CWTS database system (See section 3. Data Collection). It is worthwhile reminding that we only use articles and reviews indexed to the Science Citation Index (SCI), Social Science Citation Index (SSCI), and the Arts & Humanities Citation Index (A&HCI) databases. The Conference Proceedings Citation Index-

Science (CPCI-S) and the Emerging Sources Citation Index (ESCI) are not included in this study, therefore, only a subset of all articles and reviews by STZ hospitals in WoS were included in this analysis.

The indicator of output is denoted by P, and is defined as the cumulative number of publications of a research unit calculated using full counting. This means that publications are always fully assigned to the unit, regardless of the collaboration nature of the authorship or the number of affiliations of each author; for instance, single-authored papers or papers by two authors from the same organization or one author affiliated to two organizations.

2.4 Indicators of Impact

Three dimensions of bibliometric performance are assessed in this report: (1) publication output and impact, (2) research profile and (3) scientific. In order to evaluate each of these dimensions we calculate several field normalized impact indicators based on citations. The next paragraphs will briefly describe the operationalization of the main impact indicators used in the report.

Mean Citation Score (MCS)

The most straightforward impact indicator we compute is the Mean Citation Score, denoted by MCS. This indicator equals the average number of citations per publication. Only citations within the relevant citation window are counted, while self-citations are excluded.

A major shortcoming of the MCS indicator is that it cannot be used to make comparisons between scientific fields. This is because different fields have very different citation characteristics. For instance, using a three-year fixed-length citation window, the average number of citations of a publication of the document type article equals 2.0 in mathematics and 19.6 in cell biology. So, it clearly makes no sense to make comparisons between these two fields using the MCS indicator. Furthermore, when a variable-length citation window is used, the MCS indicator should also not be used to make comparisons between publications of different ages. In the case of a variable-length citation window, the MCS indicator favors older publications over more recent ones because older publications tend to have higher citation counts.

Mean Normalized Citation Score (MNCS)

The Mean Normalized Citation Score indicator, denoted by MNCS, provides a more sophisticated alternative to the MCS indicator. The MNCS indicator is similar to the MCS indicator except that normalization is being applied to correct for differences in citation characteristics between publications from different scientific fields and publications of different ages. The MNCS indicator is obtained by averaging the normalized citation scores of all publications of a unit. If a unit has an MNCS indicator score of one, this means that, on average, the actual number of citations of the publications of the unit equals the expected number of citations. In other words, on average, the publications of a unit have been cited equally frequently as publications that are similar in the same fields and publication years using the same citation window. An MNCS indicator score of, for example, 2.0 means that, on average, the publications of a unit have been cited twice as frequently as would be expected based on their field and publication year. As already explained, the field to which a publication belongs is determined by the publication-level classification system developed at CWTS (Waltman & van Eck, 2012).

One weakness of MNCS indicator is that it may be influenced by publications with a very large number of citations. For example, if a research unit has only one very highly cited publication, this is usually sufficient for a high score on the MNCS indicator, even if all other publications received a small number of citations.

PP (top 10%): Proportion of top 10% papers

In addition to the MNCS indicator, we computed the proportion of frequently cited publications that belong to the top 10% most frequently cited publications of their field. This indicator, which we refer to as PP (top 10%), is a percentile-based bibliometric indicator which values publications based on their position within the citation distribution of their field (Waltman & Schreiber, 2012). To examine the distribution of frequently cited papers, we ranked each publication of STZ hospitals by the number of citations received up to 2019, and identified those belonging to the 10% most frequently cited papers in a given year within their discipline. On the basis of the total output from 2009 to 2018, we calculated an expected top 10% number of publications. Furthermore, the world average or expected value for this indicator is 10%. Hence, a unit with a PP (top10%) of 20 has twice more publications in the top 10% than expected, while a unit with a PP (top 10%) of 10 has the same number of top 10% frequently cited publications as expected by the 10% threshold in their field.

As the PP (top 10%) indicator is based on citation distributions rather than on citation averages (i.e. MNCS), this indicator is not sensitive to extreme cases (i.e. very highly cited publications).

Altogether, the MNCS indicator and the PP (top 10%) indicator have somewhat opposite strengths and weaknesses; therefore, we strongly recommend relying on a combination of both indicators when assessing the impact of a research unit.

Mean Normalized Journal Score (MNJS)

The Mean Normalized Journal Score (MNJS) complements the MNCS indicator with an indicator of the performance of the journals in which publications have appeared and is a more sophisticated alternative to the Journal Impact Factor (JIF). Such an indicator is also more robust than the MNCS indicator (Waltman et al., 2010). The MNJS indicator measures the impact of the journals in which a research unit has published (i.e. the research unit's WoS indexed journal selection), compared to the world citation average in the subfields covered by these journals. The MNJS indicator is based on similar principles as the MNCS: if the MNJS indicator values are above 1.0 it means that the citation score of the journal set in which the research unit has published exceeds the citation score of all papers published in the fields and subfields to which the journals belong.

2.5 Research Profile Analysis

The research profile is a quantitative overview on the scientific scope of the research of each individual STZ hospital. It visualizes the whole spectrum of subject fields covered by the publications of each individual STZ hospital, and the corresponding impact in these fields. CWTS calculates a breakdown of output and impact into fields of science, defined by the Web of Science journal subject categories. The impact will be given by the indicator MNCS.

2.6 Collaboration Profile Analysis

This analysis provides an insight in the impact of the various types of collaborations of each individual STZ hospital. CWTS calculates a breakdown of output and impact into three types of co-operation according to the author affiliation information. We distinguish the following types of collaboration:

1. PP (no Collab): Publications authored by each individual STZ hospital only;
2. PP (nat collab): Publications by each individual STZ hospital co-authored with at least one other organization from the same country: 'national collaboration';
3. PP (Internat collab): Publications by each individual STZ hospital co-authored with at least one organization from another country: 'international collaboration'.

2.7 Collaboration Network Analysis

In this report, we have also conducted a collaborative network analysis to show the collaboration between the STZ Hospitals and their partners. For each STZ Hospital we are going to create a network map using the VosViewer tool (www.vosviewer.com). This technique depicts the relationships between elements in a two-dimensional space. Such a map is based on co-authorship relations between the specific STZ hospital and its Dutch co-authors in the scientific publications collected in the first phase of this project. In this map, the STZ hospital in represented centrally by a circle and the collaboration partners are positioned around it. Proximity of the collaborating partner is reflective of the intensity of the collaboration and size is reflective of the number of co-publications.

3. Data collection

In phase 1 of the project, publication data of the individual STZ hospitals and bibliometric data was collected to form the dataset. This dataset is the basis for calculating the main indicator set and performing advanced bibliometric analyses.

In this project, CWTS used the address-based data collection methodology. This means that we collected publications from our CI-system by looking at the address affiliations of the publication using known name- and address variants of each of the 26 individual hospitals. In this study, only journal articles and reviews indexed in the Web of Science core collection (WoS) will be used.

CWTS also studied the most recent changes (names, mergers, address, etc.) carefully prior to the start of the project. The results were shared with each individual STZ hospital for verification before starting the analysis.

By matching the provided feedback received by each individual hospital (additional or removal of publication data) against the CWTS CI system, we generated a final set of publications for each individual STZ hospital for the period 2009-2018. CWTS added a number of bibliometric data to each publication record. This additional data is all CI-based, they are necessary for the citation analysis and, particularly, the field-specific impact normalization procedures. The collected publication data together with the additional bibliometric data constitute the dataset input for analysis.

3.1 Coverage of CI Publications

As in previous studies, we have studied the references of the publications produced by the STZ hospitals. We have matched STZ hospital's output references with our extended CI-system publication database (1980-2019). This provides an estimate of the importance that CI publications has for STZ hospitals researchers. The objective is to determine to what extent these researchers themselves also cite CI Web of Science papers, and to what extent other, non-CI-system documents, thus providing some indication of how relevant the CI-system literature for their research topics and areas is.

The internal coverage for the CI-system covered publications from the STZ hospitals as a whole (aggregated) is around 90%. This means that 90% of the references in STZ hospital's publications are also covered by the CI-system, at least since 1980. This is a very high internal coverage that indicates that a bibliometric analysis for STZ hospitals is suitable.

4. Results

4.1 Performance analysis: Main bibliometric indicators

The results presented in this section relate to the main bibliometric indicators both for the STZ as a whole as well as for each of the 26 individual hospitals integrating the tertiary medical teaching hospitals group (STZ).

Table 1 contains results on the overall output between 2009 and 2018, including indicators of output and citation impact. The P in the table reflects the number of publications in which STZ hospitals were involved, i.e., full counting. Table 1 shows that a total of 19,854 CI-system covered publications, articles and reviews, have been produced by all STZ hospitals between 2009 and 2018. This output has on average 19.1 (MCS) citations per publication. The MNCS value for the whole period is 1.54 (54% higher than world average in the same fields and publication years). STZ's publications appear in journals with an impact value for the specific fields of STZ's papers also higher than world average (MNJS = 1.46). The PP(top 10%) indicator shows that 17% of publications published by al STZ hospitals are among the upper top 10% of most highly cited papers worldwide. This means that the STZ hospitals have 1.7 times more top publications than expected by the 10% threshold in the same fields and publication years. The Pnc indicator reveals that 8% of publications are not cited by others during the given period.

Table 1. Main bibliometric indicators for all STZ hospitals (2009-2018)

	P	Mcs	Mncs	Mnjs	PP (top 10%)	Pnc	Int Cov
All STZ hospitals	19,854	19.10	1.54	1.46	17%	8%	0.90

Table 2 shows the development of the output and impact indicators over time (i.e. time trends). Table 2 shows that the output (P) for all STZ has steadily increased over time, with an increase of about 42% for P between the first (i.e. 2009-2012) and the last time period (i.e. 2015-2018).

Table 2 Output and impact indicators for all STZ hospitals (2009-2018), time trend analyses

Period	p	Mncs	Mnjs	PP(top 10%)
2009-2012	6,548	1.47	1.44	17%
2010-2013	7,080	1.53	1.47	17%
2011-2014	7,571	1.47	1.41	16%
2012-2015	8,010	1.53	1.45	16%
2013-2016	8,495	1.54	1.45	16%
2014-2017	8,939	1.56	1.45	16%
2015-2018	9,324	1.61	1.51	17%

Figure 1 summarizes the results of the field normalized citation scores for all STZ hospitals over time. In general, the main impact indicators have remained high and quite stable with a slightly increased mainly in 2010-2013 and 2015-2018.

Figure 1 Field Normalized Impact Indicators (MNCS, MNJS, PP(Top 10%)) time trend analysis

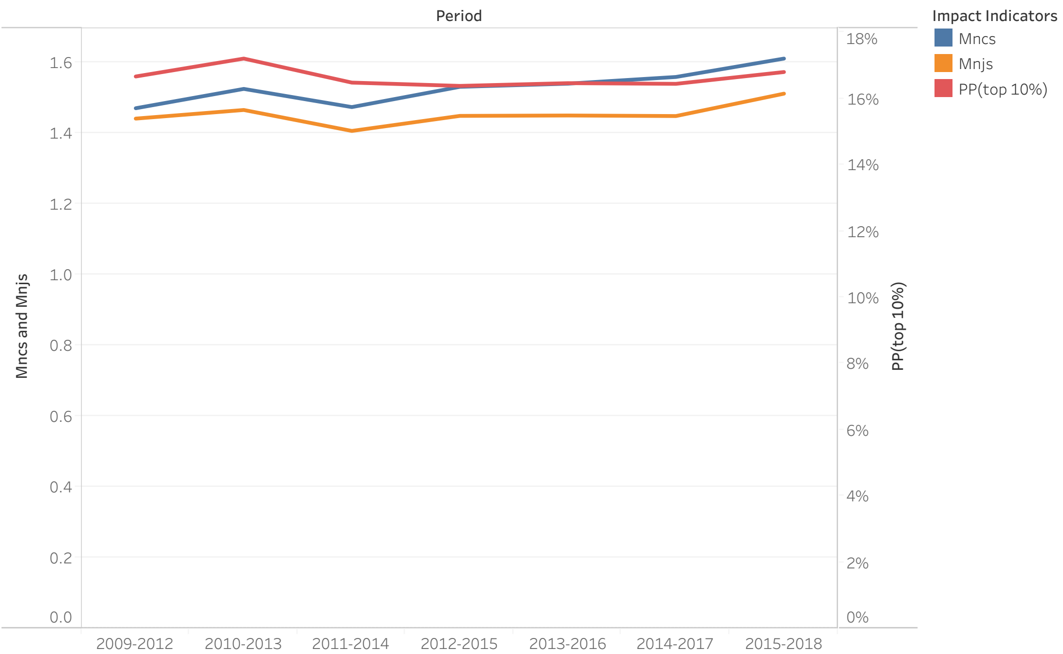


Table 3 shows the results for each individual STZ hospital. In terms of CI-system covered publications, articles and reviews (P), we can see that St Antonius Ziekenhuis has the highest output (P=2,516). When looking at the impact as measured by MNCS, Reinier de Graaf Groep is doing very well with a MNCS of 2.17, followed by Noordwest Ziekenhuisgroep (MNCS=2.10), Meander Medical Centrum (MNCS=2.06) and Canisius-Wilhelmina Ziekenhuis

(MNCS=2.00). All the publications produced by those hospitals score twice higher than world average (1.00). In the given period, the impact as measured by the PP(top10%) is above 20% for many of the STZ's Hospitals which is high. As mentioned before, the PP (top 10%) indicator is based on citation distributions rather than on citation averages (i.e. MNCS), so it means that this indicator is not sensitive to extreme cases and that the high scores are not due to a few highly cited publications.

Table 3. Main bibliometric indicators for each individual STZ hospital (2009-2018)

	P	Mcs	Mncs	Mnjs	PP (top 10%)	Pnc	Int Cov
Albert Schweitzer Hospital	506	15.16	1.45	1.46	18%	9%	0.90
Amphia	1,186	24.83	1.93	1.85	20%	8%	0.90
Canisius-Wilhelmina Ziekenhuis	1,196	24.50	2.00	1.69	20%	8%	0.90
Catharina Ziekenhuis	1,909	23.70	1.82	1.79	19%	8%	0.90
Deventer Ziekenhuis	423	19.89	1.62	1.76	19%	7%	0.88
Elisabeth-TweeSteden Ziekenhuis	1,371	22.71	1.73	1.64	18%	7%	0.89
Gelre Ziekenhuis	519	26.48	1.97	1.86	18%	6%	0.89
Haaglanden Medisch Centrum	1,152	21.13	1.71	1.59	18%	8%	0.89
HagaZiekenhuis	1,014	23.18	1.77	1.63	20%	8%	0.91
Isala	1,625	21.21	1.69	1.66	17%	8%	0.90
Jeroen Bosch Ziekenhuis	903	22.01	1.66	1.64	19%	9%	0.89
Maasstad Ziekenhuis	754	20.39	1.89	1.82	21%	6%	0.90
Martini Ziekenhuis	522	15.11	1.42	1.57	14%	8%	0.88
Meander Medical Center	752	28.12	2.06	1.94	19%	6%	0.91
Medisch Centrum Leeuwarden	782	18.82	1.67	1.61	18%	8%	0.89
Medisch Spectrum Twente	1,179	21.04	1.72	1.66	19%	7%	0.90
Máxima Medical Center	1,109	15.55	1.41	1.48	16%	8%	0.88
Noordwest Ziekenhuisgroep	871	27.86	2.10	1.93	20%	8%	0.90
Onze Lieve Vrouwe Gasthuis	1,961	22.35	1.86	1.77	20%	8%	0.89
Reinier de Graaf Groep	709	28.51	2.17	1.95	20%	6%	0.90
Rijnstate Ziekenhuis	1,095	23.99	1.93	1.83	20%	7%	0.90
Sint Franciscus Vlietland Groep	553	26.65	1.91	1.88	18%	7%	0.92
Spaarne Gasthuis	769	24.09	1.89	1.88	21%	6%	0.89
St. Antonius Ziekenhuis	2,516	22.50	1.87	1.76	19%	6%	0.92
VieCuri Medisch Centrum	480	18.12	1.75	1.70	16%	9%	0.89
Zuyderland Medisch Centrum	1,455	22.71	1.82	1.59	17%	8%	0.89

Figure 2 shows the relationship between the total number of publications and the mean normalized citation impact (MNCS) during the period 2009-2018 of all STZ hospitals. As can be seen, the publications of all STZ hospitals score above the world average (1.00) in terms of MNCS. Four STZ hospitals have produced more than 1500 publications in the given period: St. Antonius Ziekenhuis, Onze

Lieve Vrouw Gasthuis, Catharina Ziekenhuis and Isala. Reinier de Graaf Groep is the STZ hospital that has the highest MNCS (2.17).

Figure 2. MNCS x Total output (P), (2009-2018)

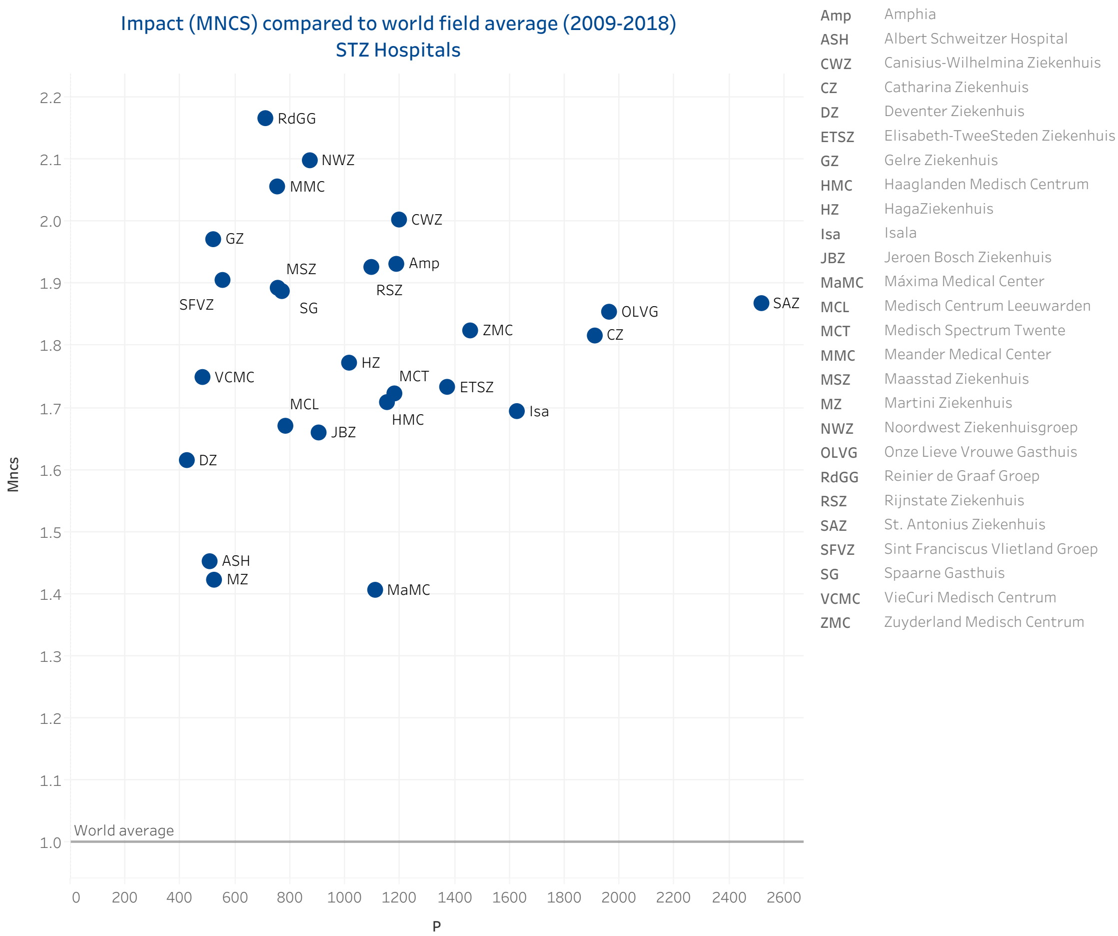
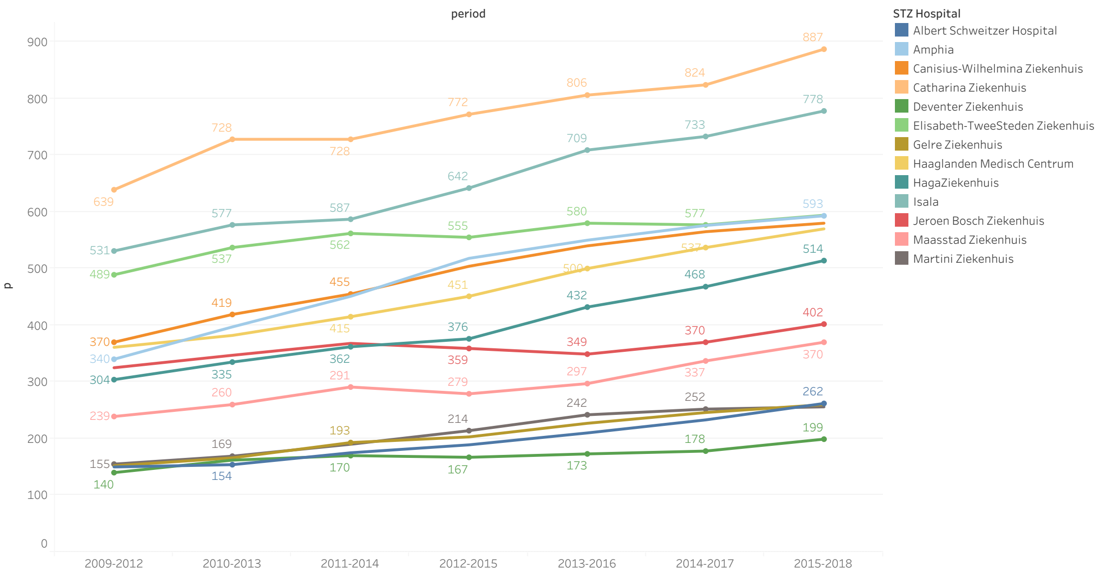


Figure 3 shows that the output (P) for each STZ hospital has steadily increased over time for most of them. Annex B shows the complete table, output and impact, over time per STZ hospital.

Figure 3. Total output (P) per STZ hospital over time.



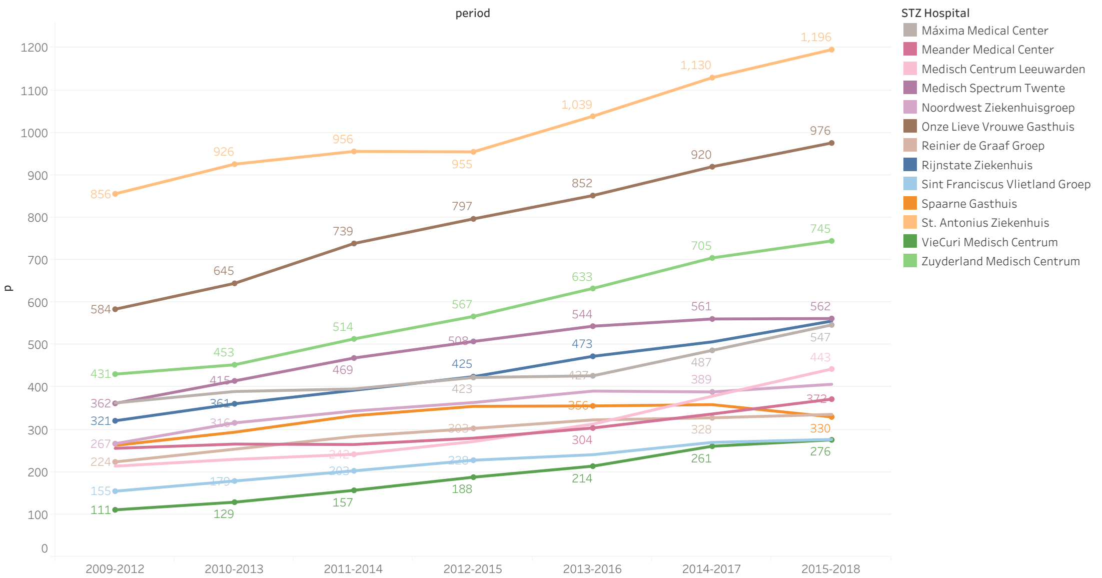
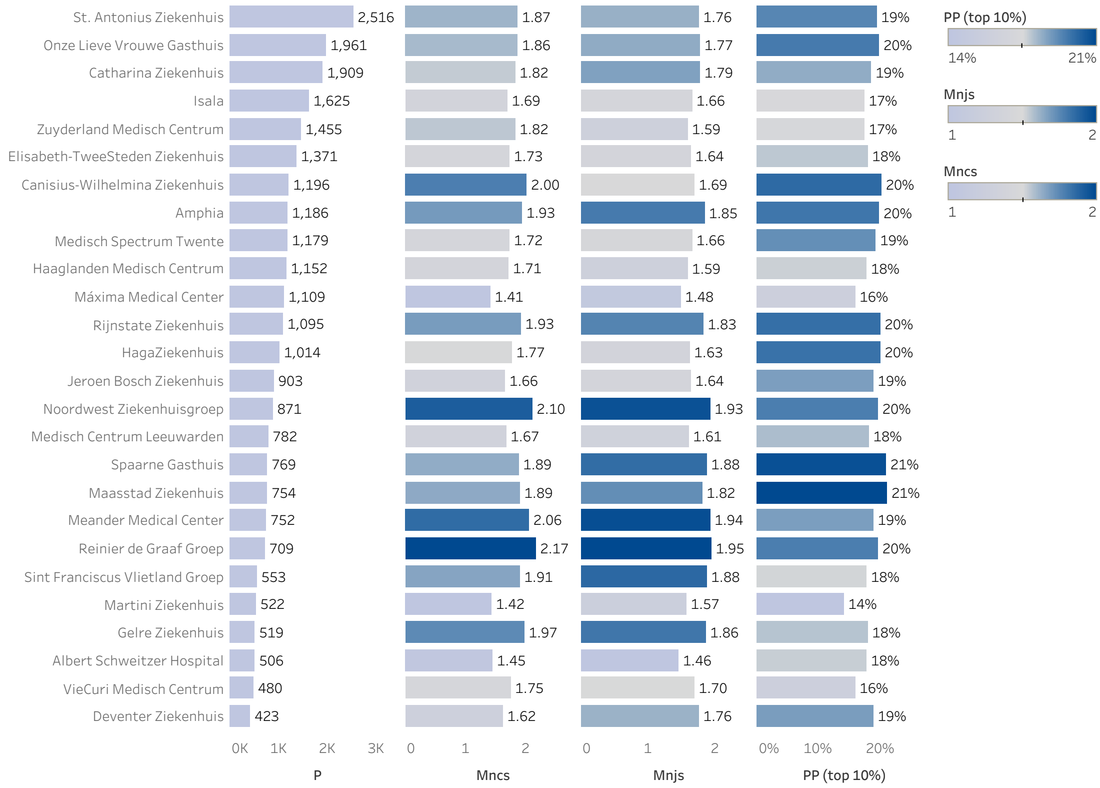


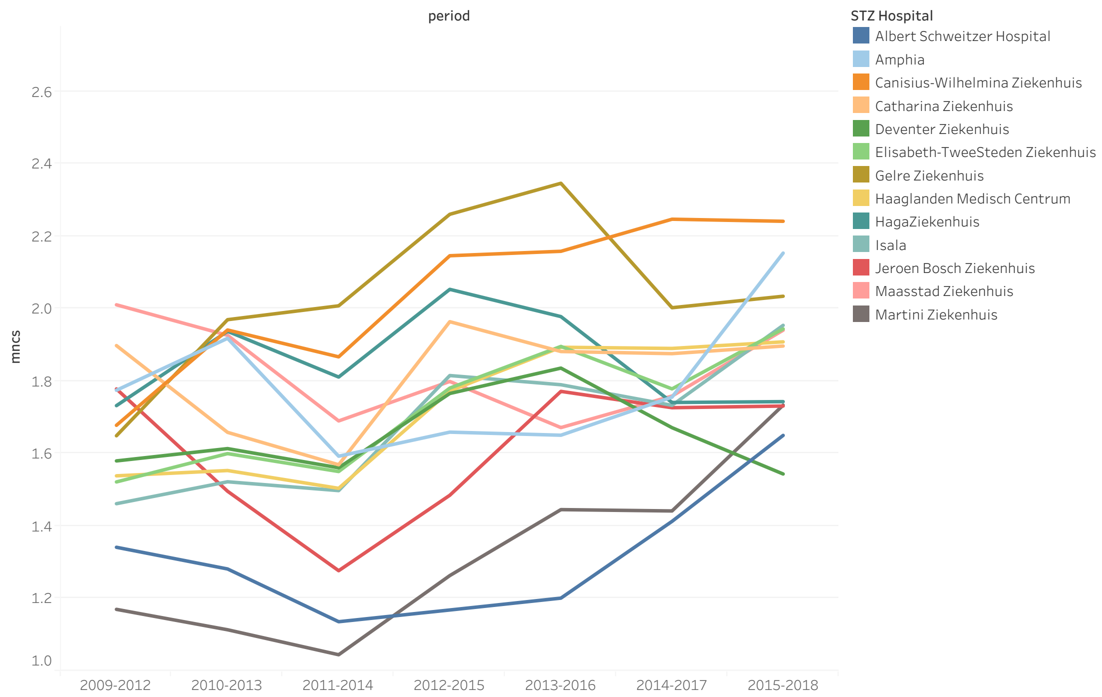
Figure 4 gives an overview of the main indicators in relation to the output. The darkest blue in the three columns (MNCS, MNJS, PP (top 10%)) indicates the higher impact and, the lightest blue, the lower impact . From this figure, we can then see that a high number of publications (P) does not necessarily lead to a higher impact.

Figure 4. Output and impact (MNCS, MNJS, PP (top 10%)), (2009-2018)



Figures 5 and 6 give an overview of the impact indicators, MNCS and PP(Top 10%) over time per each STZ hospital. While in terms of the output the general trend per hospital is a growing pattern (Figure 3), for the evolution over time of the impact indicators does not seem to be a general pattern and depends of each of the STZ hospital analyzed. As it was mentioned previously, Annex B shows the complete table, output and impact, over time per STZ hospital.

Figure 5. MNCS per STZ hospital over time.



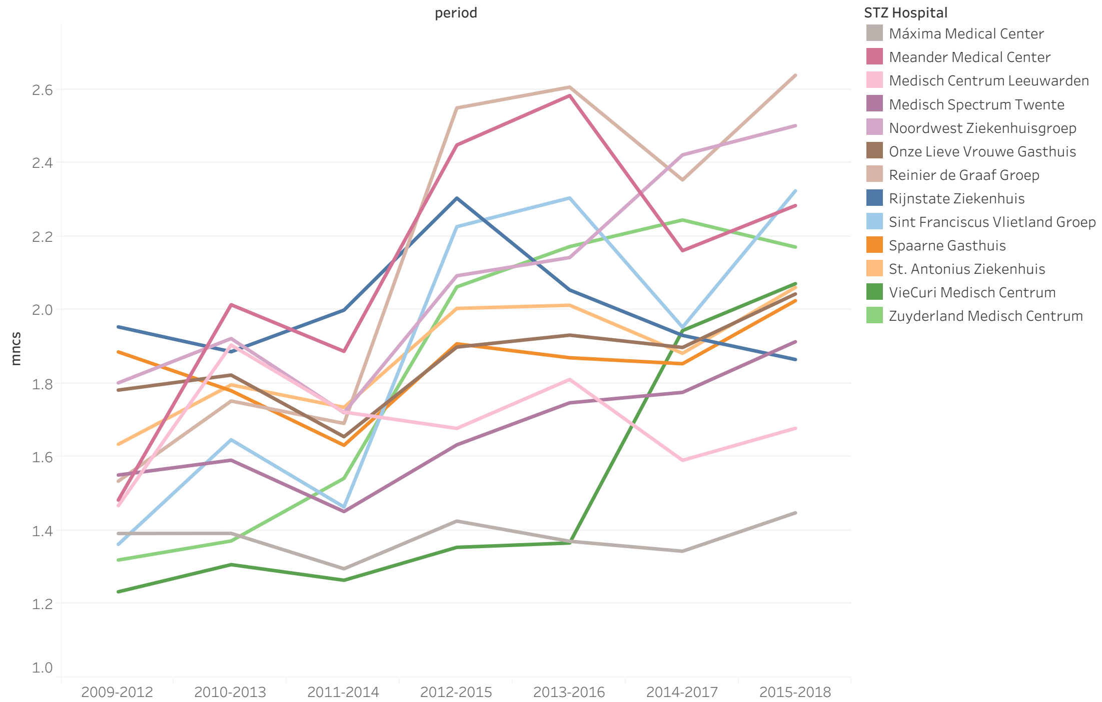
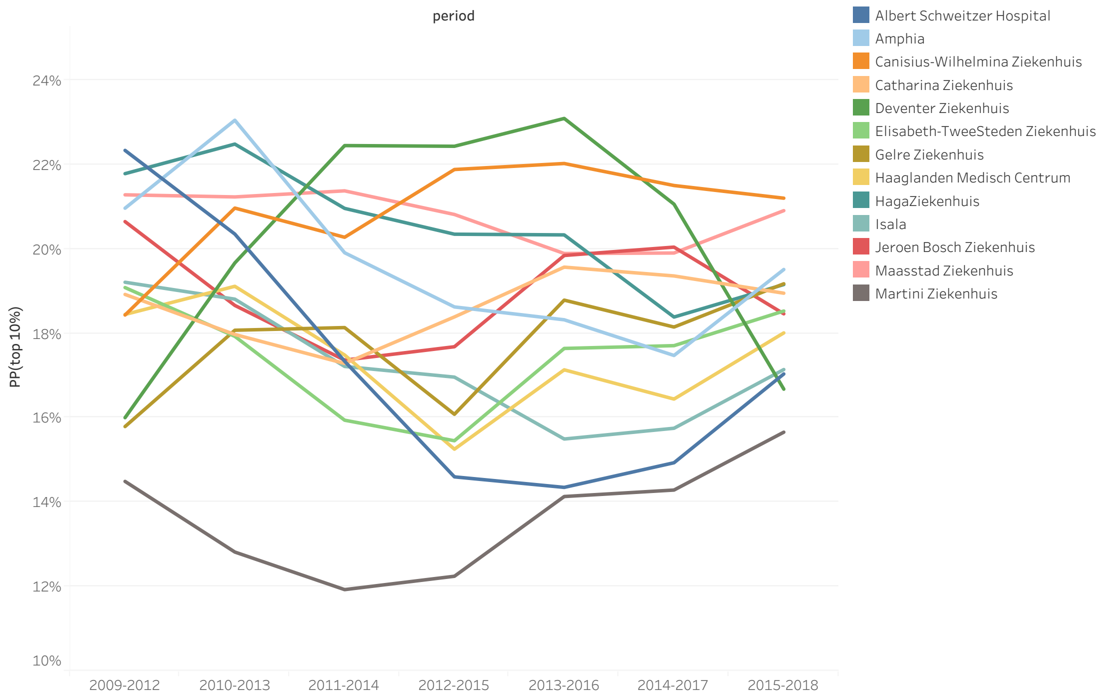
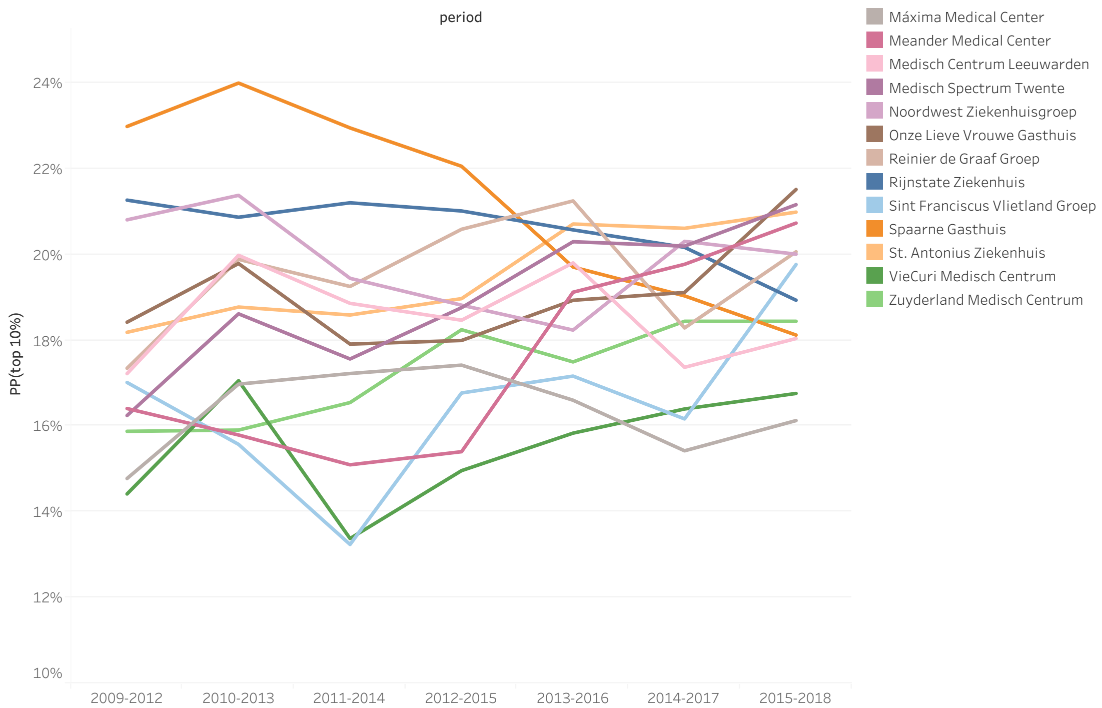


Figure 6. PP(top 10%) per STZ hospital over time.





4.2 Special indicators: Research profile and collaboration profile

In this subsection, we add more details to the output and impact of each individual STZ hospital by disaggregating output and impact in different subsets of publications – research areas -. Only research fields that account for a minimum of 1% share of STZ's total output were included in the figures. Therefore, the full research profile of STZ hospitals can be found in a separate excel file.

Additionally, we distribute the output of the overall STZ hospitals as well as the output of each individual STZ hospital over three types: publications involving international collaboration, publications involving collaboration with other Dutch organizations and publications authored by STZ hospital only. In the figures below, the MNCS indicator values (next to the bar charts) are computed using full counting.

All STZ hospitals

In Figure 7, we show the most important fields of activity for all STZ hospitals. Only research fields that account for a minimum of 1% share of STZ's total output were included in the figure. The most important fields of activity in terms of share of output are 'Surgery' (MNCS=1.40), 'Cardiac & Cardiovascular Systems (MNCS=1.48) and 'Oncology' (MNCS=1.84), with at least 5% share of STZ's total output. The impact of STZ's publications in their main fields of activity is generally high, with MNCS scores ranging from 40% to 82% above world average.

Other important fields that account for more than 1% of STZ's total outputs with a moderate amount of publications and a very high impact (MNCS>2) are 'Medicine, General & Internal' (MNCS=4.95) and 'Rheumatology' (MNCS=2.10).

Figure 7. Research profile for all STZ hospitals (2009 - 2018)

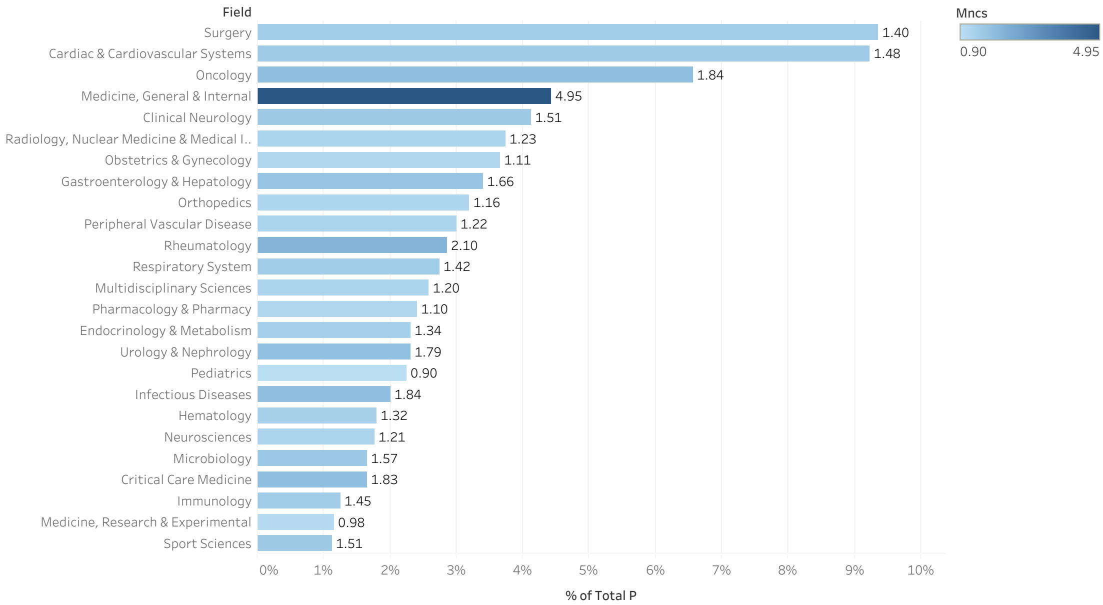
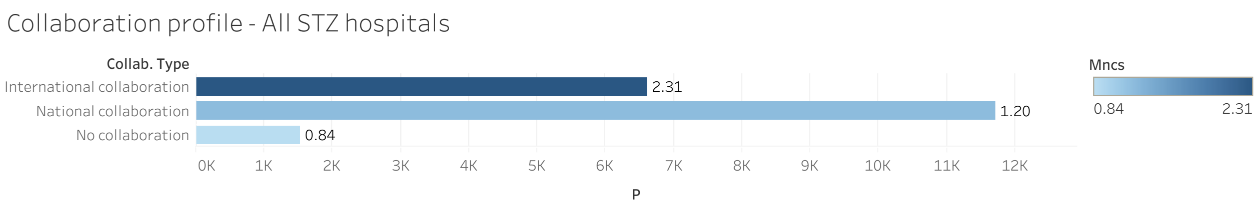


Figure 8 displays the collaboration profile of all STZ hospitals. As can be seen, the output distribution clearly shows that over the past 10 years, the main type involves massively national collaboration (P=11,716) whereas international collaboration and no collaboration only count respectively for 6,614 publications and 1,524 publications. The impact of the three types also differs substantially. As many other bibliometrics study show the impact of publications involving international collaboration is higher (MNCS=2.31) followed by national collaboration (MNCS=1.20) and at last, no collaboration which scores slightly under the word average (MNCS=0.84).

Figure 8. Collaboration profile for all STZ hospitals (2009-2018)



Albert Schweitzer Hospital

Figure 9. Research profile of Albert Schweitzer Hospital (2009-2018)

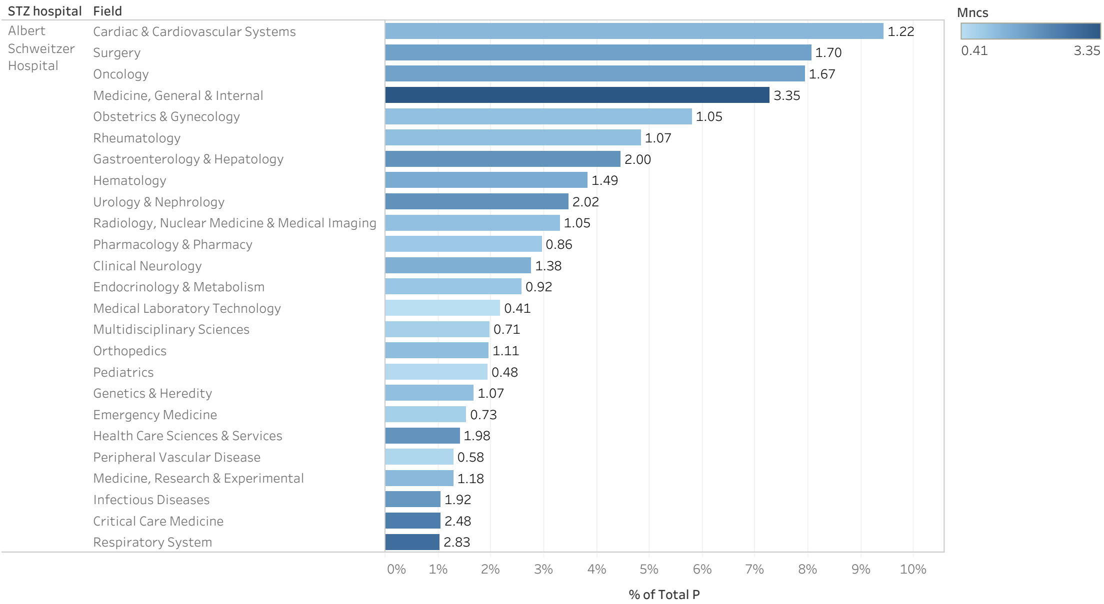
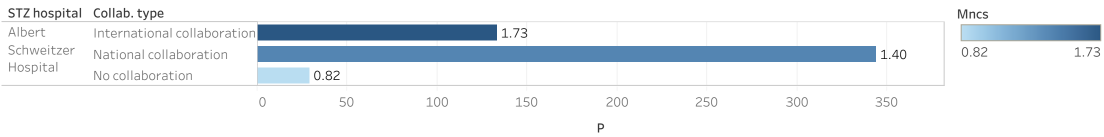


Figure 10. Collaboration profile of Albert Schweitzer Hospital (2009-2018)



Amphia

Figure 11. Research profile of Amphia (2009-2018)

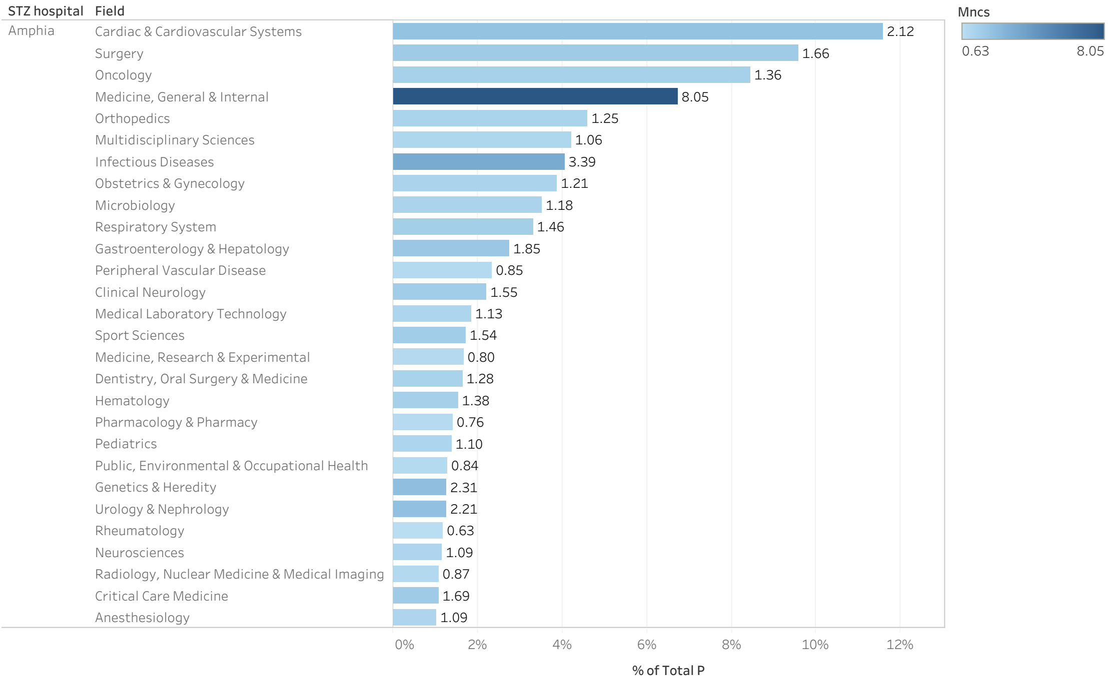
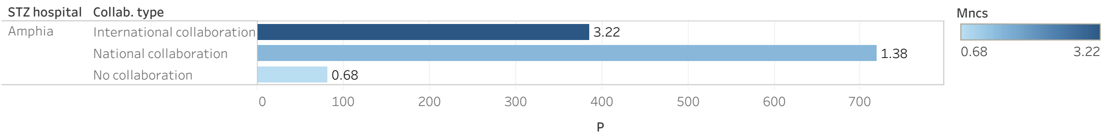


Figure 12. Collaboration profile of Amphia (2009-2018)



Canisius-Wilhelmina Ziekenhuis

Figure 13. Research profile of Canisius-Wilhelmina Ziekenhuis (2009-2018)

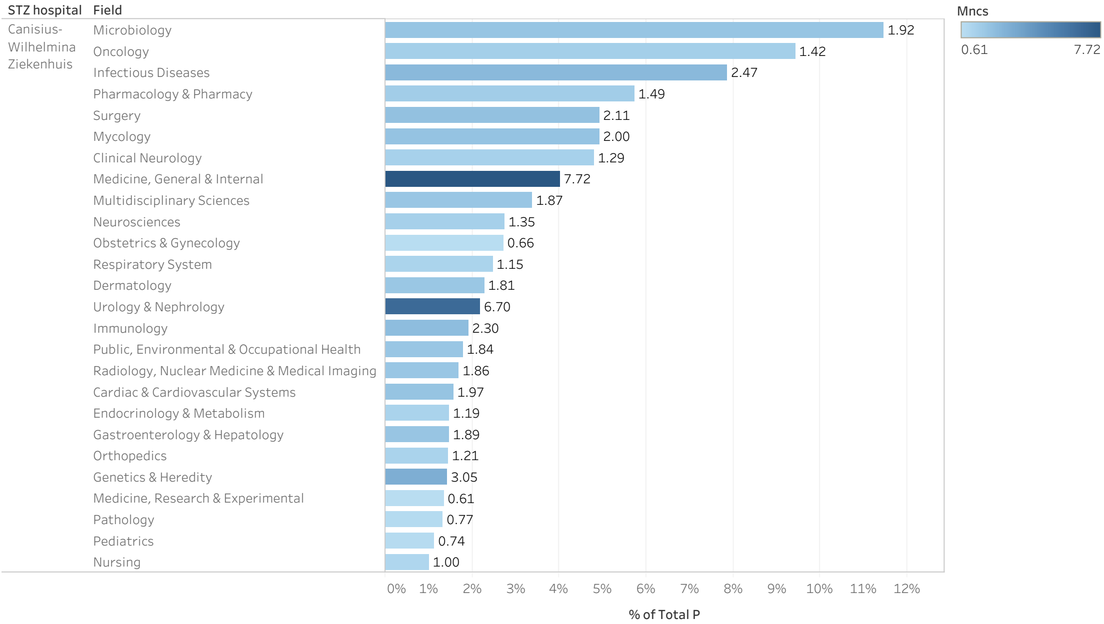
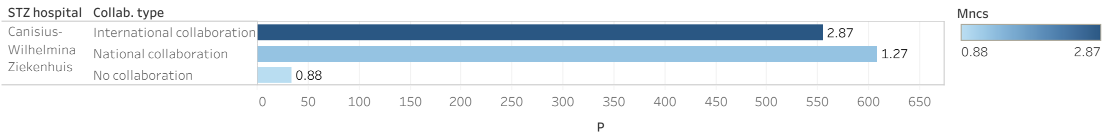


Figure 14. Collaboration profile of Canisius-Wilhelmina Ziekenhuis (2009-2018)



Catharina Ziekenhuis

Figure 15. Research profile of Catharina Ziekenhuis (2009-2018)

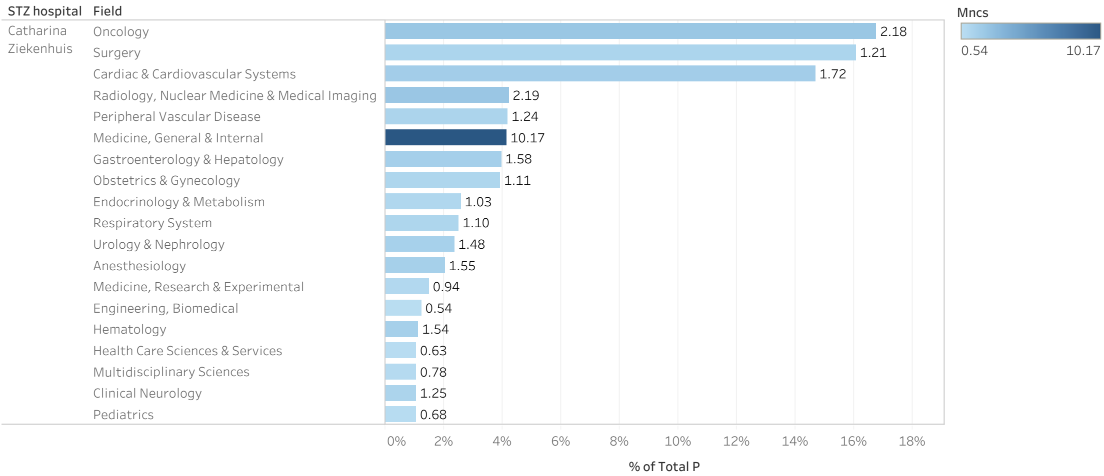
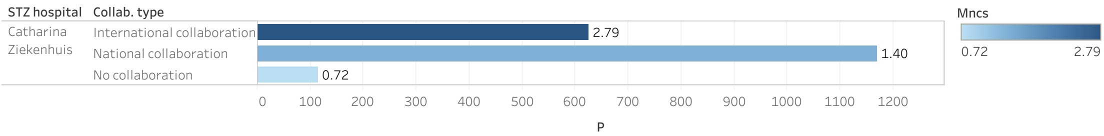


Figure 16. Collaboration profile of Catharina Ziekenhuis (2009-2018)



Deventer Ziekenhuis

Figure 17. Research profile of Deventer Ziekenhuis (2009-2018)

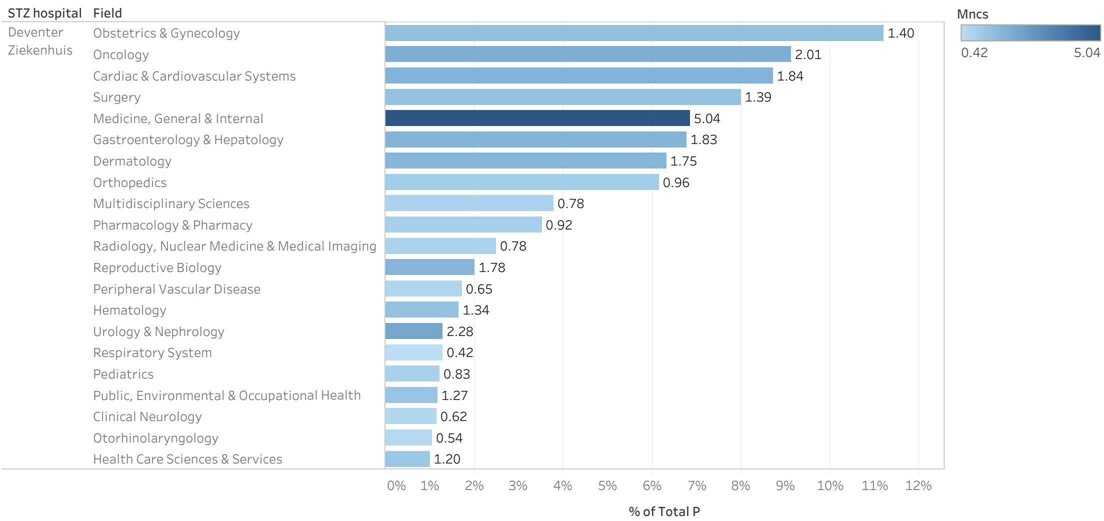
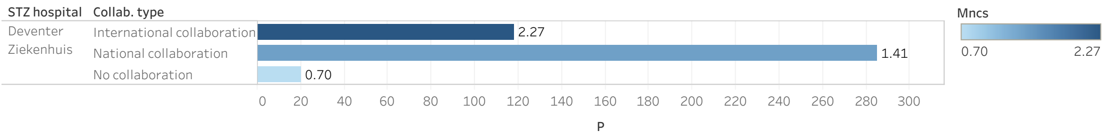


Figure 18. Collaboration profile of Deventer Ziekenhuis (2009-2018)



Elisabeth-TweeSteden Ziekenhuis

Figure 19. Research profile of Elisabeth-TweeSteden Ziekenhuis (2009-2018)

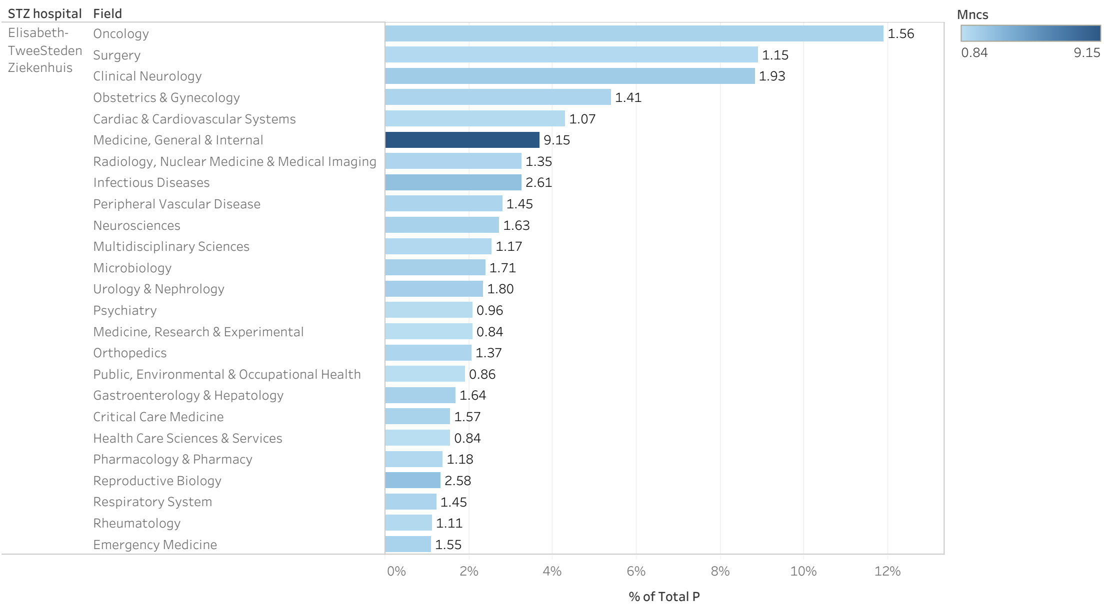
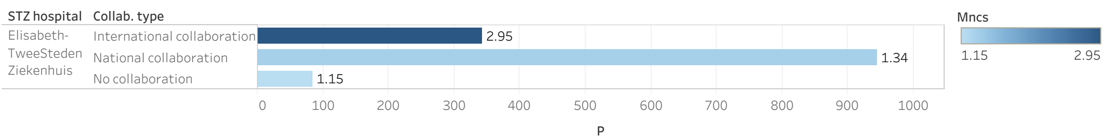


Figure 20. Collaboration profile of Elisabeth-TweeSteden Ziekenhuis (2009-2018)



Gelre Ziekenhuis

Figure 21. Research profile of Gelre Ziekenhuis (2009-2018)

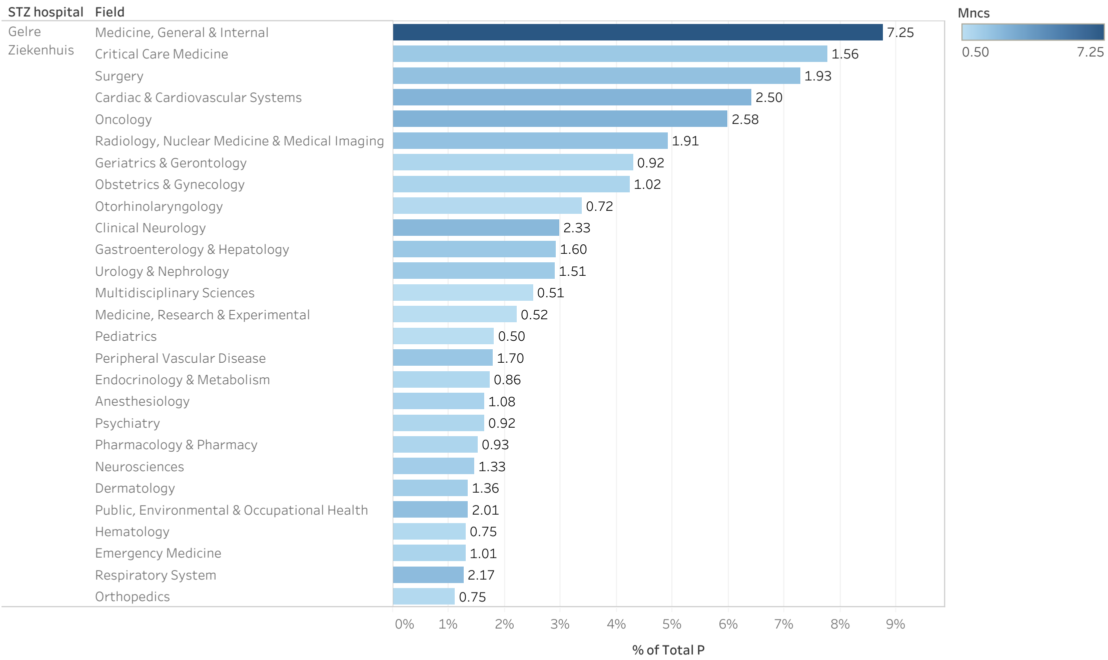
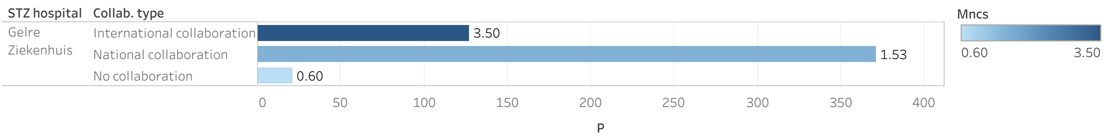


Figure 22. Collaboration profile of Gelre Ziekenhuis (2009-2018)



Haaglanden Medisch Centrum

Figure 23. Research profile of Haaglanden Medisch Centrum (2009-2018)

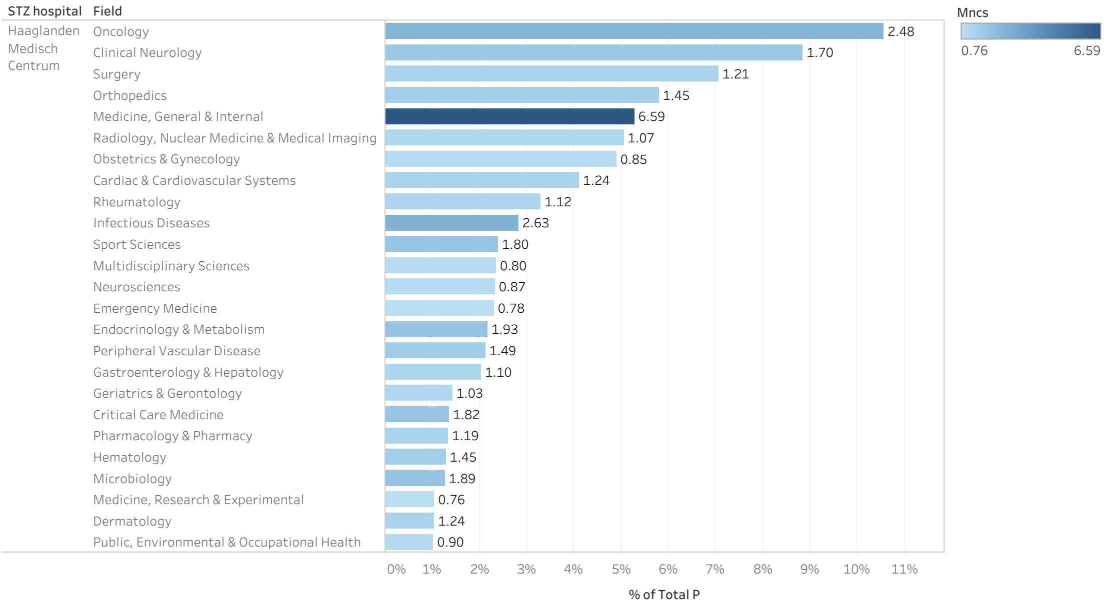
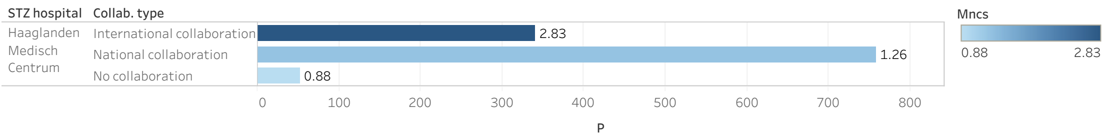


Figure 24. Collaboration profile of Haaglanden Medisch Centrum (2009-2018)



HagaZiekenhuis

Figure 25. Research profile of HagaZiekenhuis (2009-2018)

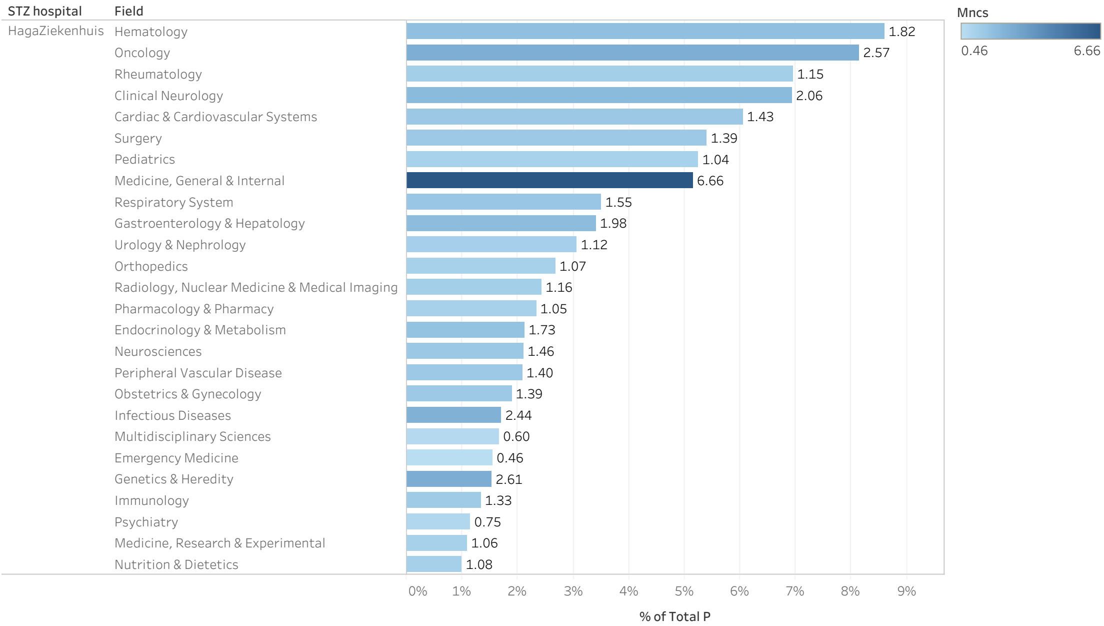
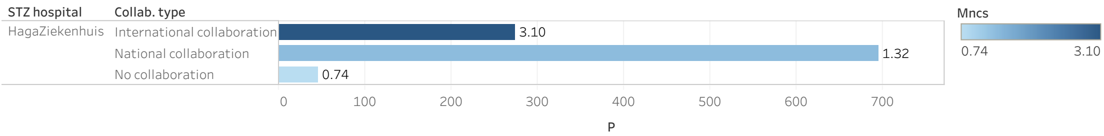


Figure 26. Collaboration profile of HagaZiekenhuis (2009-2018)



Isala

Figure 27. Research profile of Isala (2009-2018)

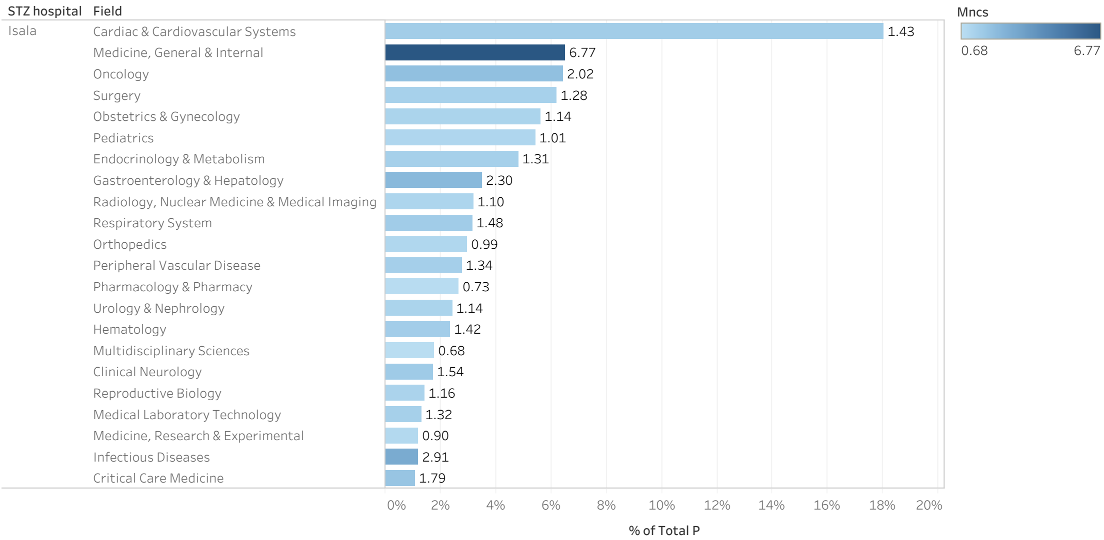
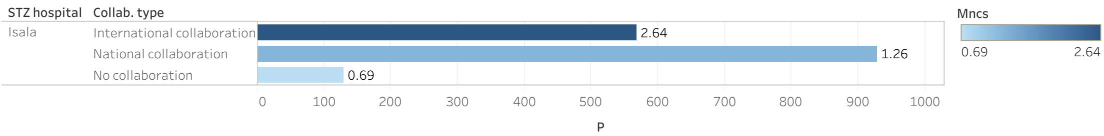


Figure 28. Collaboration profile of Isala (2009-2018)



Jeroen Bosch Ziekenhuis

Figure 29. Research profile of Jeroen Bosch Ziekenhuis (2009-2018)

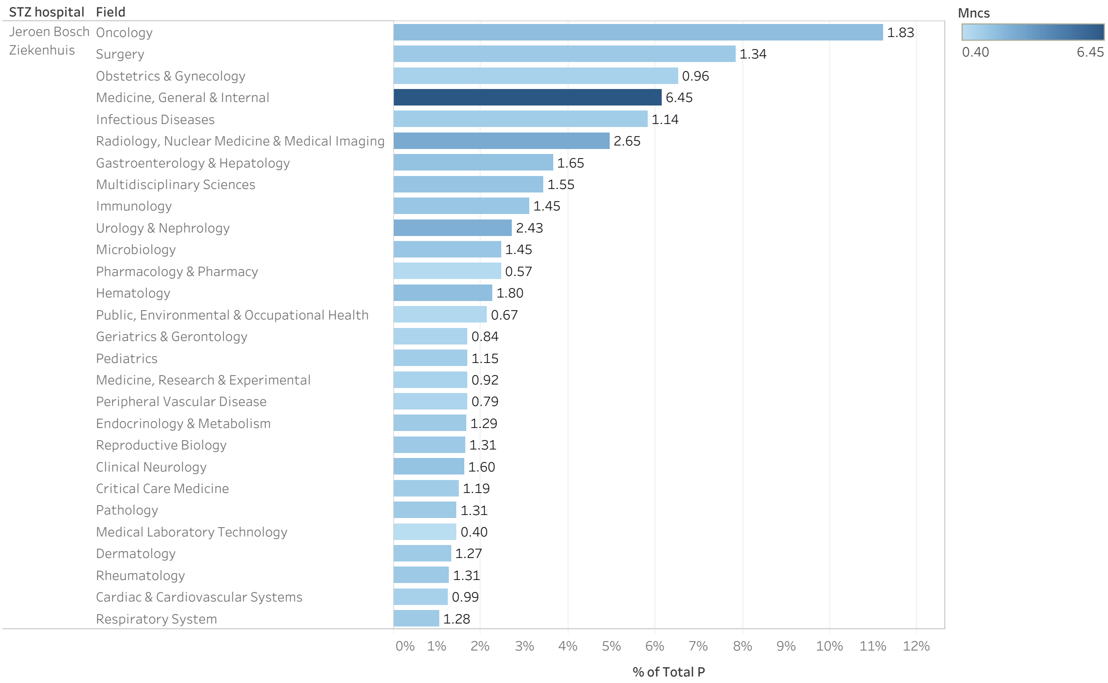
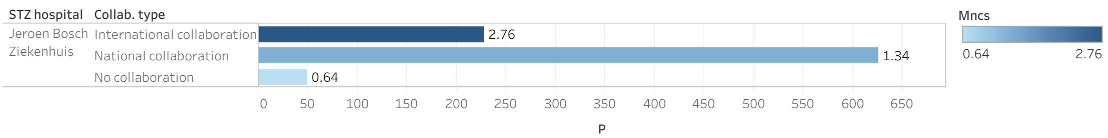


Figure 30. Collaboration profile of Jeroen Bosch Ziekenhuis (2009-2018)



Maasstad Ziekenhuis

Figure 31. Research profile of Maasstad Ziekenhuis (2009-2018)

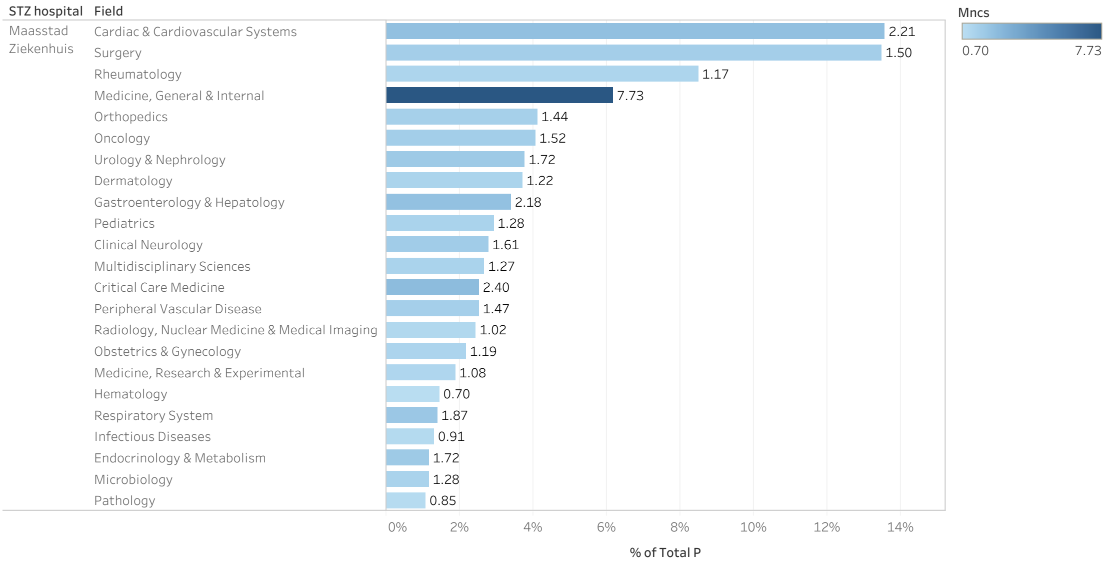
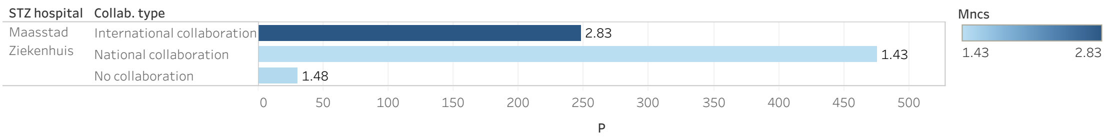


Figure 32. Collaboration profile of Maasstad Ziekenhuis (2009-2018)



Martini Hospital

Figure 33. Research profile of Martini Hospital (2009-2018)

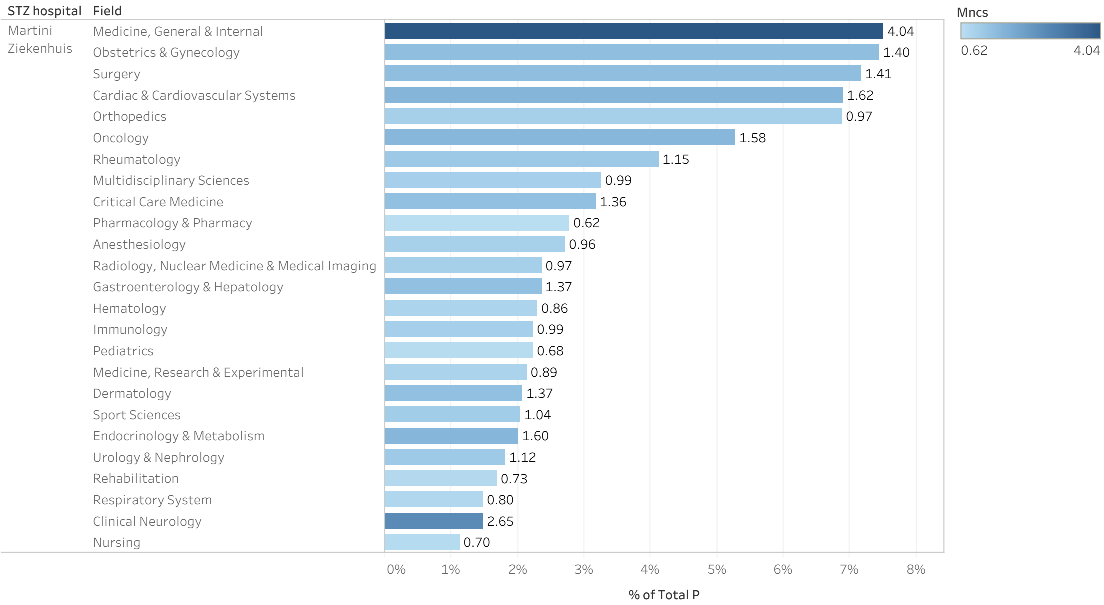
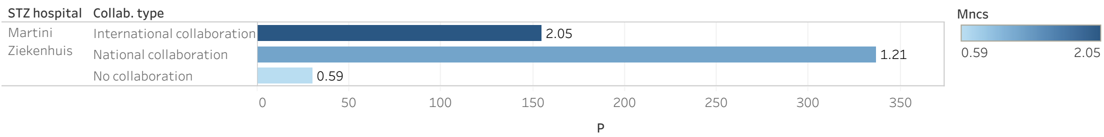


Figure 34. Collaboration profile of Martini Hospital (2009-2018)



Maxima Medical Centrum

Figure 35. Research profile of Maxima Medical Centrum (2009-2018)

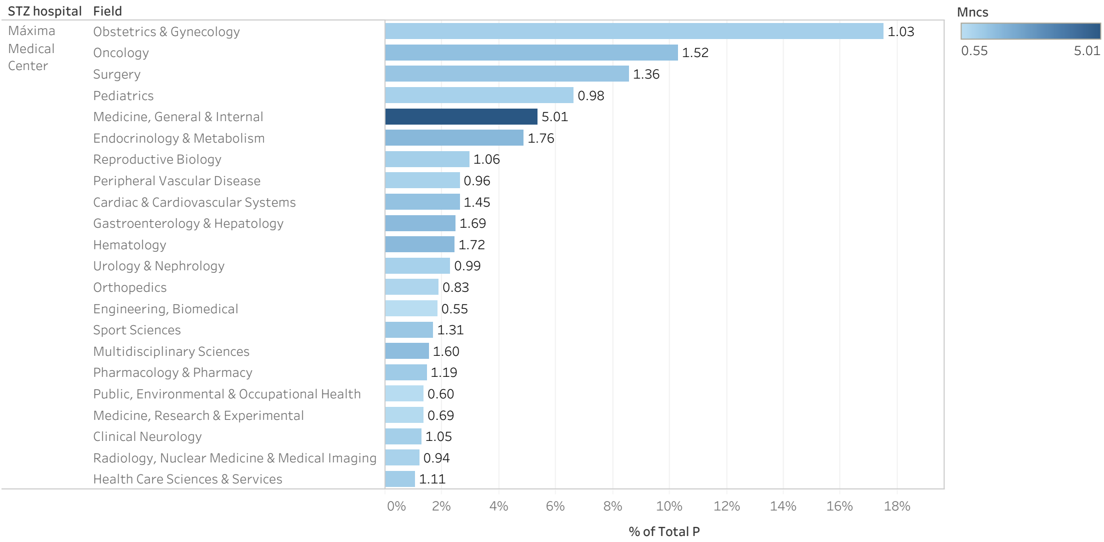
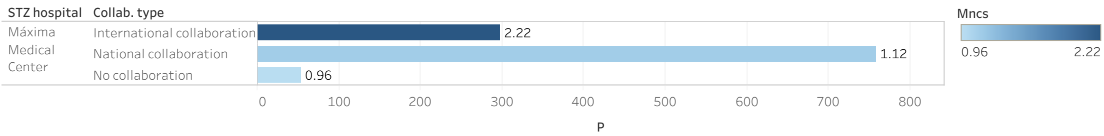


Figure 36. Collaboration profile of Maxima Medical Centrum (2009-2018)



Meander Medical Center

Figure 37. Research profile of Meander Medical Center (2009-2018)

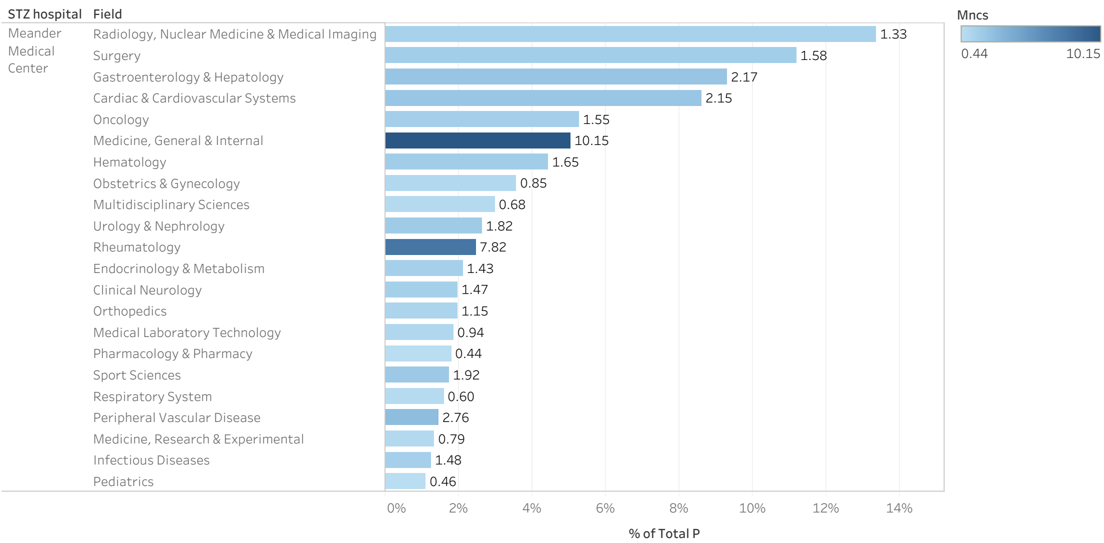
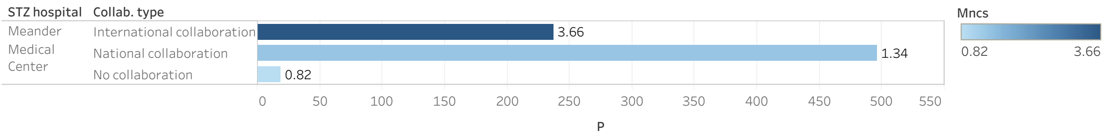


Figure 38. Collaboration profile of Meander Medical Center (2009-2018)



Medisch Centrum Leeuwarden

Figure 39. Research profile of Medisch Centrum Leeuwarden (2009-2018)

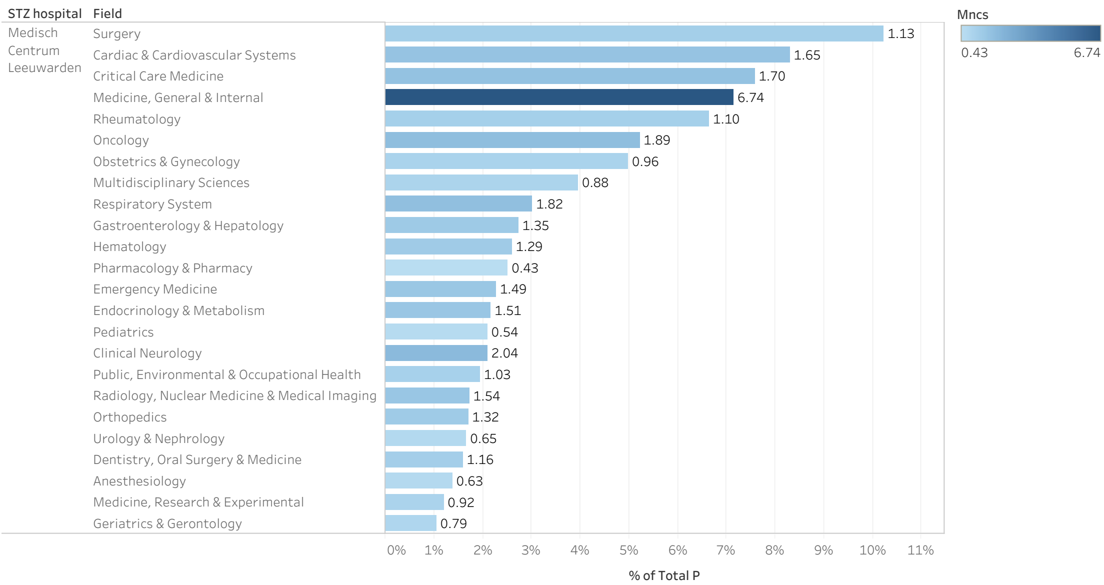
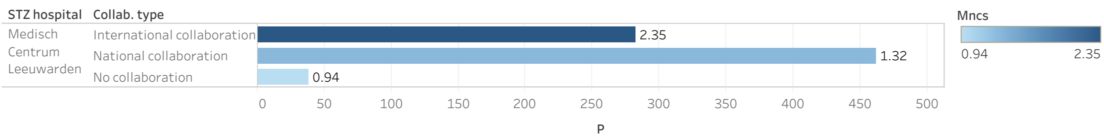


Figure 40. Collaboration profile of Medisch Centrum Leeuwarden (2009-2018)



Medisch Spectrum Twente

Figure 41. Research profile of Medisch Spectrum Twente (2009-2018)

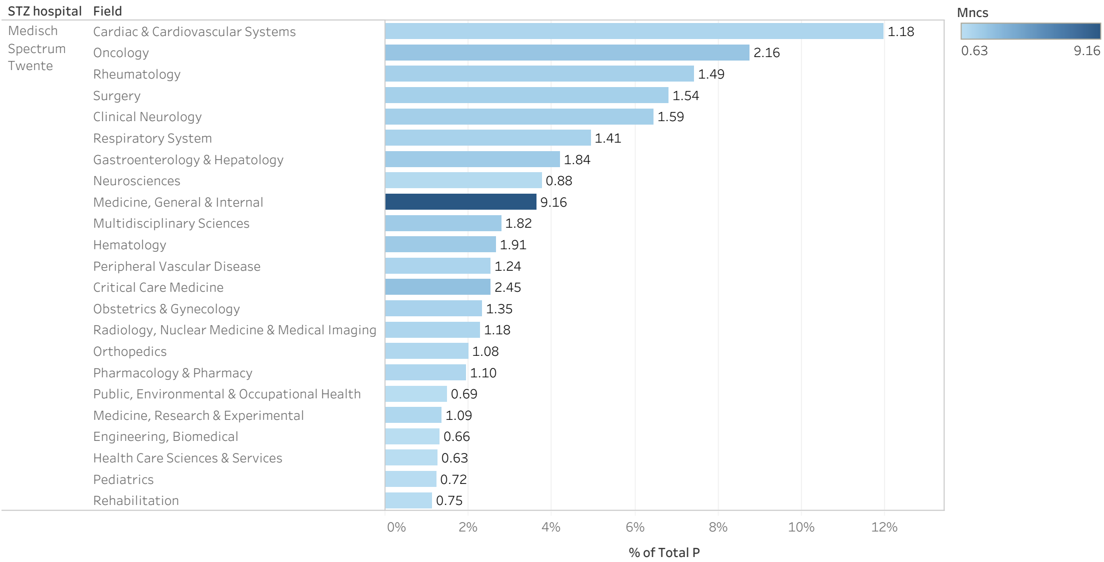
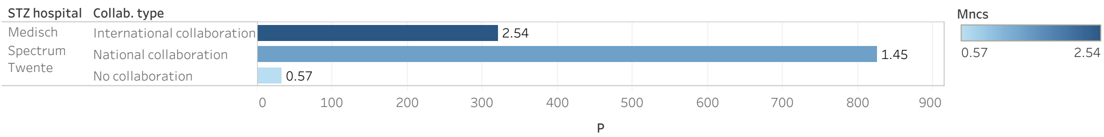


Figure 42. Collaboration profile of Medisch Spectrum Twente (2009-2018)



Noordwest Ziekenhuisgroep

Figure 43. Research profile of Noordwest Ziekenhuisgroep (2009-2018)

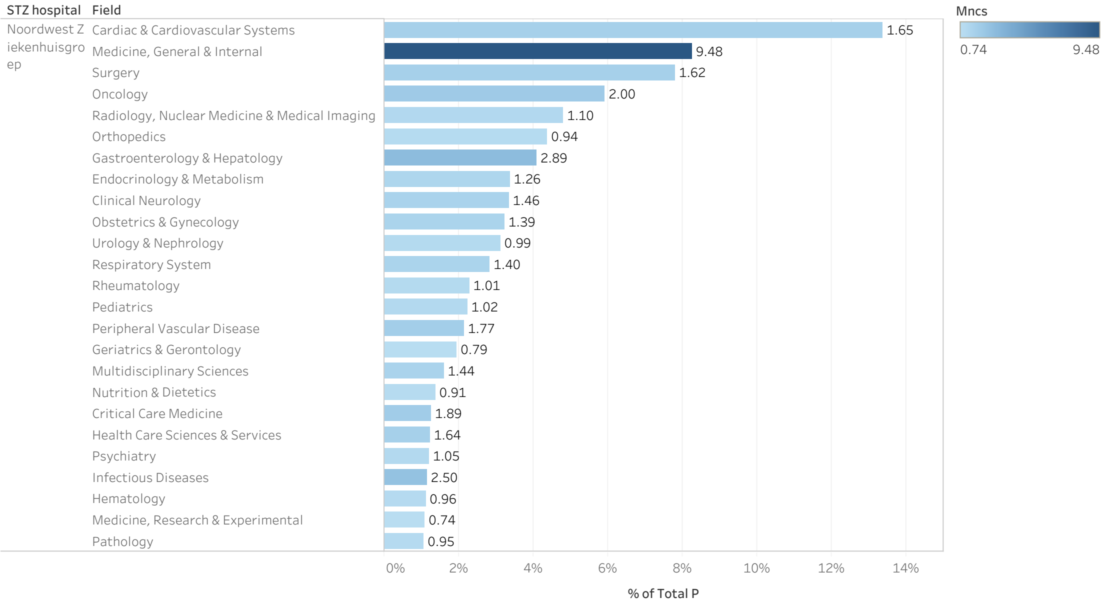
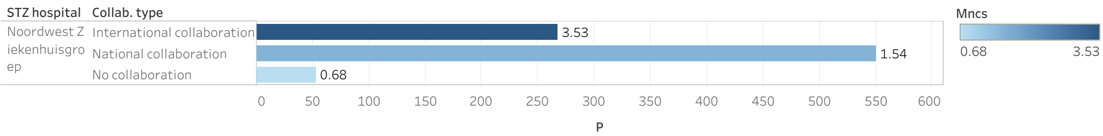


Figure 44. Collaboration profile of Noordwest Ziekenhuisgroep (2009-2018)



Onze Lieve Vrouw Gasthuis

Figure 45. Research profile of Onze Lieve Vrouw Gasthuis (2009-2018)

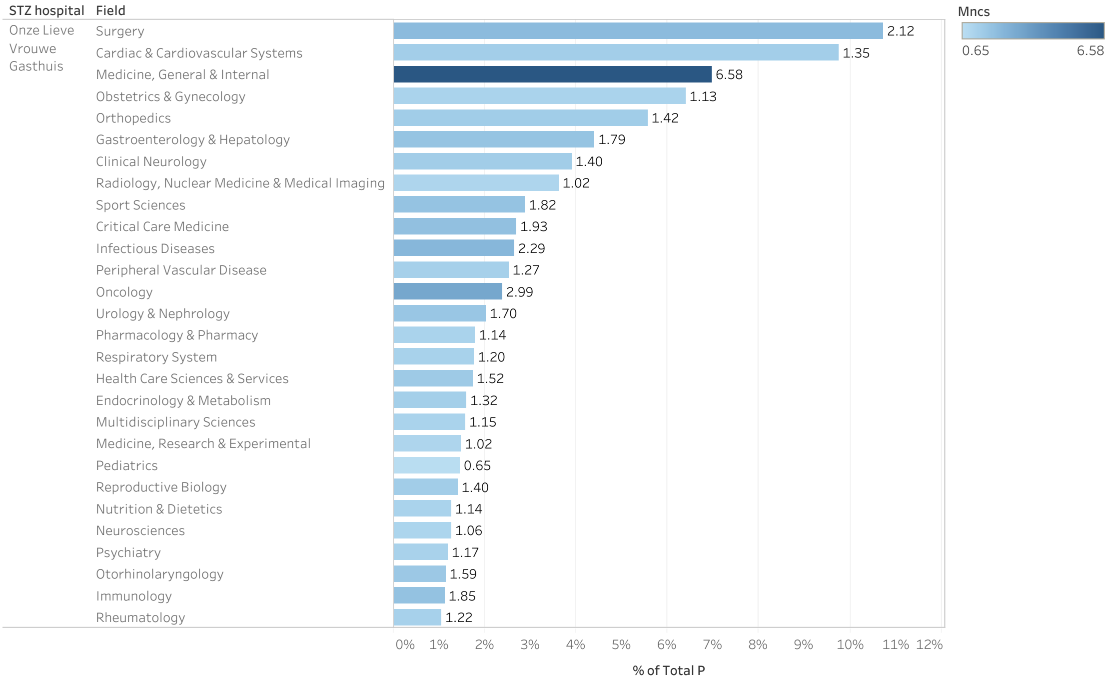
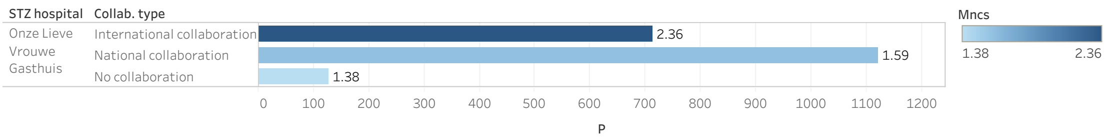


Figure 46. Collaboration profile of Onze Lieve Vrouw Gasthuis (2009-2018)



Reinier de Graaf Groep

Figure 47. Research profile of Reinier de Graaf Groep (2009-2018)

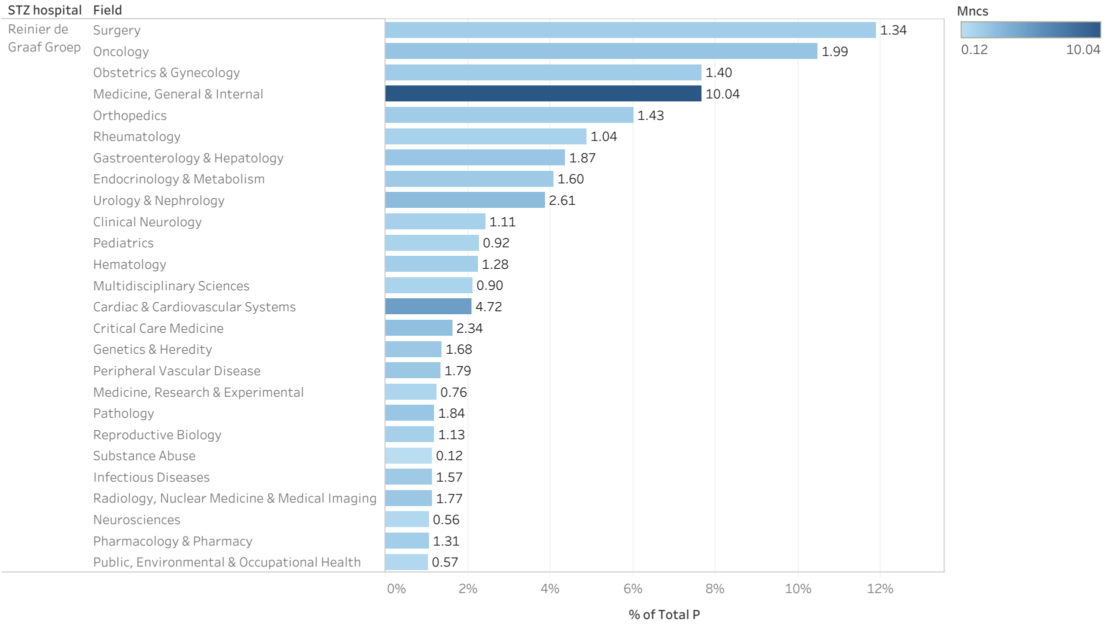
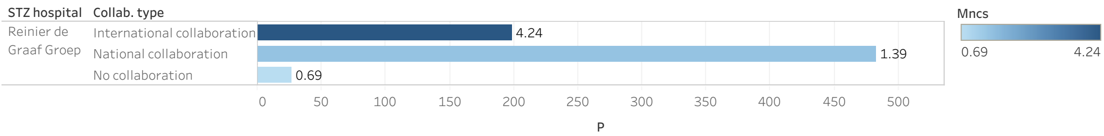


Figure 48. Collaboration profile of Reinier de Graaf Groep (2009-2018)



Rijnstate Ziekenhuis

Figure 49. Research profile of Rijnstate Ziekenhuis (2009-2018)

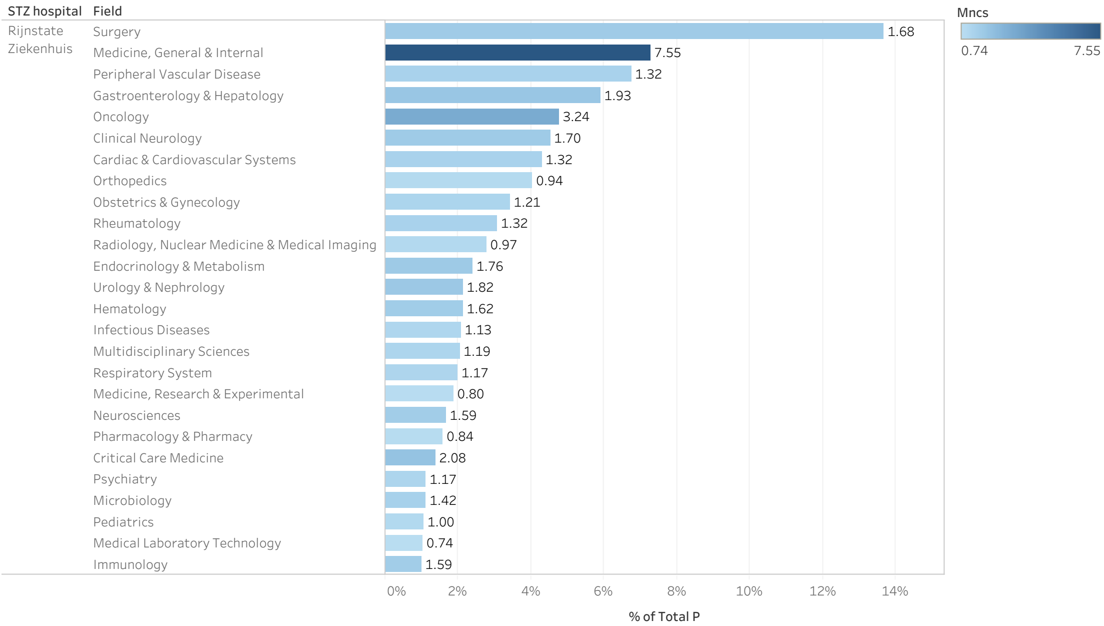
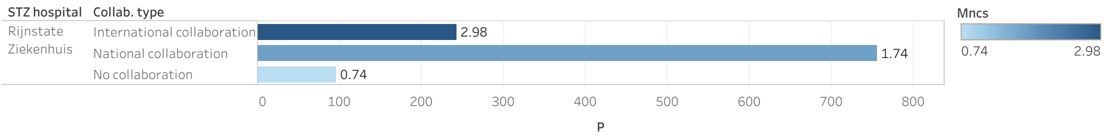


Figure 50. Collaboration profile of Rijnstate Ziekenhuis (2009-2018)



Sint Franciscus Vlietland Groep

Figure 51. Research profile of Sint Franciscus Vlietland Groep (2009-2018)

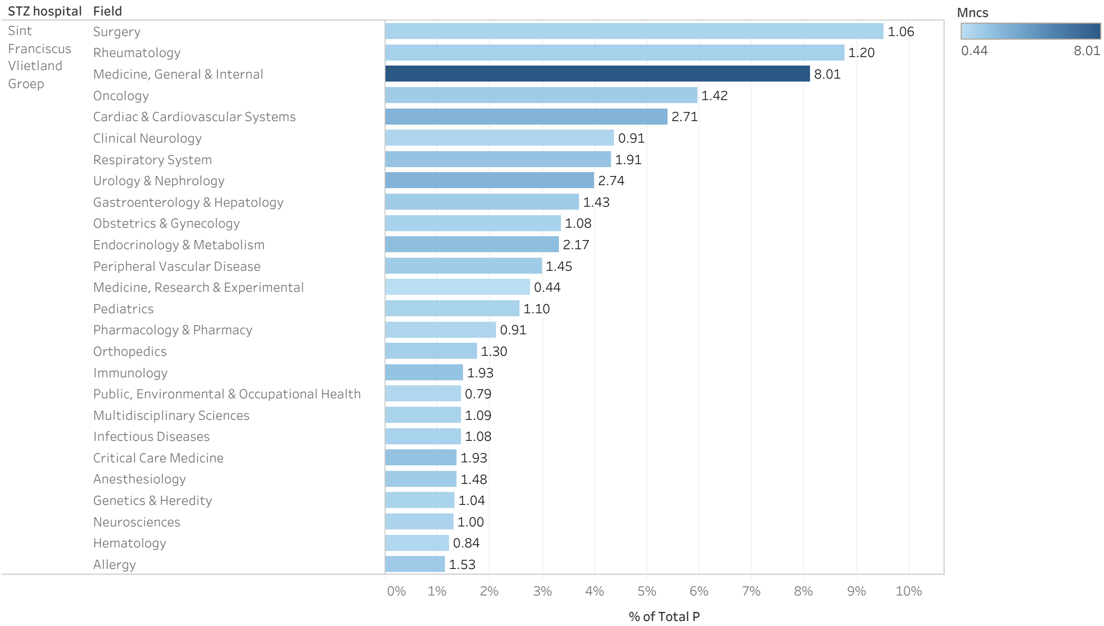
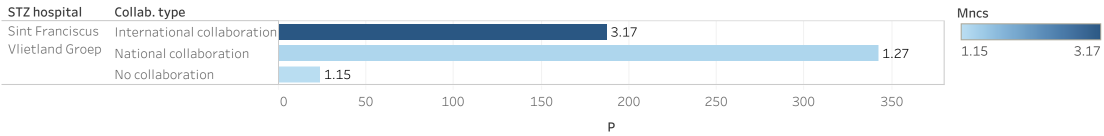


Figure 52. Collaboration profile of H Sint Franciscus Vlietland Groep (2009-2018)



Spaarne Gasthuis

Figure 53. Research profile of Spaarne Gasthuis (2009-2018)

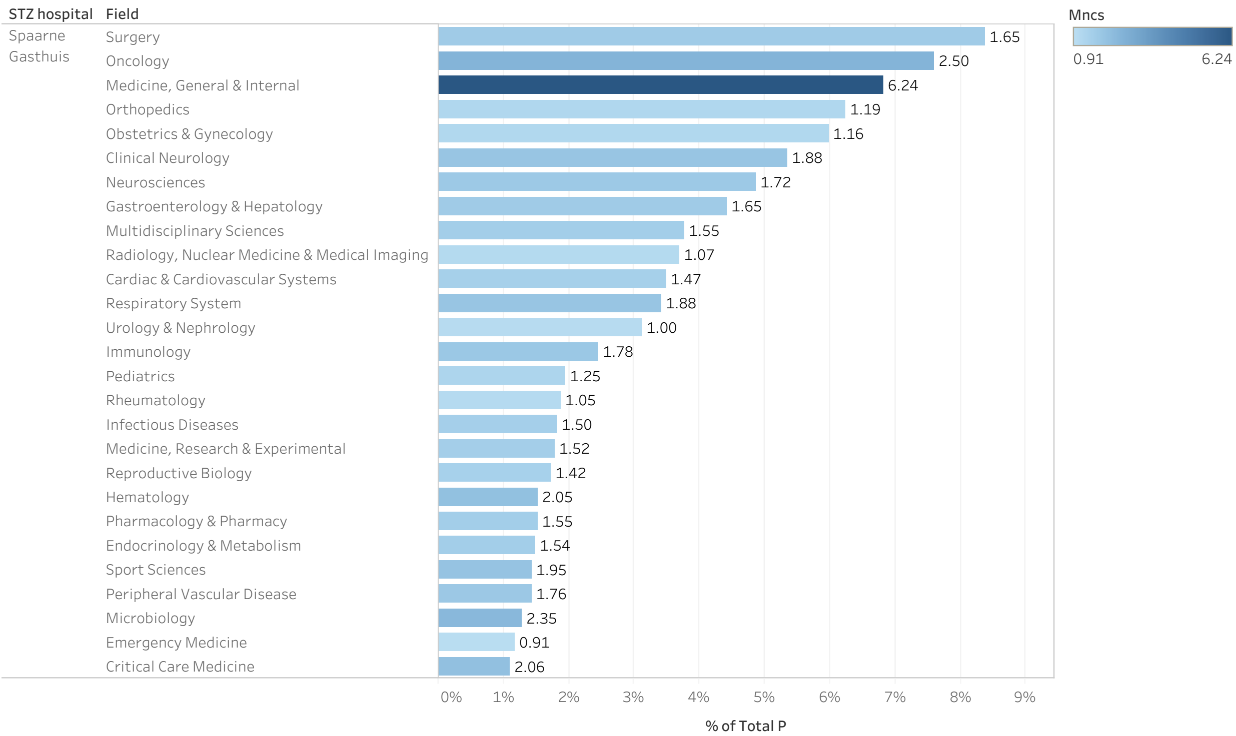
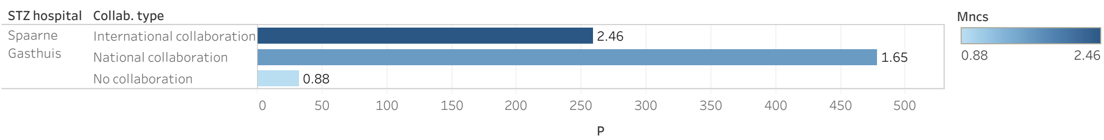


Figure 54. Collaboration profile of Spaarne Gasthuis (2009-2018)



St. Antonius Ziekenhuis

Figure 55. Research profile of St. Antonius Ziekenhuis (2009-2018)

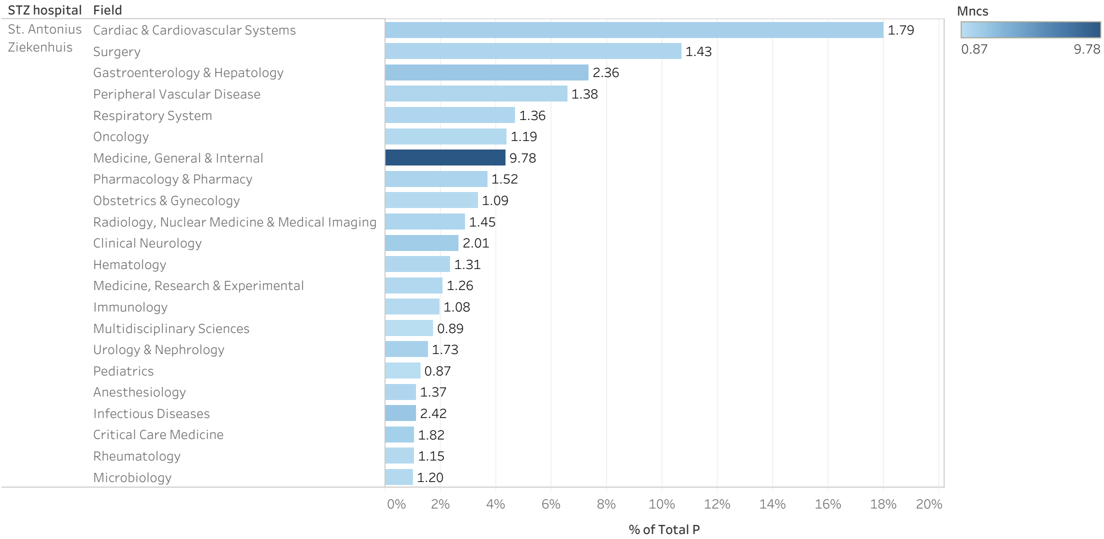
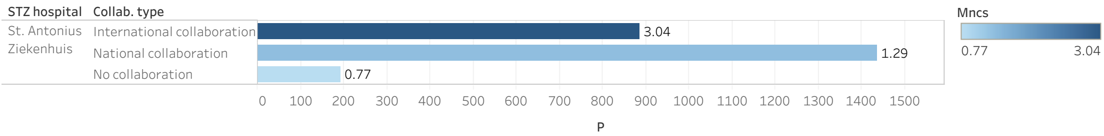


Figure 56. Collaboration profile of St. Antonius Ziekenhuis (2009-2018)



VieCuri Medisch Centrum

Figure 57. Research profile of VieCuri Medisch Centrum (2009-2018)

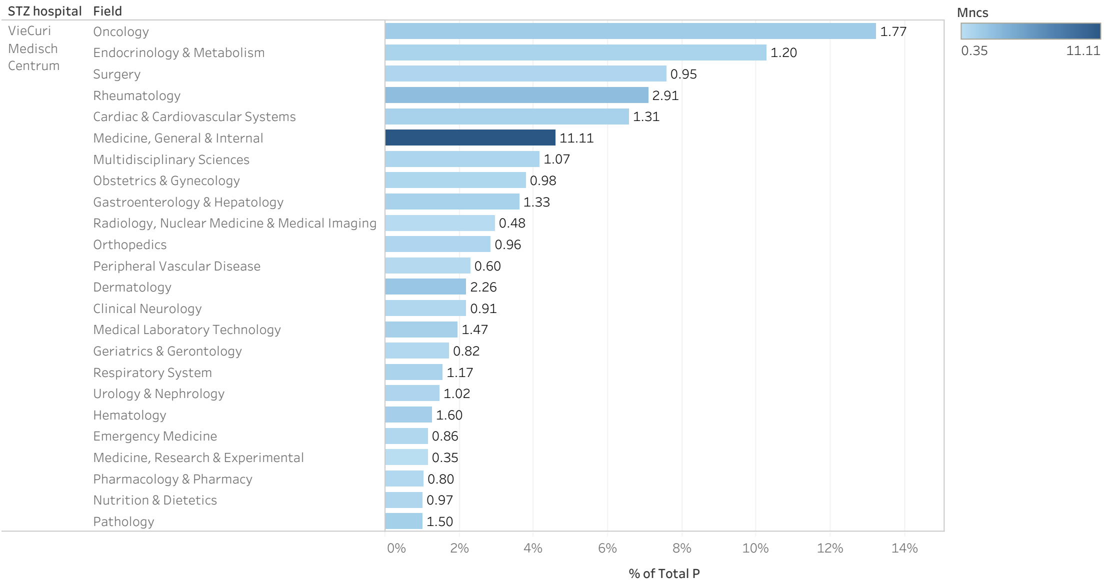
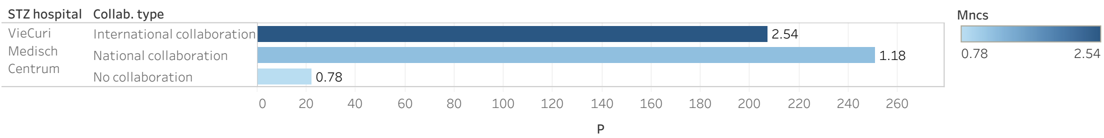


Figure 58. Collaboration profile of VieCuri Medisch Centrum (2009-2018)



Zuyderland Medisch Centrum

Figure 59. Research profile of Zuyderland Medisch Centrum (2009-2018)

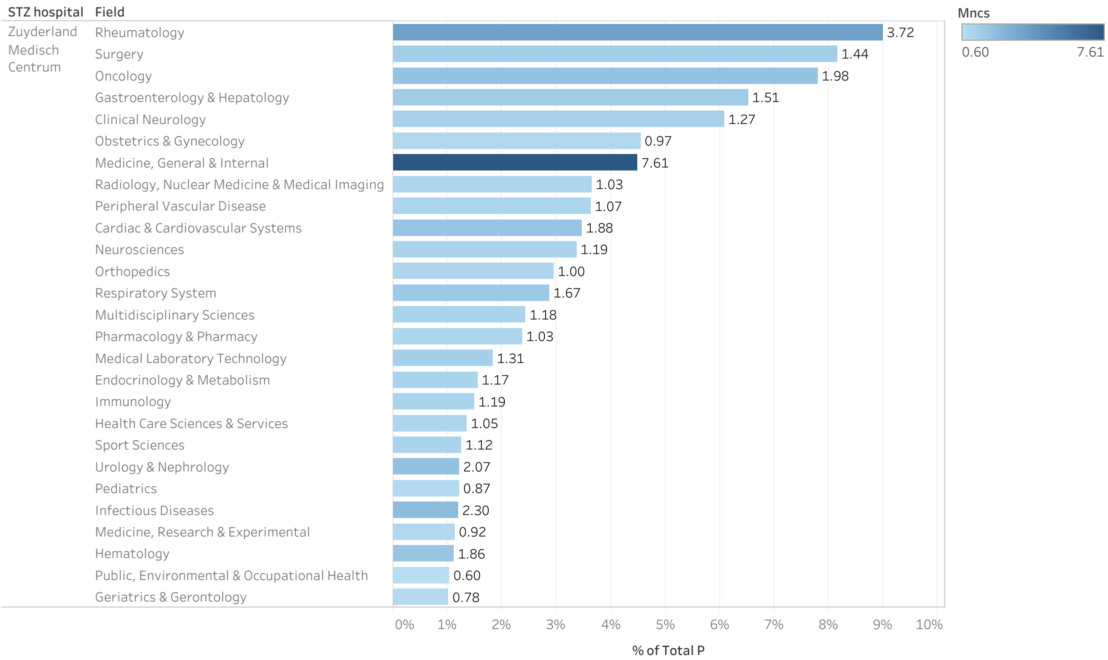
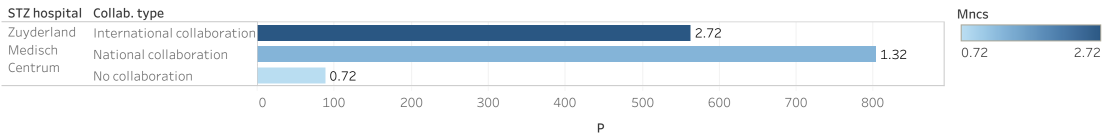


Figure 60. Collaboration profile of Zuyderland Medisch Centrum (2009-2018)



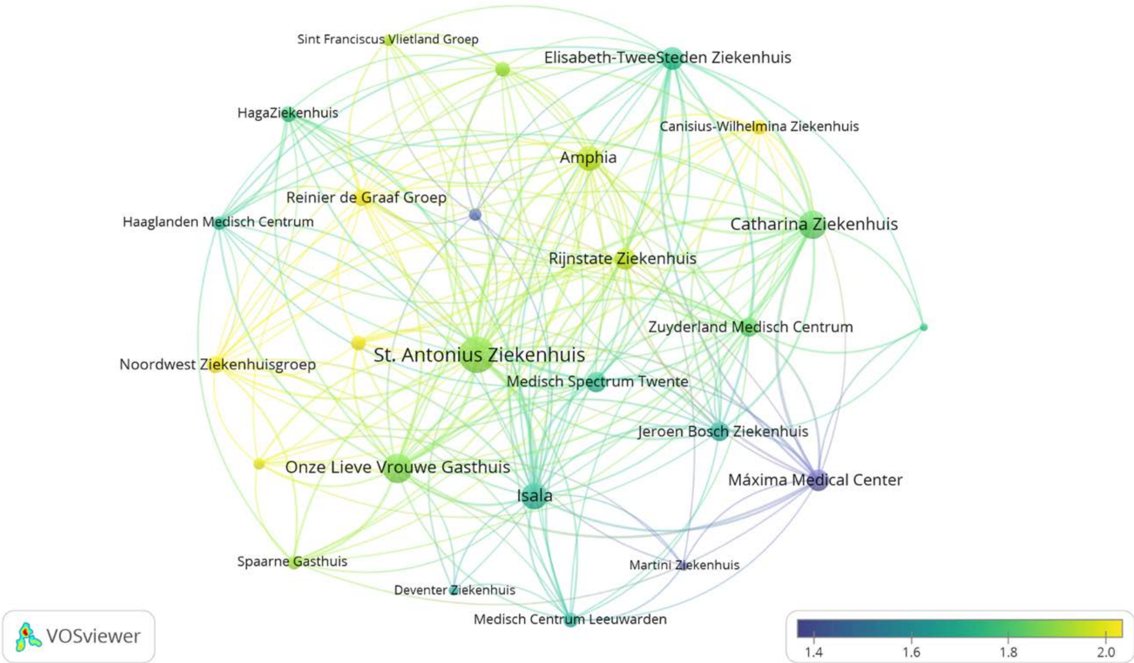
4.3 Collaboration Network Analysis

This section shows network graphs based on the relationship (co-publication based) among STZ hospitals and their Dutch partners during the period of analysis. With the VOSviewer software, we constructed the collaboration network visualization maps in which the distance between organization provides an indication of the relatedness as measured by co-publications. The size of the dots in the maps indicates the number of publications; the biggest the dot is, the more publications.

4.3.1 Collaboration network analysis between STZ hospitals

In this section, we have constructed a so-called overlay visualization in which colors are used to display the impact [as measured by MNCS] of the publications published in collaboration. For the sake of this report, we have used the following code color where, by default, colors range from blue (lowest impact) to green to yellow (highest impact). The stronger two STZ hospitals are connected, the closer they are to each other. Also, we have set a threshold of minimum 10 publications co-published between organizations, so that the map is easy to read and inclusive enough.

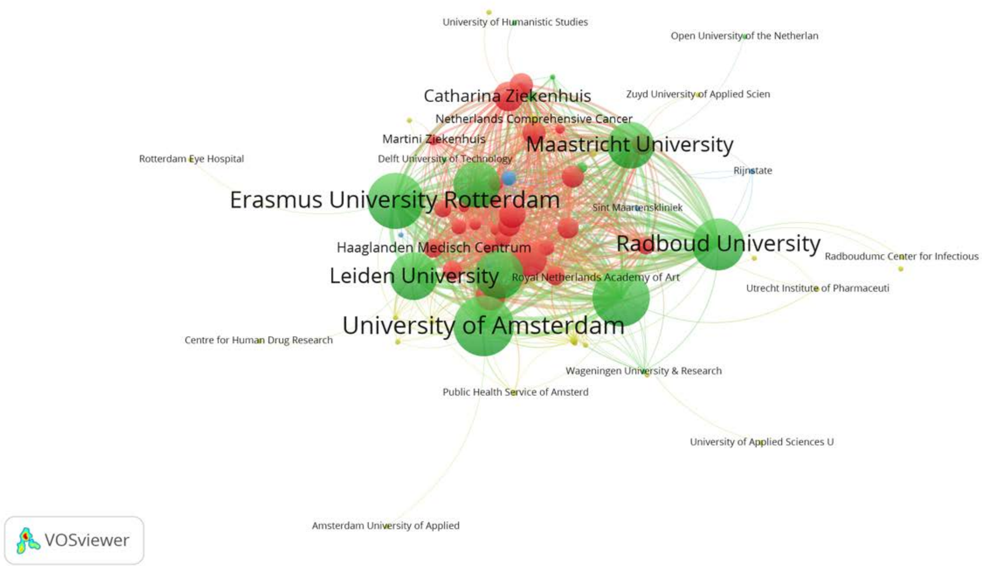
Figure 61. Overlay visualization of the collaboration activity between STZ hospitals



4.3.2 Collaboration network analysis between all STZ hospitals and all their co-publishing partner organizations

Figure 57 show the main component of the collaboration network between STZ hospitals and other Dutch Organizations. All the connected organizations in the Netherlands have been selected. The colors indicate the STZ hospitals (red), academic hospitals (blue), universities (green) and other type of organizations (yellow). The stronger two organizations are connected, the closer they are to each other. Here, we have also set a threshold of minimum 10 publications co-published between organizations.

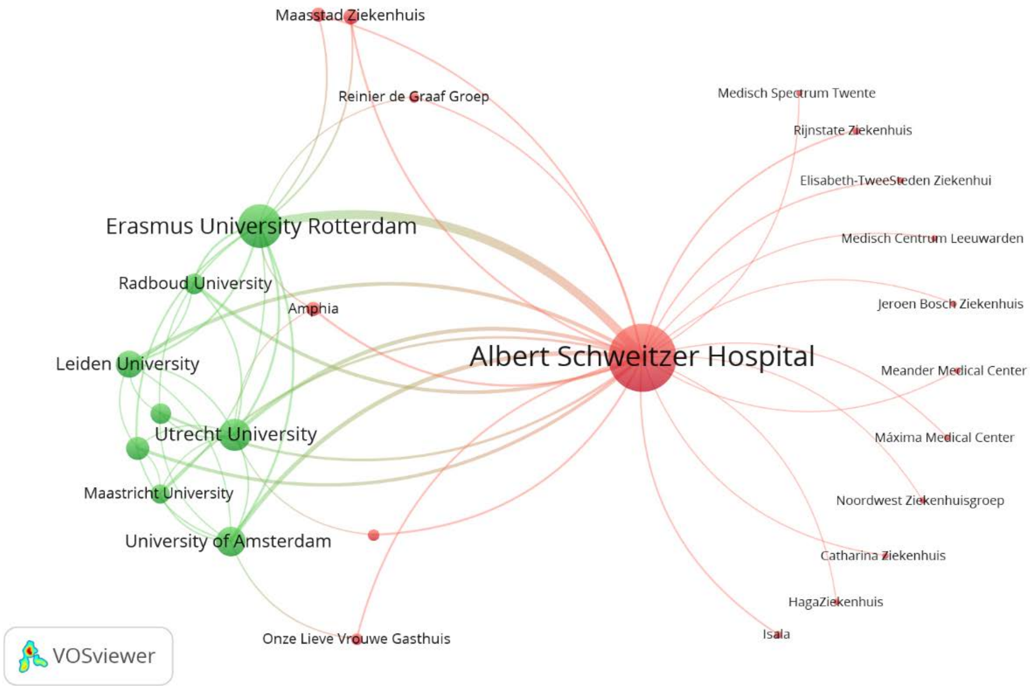
Figure 62. Network map of the collaboration between STZ Hospitals and their co-publishing partner organizations



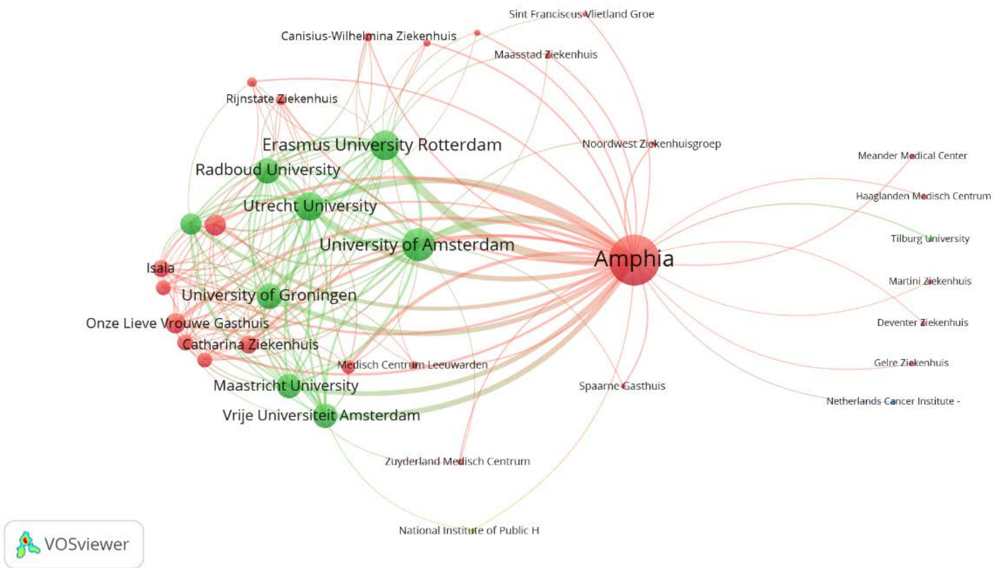
4.3.3 Collaboration network analysis between each individual STZ hospital and all their co-publishing partner organizations

In this section, we go a step further by highlighting the structure of the entire collaborative network of the each individual SZT hospital. We can set up an ego network for every organization. This is a network centered around the organization itself ("ego") with commitments to and between its co-publishing partner organizations ("alters"). Two organizations in this network have a connection strength corresponding to the number of publications assigned to both of them. A condition that is set here is that all publications that are considered are in any case assigned to the ego organization. This means that all alter organizations are by definition connected to the ego organization, and connections between alter organizations indicate the number of publications that the two alter organizations and the ego organization have in common. In this section, we have set a threshold of minimum 30 publications co-published between organizations, so that the map is inclusive enough.

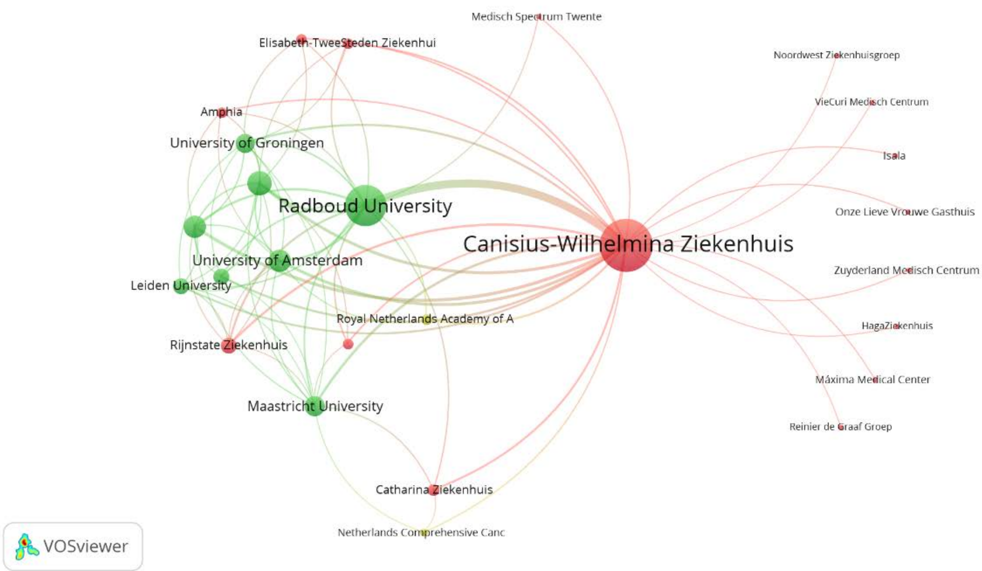
Albert Schweitzer Hospital



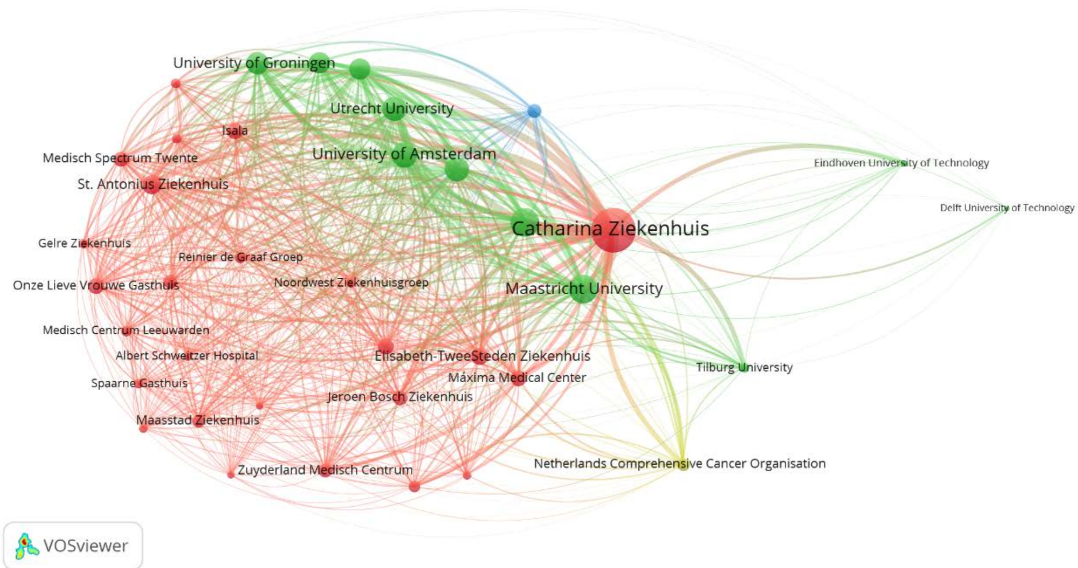
Amphia



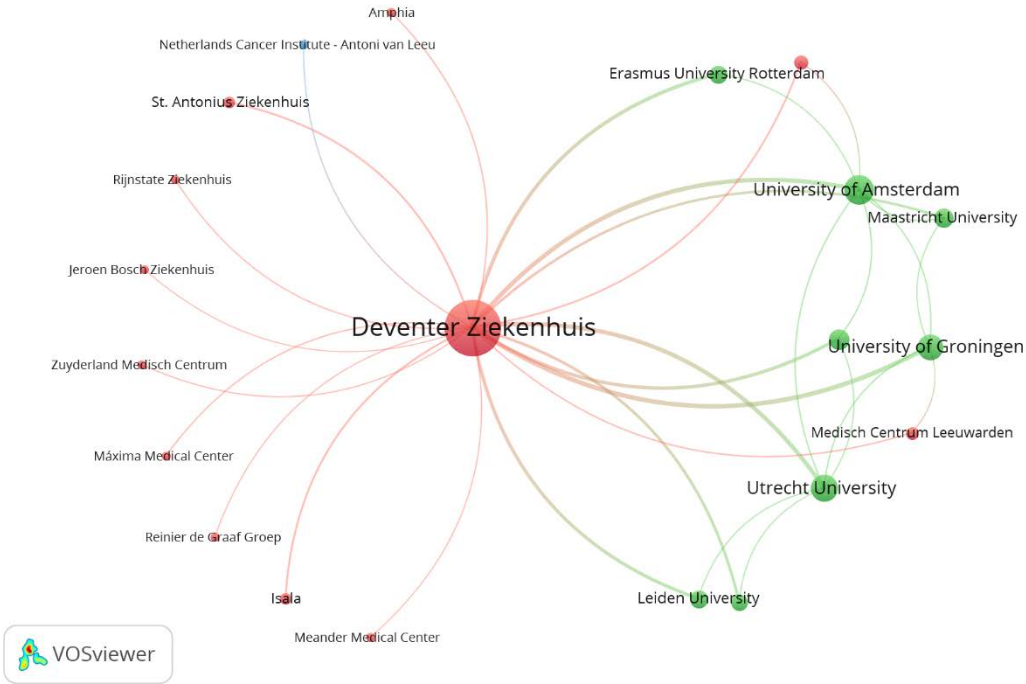
Canisius-Wilhelmina Ziekenhuis



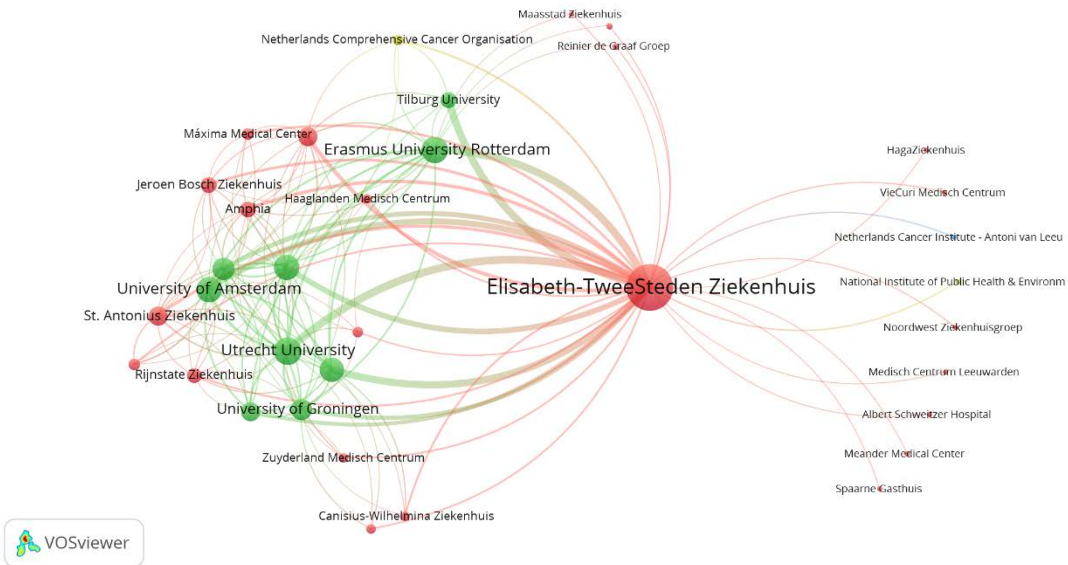
Catharina Ziekenhuis



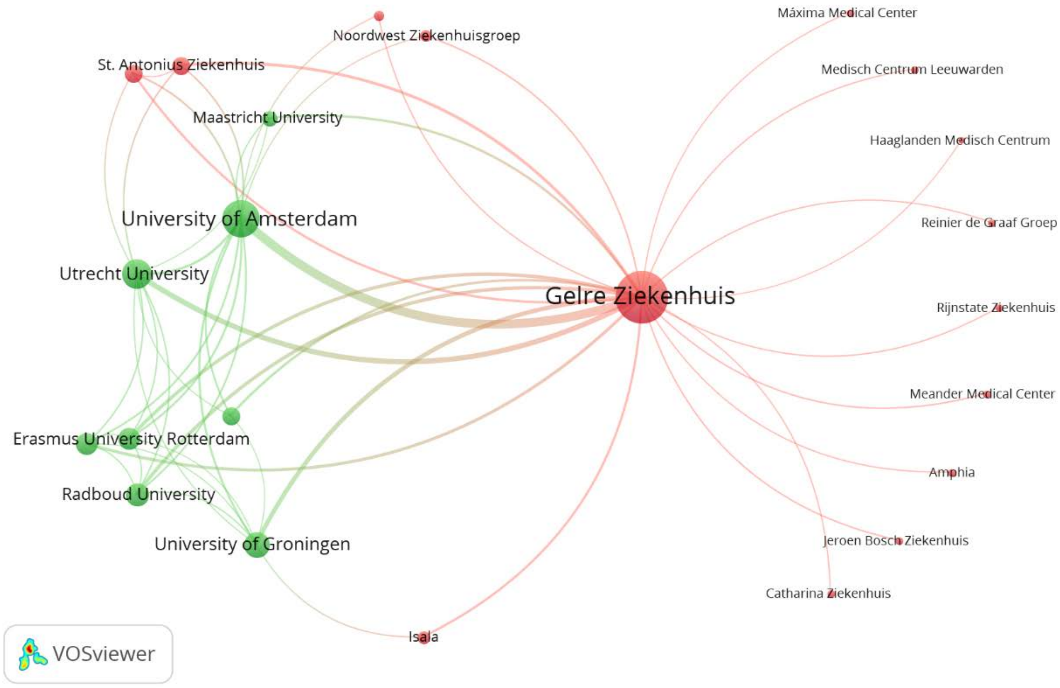
Deventer Ziekenhuis



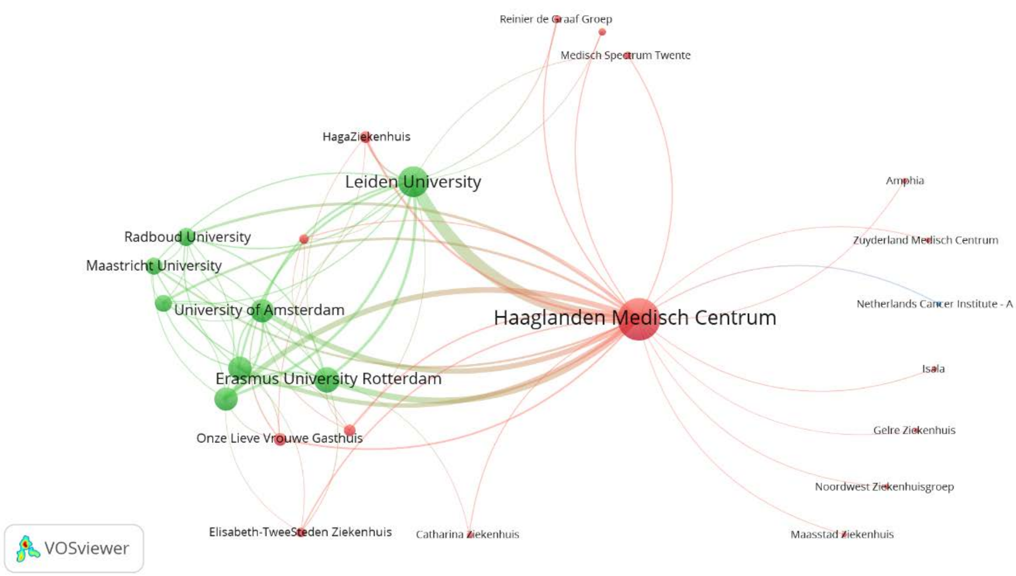
Elisabeth-TweeSteden Ziekenhuis



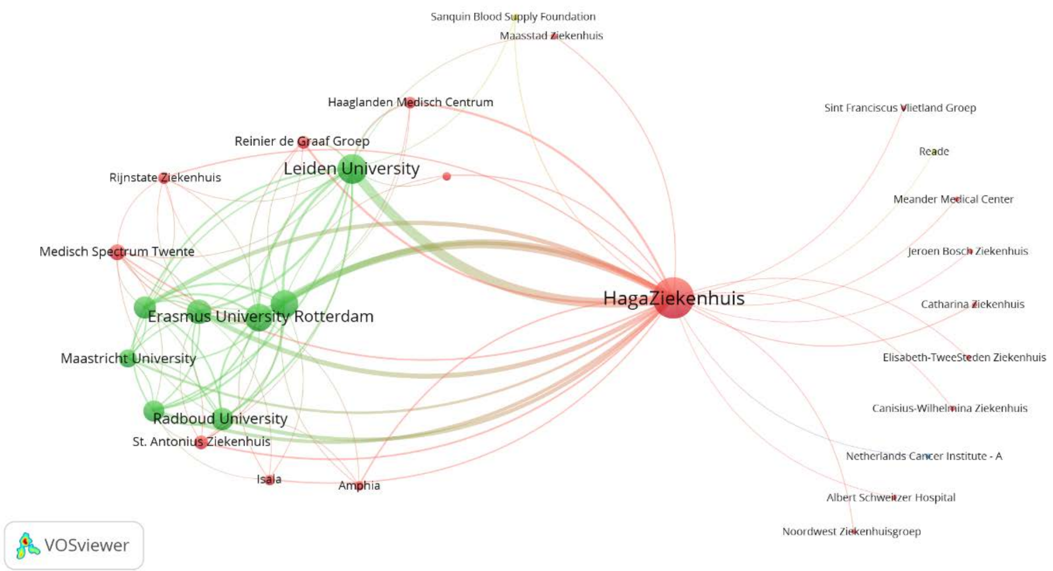
Gelre Ziekenhuis



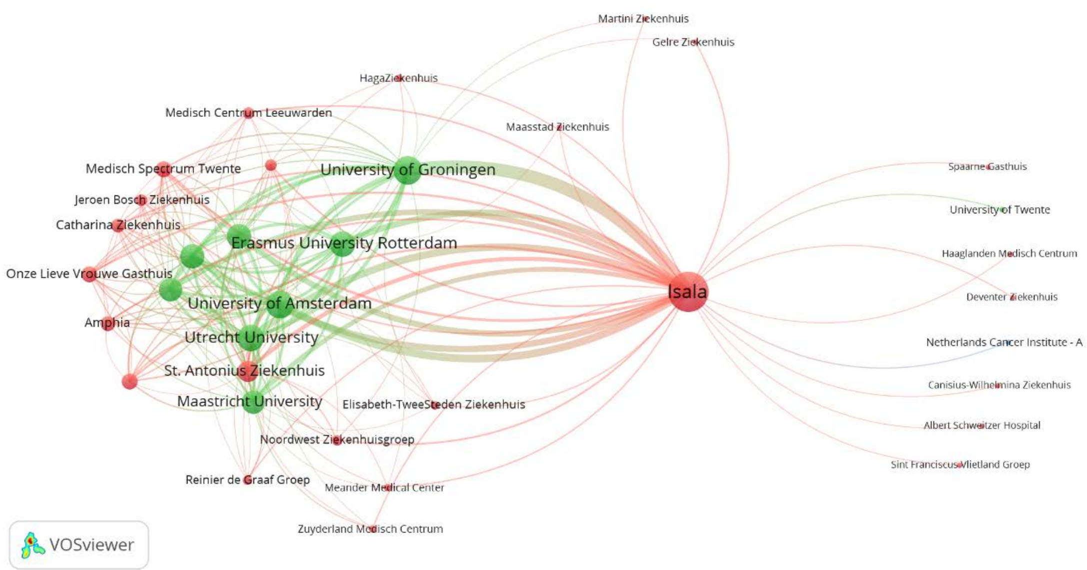
Haaglanden Medisch Centrum



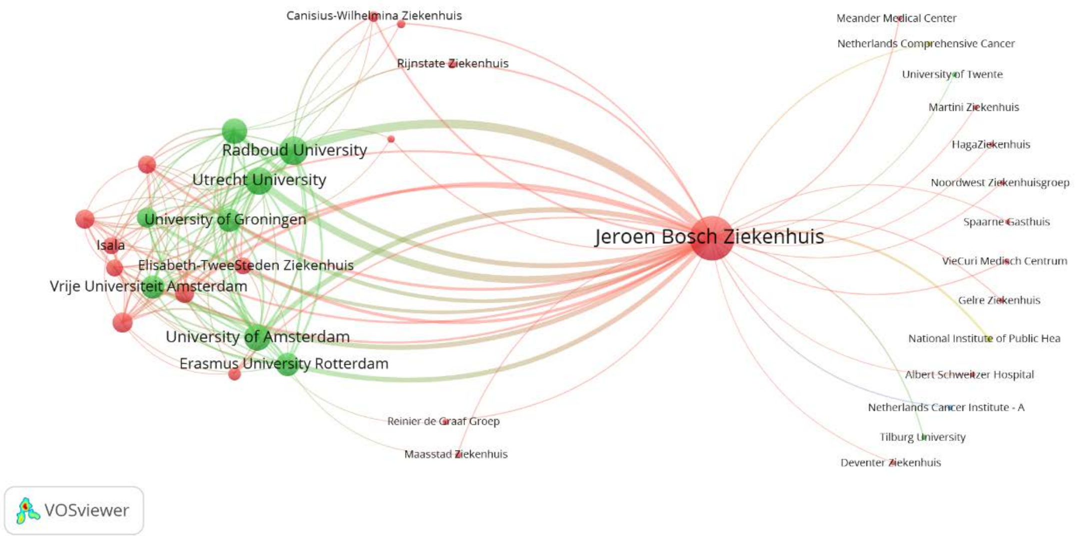
HagaZiekenhuis



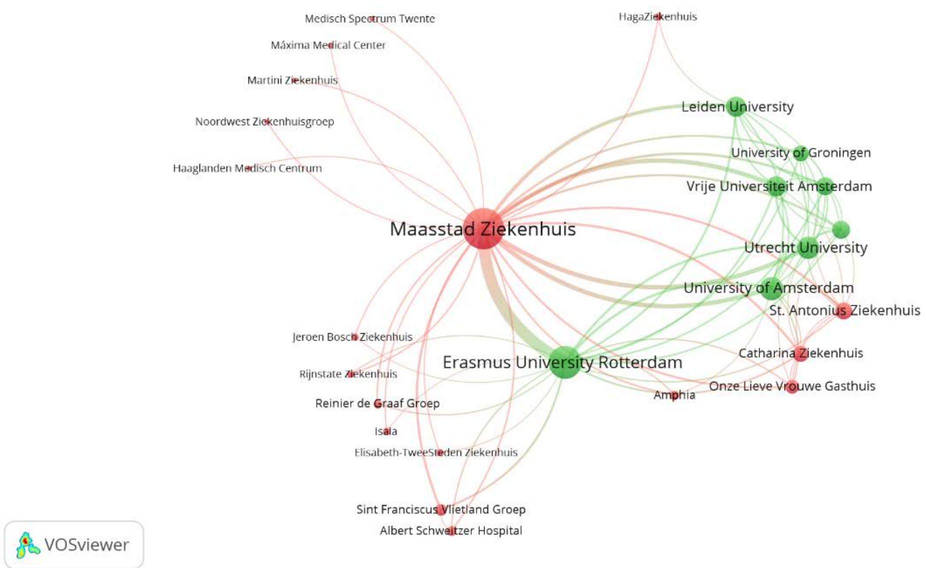
Isala



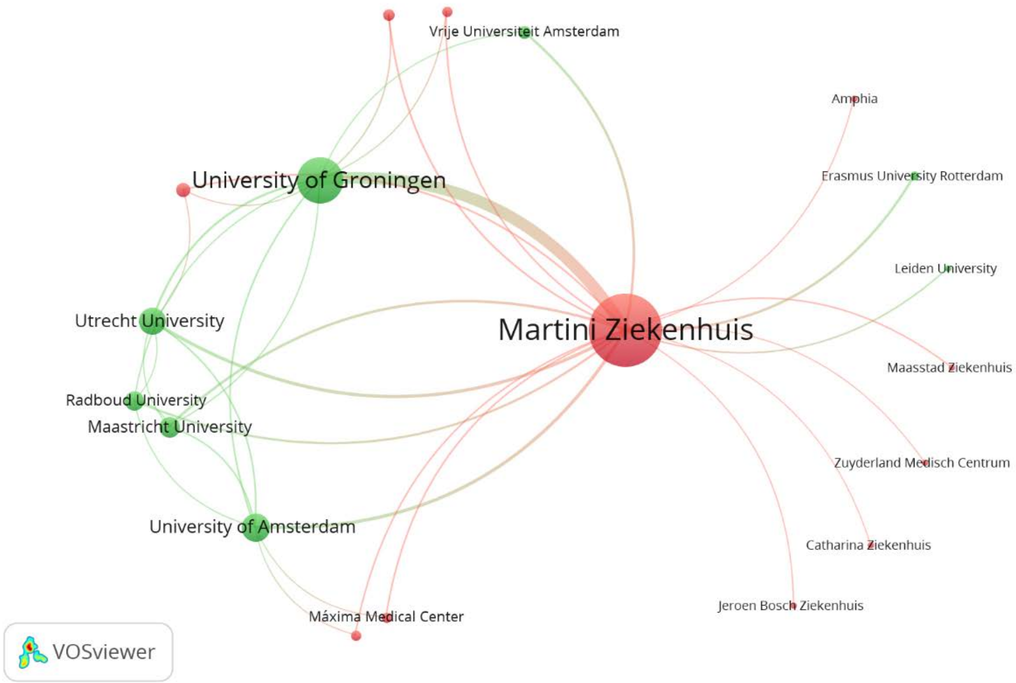
Jeroen Bosch Ziekenhuis



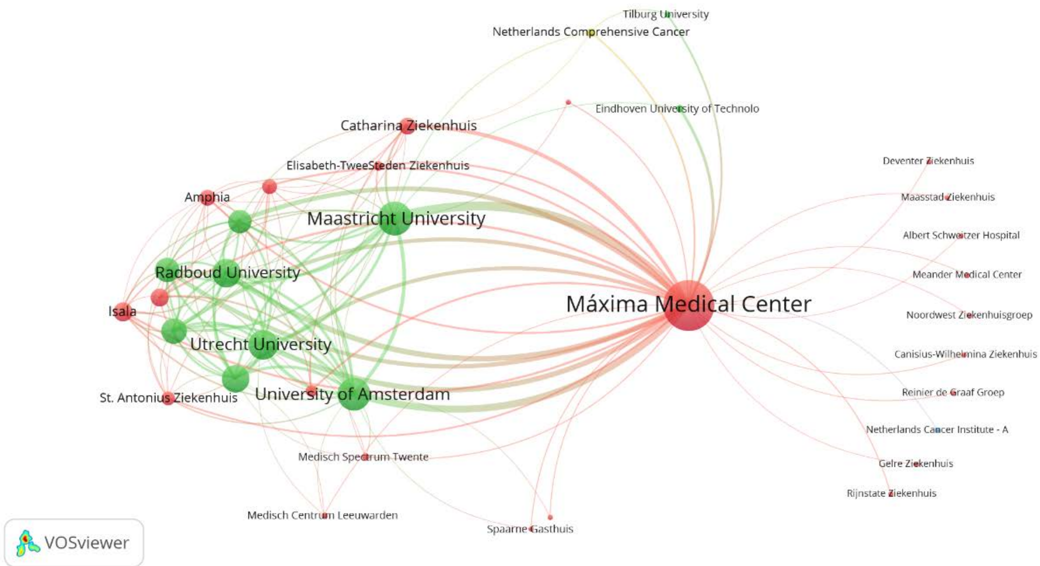
Maasstad Ziekenhuis



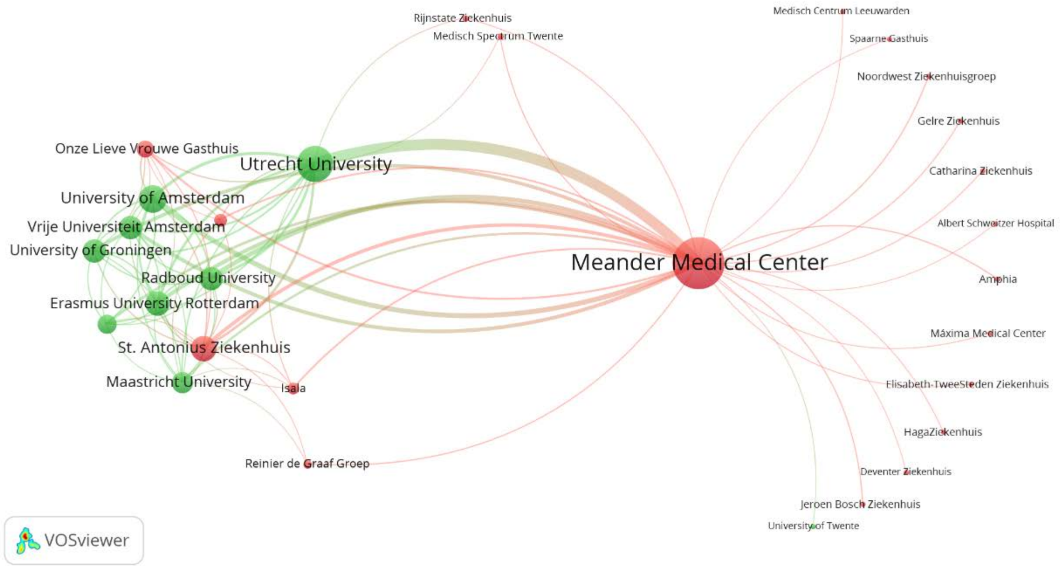
Martini Ziekenhuis



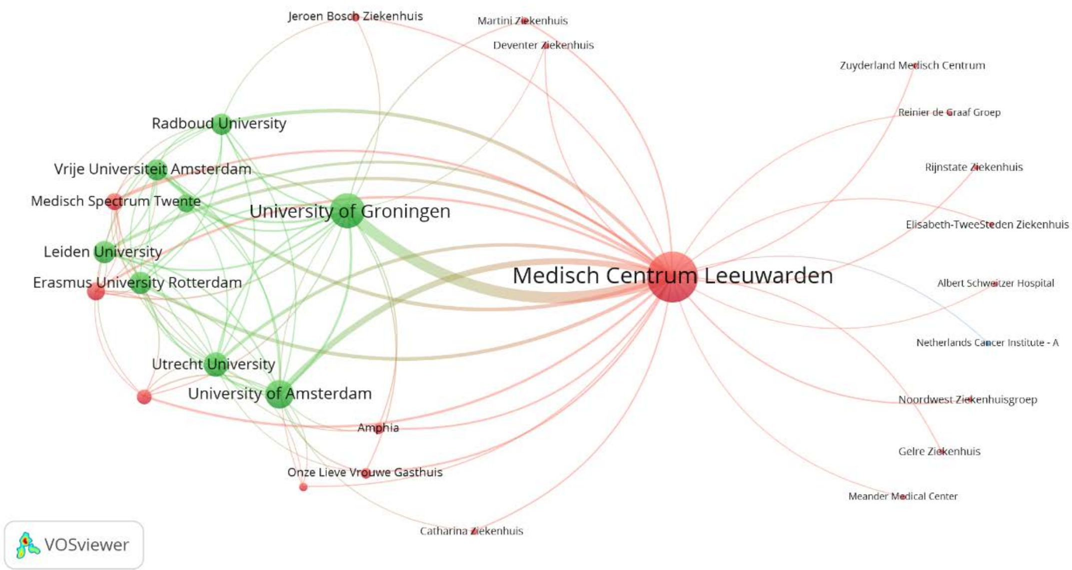
Máxima Medical Center



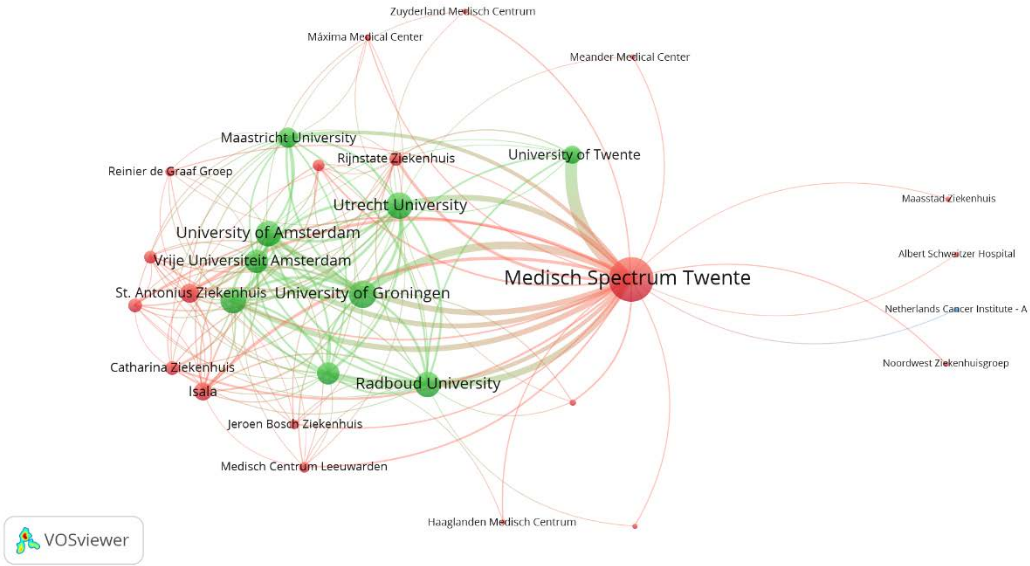
Meander Medical Center



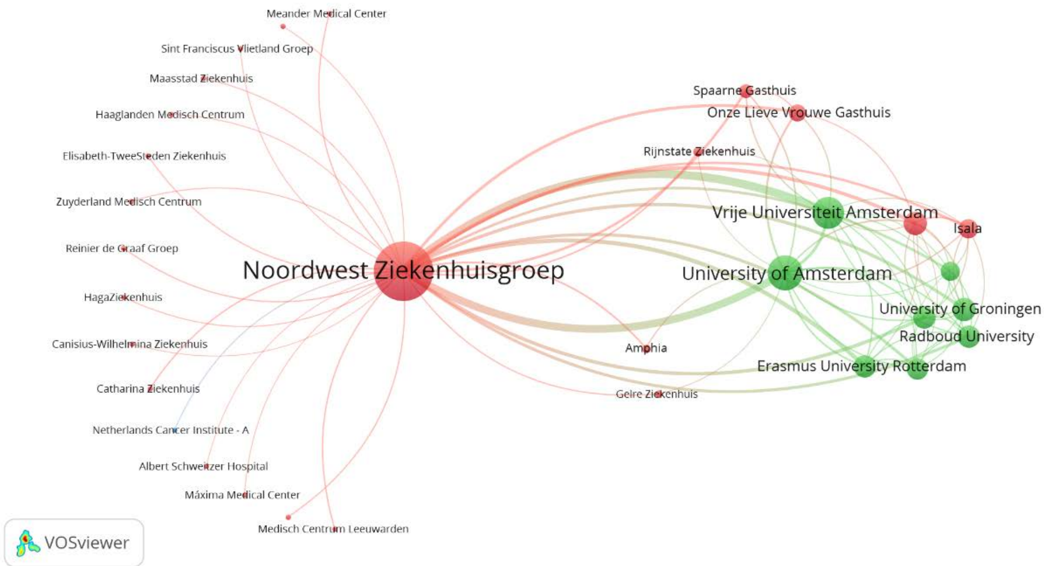
Medisch Centrum Leeuwarden



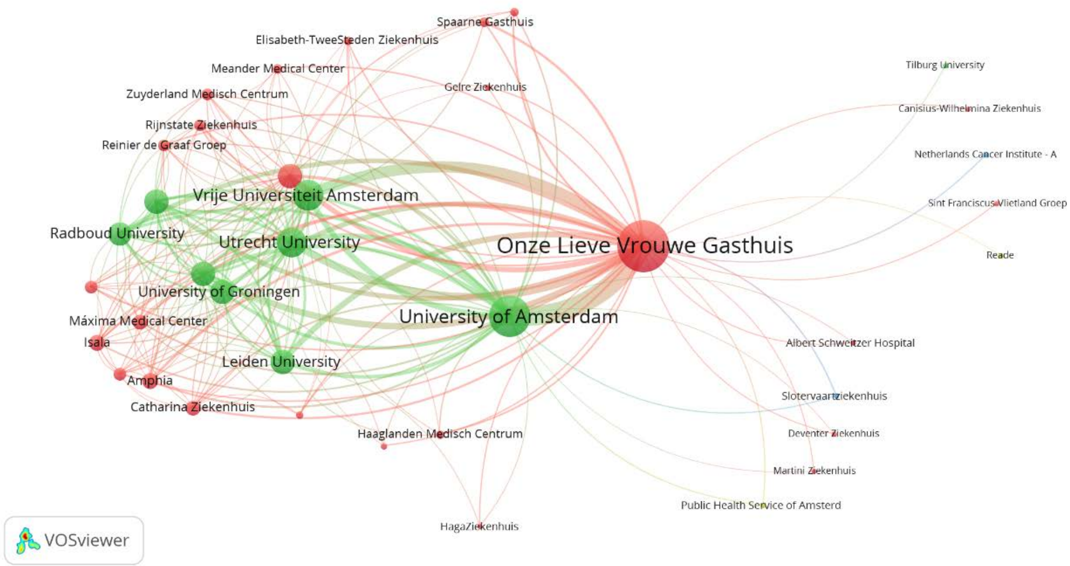
Medisch Spectrum Twente



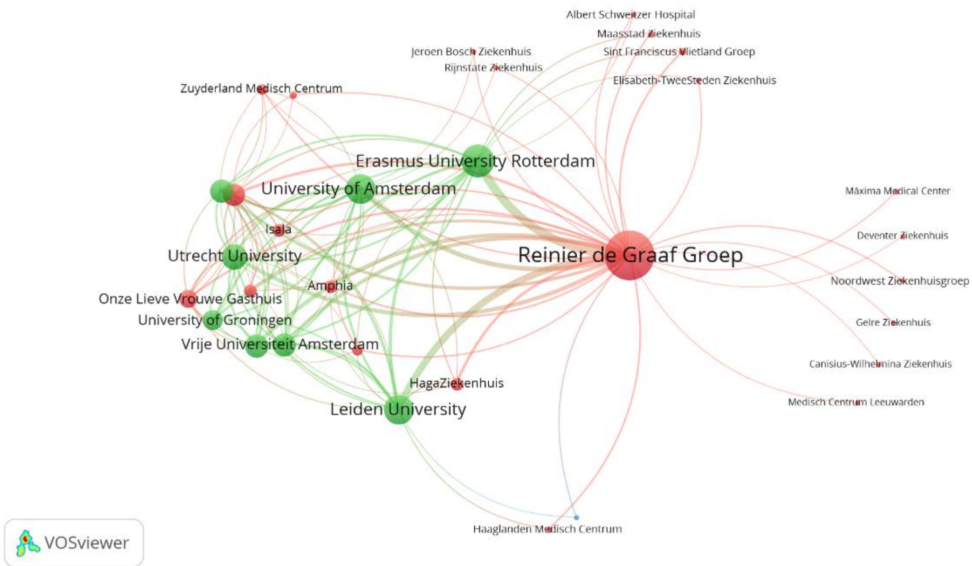
Noordwest Ziekenhuisgroep



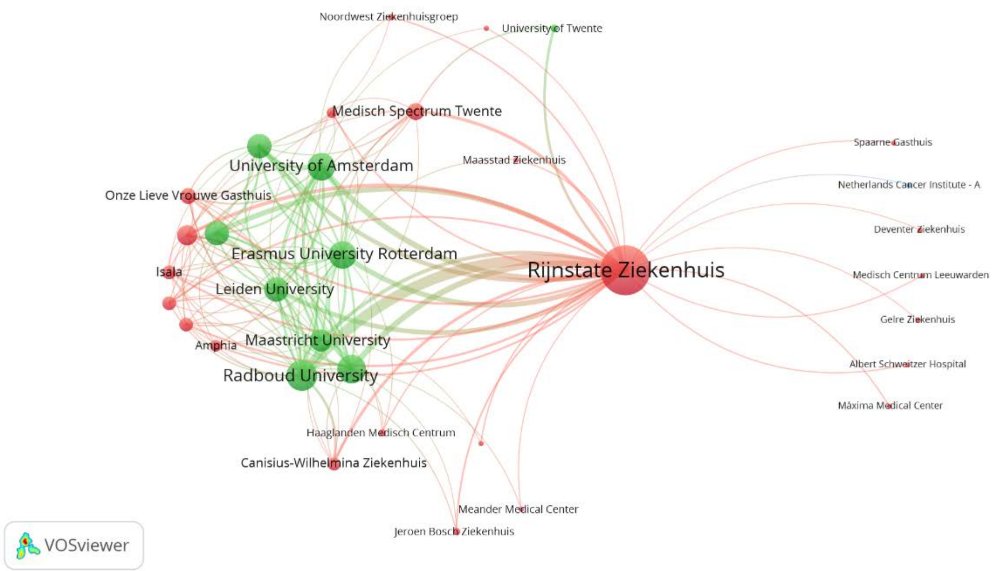
Onze Lieve Vrouwe Gasthuis



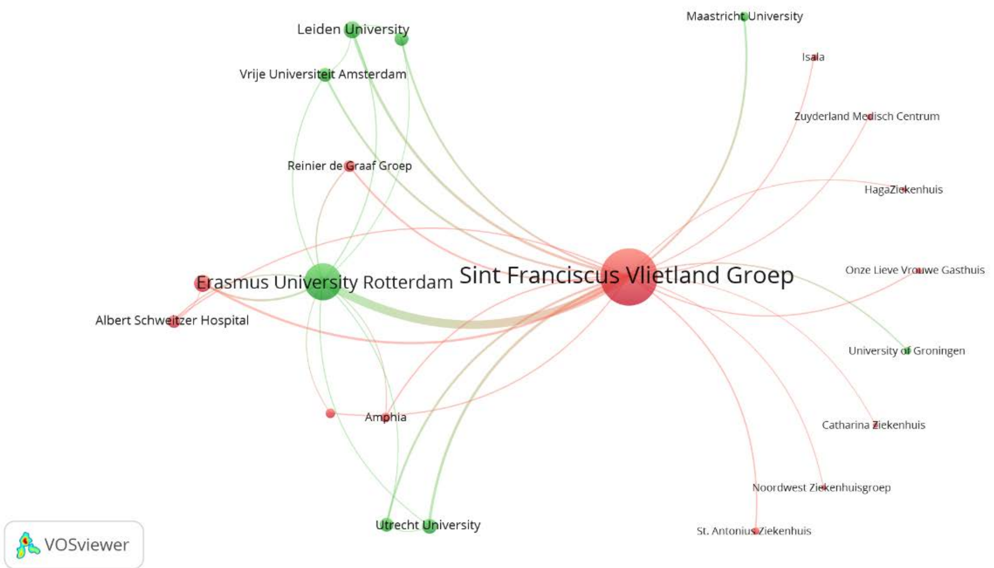
Reinier de Graaf Groep



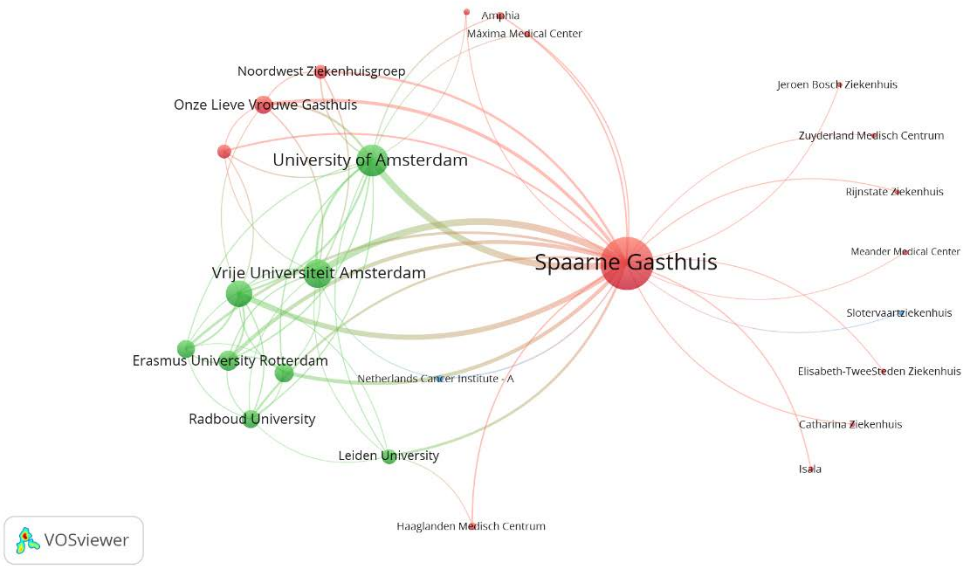
Rijnstate Ziekenhuis



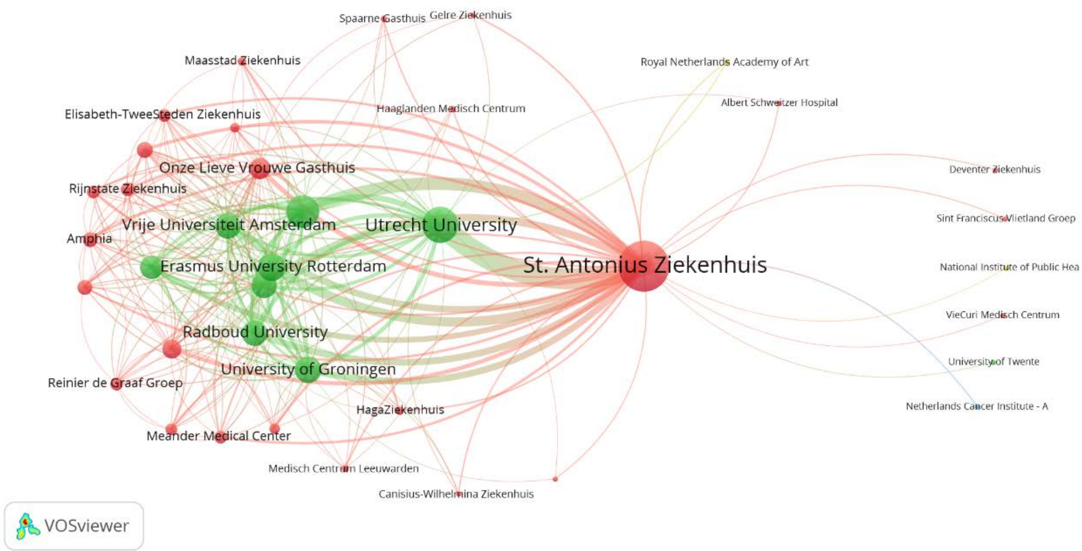
Sint Franciscus Vlietland Groep



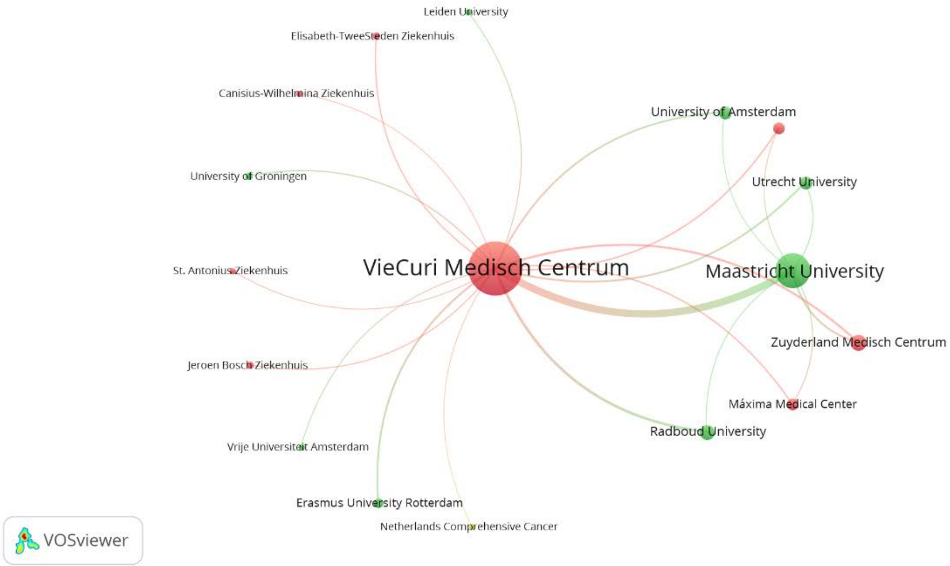
Spaarne Gasthuis



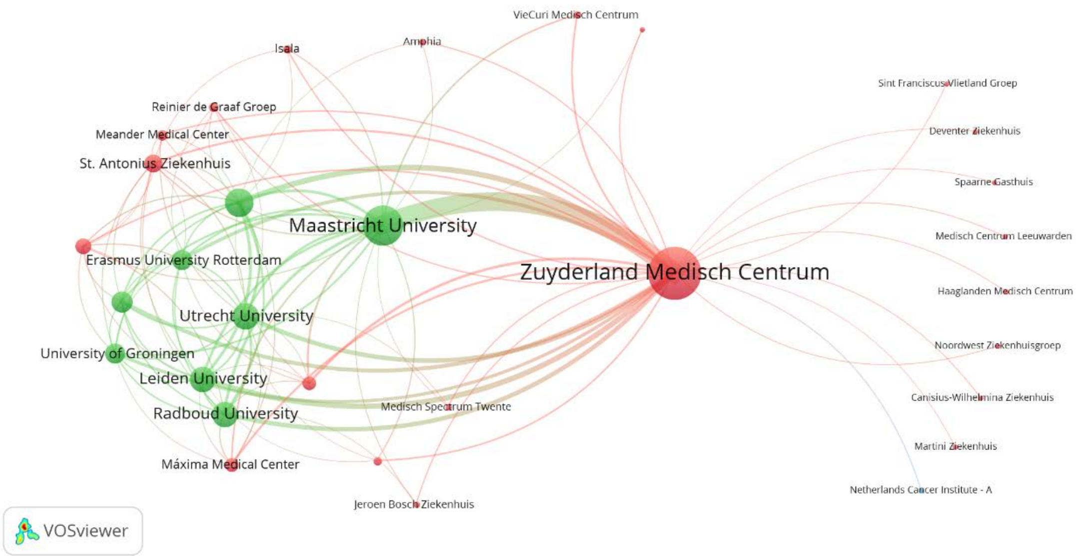
St. Antonius Ziekenhuis



VieCuri Medisch Centrum



Zuyderland Medisch Centrum



Conclusions

The bibliometric performance analysis of the STZ hospitals shows some differences in several areas. While some small differences are noticeable in the total publication output and the collaboration patterns, the realized impact and the extent to which they position themselves in the general landscape of science (field of science) differ substantially.

In the given period (2009-2018), the results of the scientific performance through bibliometric analysis reveal that the output of STZ hospitals as a whole is consequent (P=19,854). This output has on average 19.1 (MCS) citations per publication, the MNCS is 54% higher than world average in the same fields and publication years. STZ's publications appear in journals with an impact value also higher than world average (MNJS = 1.46) and the PP(top 10%) indicator shows that 17% of publications published by all STZ hospitals are among the upper top 10% of most highly cited papers worldwide.

The most important fields for STZ hospitals as a whole are 'Surgery' (MNCS=1.40), 'Cardiac & Cardiovascular Systems (MNCS=1.48) and 'Oncology' (MNCS=1.84) in terms of share of output. It is worth to mention that the field of 'Medicine, General & Internal' stands out in terms of impact (MNCS=4.97).

The collaboration analysis shows that most of CI-system covered publications, articles and reviews, have been produced by all STZ hospitals in national collaboration. It is notable that publications involving international collaboration have a higher impact on average (MNCS=2.31). When looking more specifically to each individual STZ hospital, the same trend occurs. The largest share of publications is produced in national collaboration, followed by international collaboration and only a limited number of publications have no collaboration at all.

At last, the collaboration network analysis allows us to get a better understanding of the collaboration between each STZ hospital and, the collaboration between STZ hospitals and their partners. It seems that STZ hospitals as a whole collaborate intensively with universities.

Relevant literature

Van Eck, N.J., & Waltman, L. (2014). Visualizing bibliometric networks. In Y. Ding, R. Rousseau, & D. Wolfram (Eds.), *Measuring scholarly impact: Methods and practice* (pp. 285-320). Springer. (book chapter, preprint)

Waltman, L., & Van Eck, N.J. (2012). A new methodology for constructing a publication-level classification system of science. Journal of the American Society for Information Science and Technology, 63(12), 2378-2392

Waltman, L., & Van Eck, N.J. (2013). A smart local moving algorithm for large-scale modularity-based community detection. European Physical Journal B, 86(11), 471.

Waltman, L., Calero-Medina, C., Kosten, J., Noyons, E.C.M., Tijssen, R.J.W., Van Eck, N.J., Van Leeuwen, T.N., Van Raan, A.F.J., Visser, M.S., & Wouters, P. (2012). The Leiden Ranking 2011/2012: Data collection, indicators, and interpretation. Journal of the American Society for Information Science and Technology, 63(12), 2419-2432. arXiv:1202.3941.

Annex A: Publication-based classification

The CWTS citation database is a bibliometric version of Web of Science (WoS). One of the special features of this database is the publication-based classification. This classification is an alternative to the WoS journal classification, the WoS subject categories. The reason to have this publication-based classification is the problems we encounter using the journal classification for particular purposes. We discern the following as most prominent ones.

1. *Journal scope (including multi-disciplinary journals)*

A journal classification introduces sets of journals to represents a class, in this case a subject category. This implies that journals have a similar scope. The don't need to be comparable with regard to volume (number of articles per year) but they should represent a similar specialization. This is not the case, of course. Journals represent a very broad spectrum. There a very specialized journals (e.g., *Scientometrics*) and very general ones (e.g., *Nature* or *Science* but also *British Medical Journal*). The classification scheme can therefore not be very specialized. In WoS a subject category Multi-disciplinary hosts the very general ones so that a bibliometric analysis of, for instance, the *Social Sciences* or *Nanotechnology*, using this classification, will not take papers in Nature into consideration.

2. *Granularity of the WoS subject categories*

The WoS journal classification scheme contains 250 elements. As such it is a stable system. In many cases however, it appears that these 250 subject categories are insufficient to be used for proper field analyses. The problem, however, is that the granularity of the system looks somewhat arbitrary. 'Biochemistry & Molecular biology' on the one hand and 'Ornithology' on the other, for instance, represent rather different aggregates of research. This is illustrated by the number of journals in each of them. Where the category 'Biochemistry & Molecular biology' contains almost 500 journals, 'Ornithology' has only 27. We acknowledge that there is no perfect granularity but we argue that in the WoS subject categories the differences are really too big. A classification based on more objective grounds does not solve this problem but at least is transparent.

3. *Multiple assignment of journals to categories*

In journal classifications from multi-disciplinary databases, journals are assigned to more than one category. Journals often have broader scopes than the categories 'allow'. Also, here there are large differences between categories. In the example we used before, 'Biochemistry & Molecular biology,' journals are on average assigned to almost 2 categories. This means that (on average) each journal in this category is also assigned to one other category. For the more specialized category of 'Ornithology' the average is 1. This means that in this category all journals are assigned to this one only. If publications in journals with a multiple assignment would always cover the categories at stake, this should not necessarily be a problem. However, mostly it means that such journals contain structurally publications form the different categories. Therefore, publications may be assigned to two categories although they belong to just one of them.

The CWTS publication-based classification scheme

An advanced alternative for the Web of Science journal classification has been developed at CWTS. It counters three major issues:

1. Journal scope (including multi-disciplinary journals)
2. Granularity of the WoS subject categories
3. Multiple assignment of journals to categories

The CWTS publication based classification is developed as described in Waltman & Van Eck (2012) . Since the first version there have been yearly updates of the system. The main characteristics of the classification are as follows.

Publication to publication citation clustering

Clusters of publications are created on the basis of citations from one publication to another. Almost 20 Millions of publications are processed. The clusters contain publications from multiple years (2000-2016). Each publication is assigned to one cluster only at each level. A cluster is considered and, in many cases, validated as representative for disciplines, research areas, fields or sub-fields. For each cluster, we can calculate growth indices pointing at changing research foci over time.

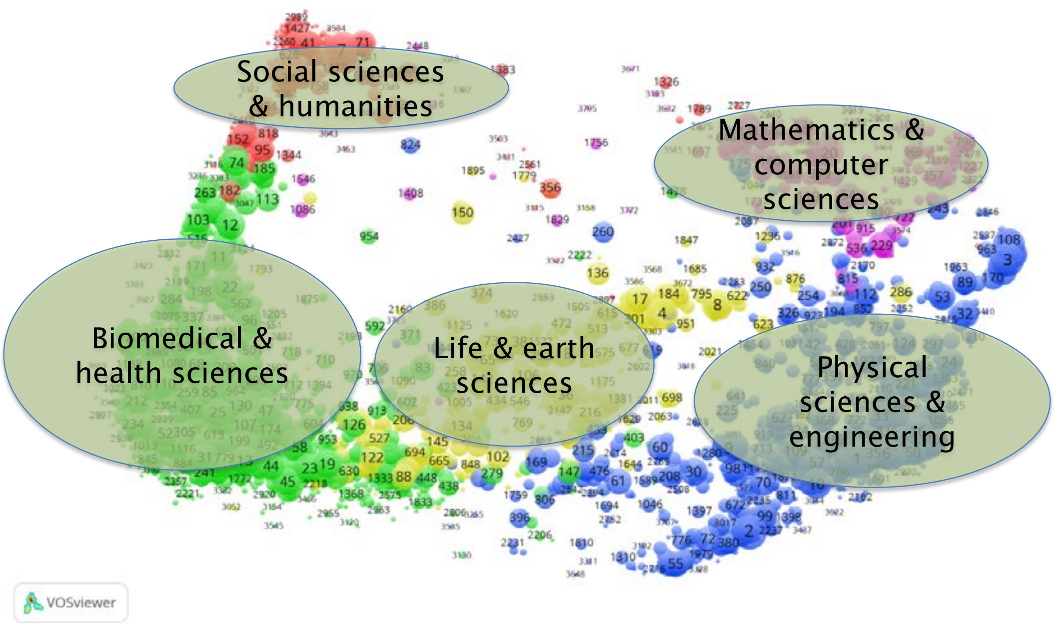
Multi-level clustering

The classification scheme has at present three different levels. The clusters are hierarchically organized. Currently we discern the following levels.

1. A top level of 25 clusters (areas)
2. A second level of 805 clusters (fields)
3. A third level of 4,003 clusters (sub-fields)

Labels

In a 'self-organized' classification scheme like ours, the labeling of clusters is the biggest challenge. As such, our clusters have no name. Still there is sufficient information available for each cluster to characterize them by suggested labels. These suggestions are based on journal categories, journal names, keywords, publication titles and key authors. An impression of our classification scheme is depicted in the VOSviewer map below. In this map the citation relations between the clusters on the second level are used to position the hundreds of clusters in a two-dimensional space. The VOS mapping technique places clusters that have a strong citation traffic in each other vicinity while clusters with a weak relation are distant from each other.



Map of all sciences based on WoS publication classification (805 clusters at intermediate level)

Annex B: Impact indicators over time per STZ Hospitals.

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Albert Schweitzer Hospital	2009-2012	150	1.34	1.29	22%
Albert Schweitzer Hospital	2010-2013	154	1.28	1.19	20%
Albert Schweitzer Hospital	2011-2014	175	1.14	1.13	17%
Albert Schweitzer Hospital	2012-2015	189	1.17	1.14	15%
Albert Schweitzer Hospital	2013-2016	210	1.20	1.28	14%
Albert Schweitzer Hospital	2014-2017	233	1.41	1.48	15%
Albert Schweitzer Hospital	2015-2018	262	1.65	1.71	17%
Amphia	2009-2012	340	1.77	1.91	21%
Amphia	2010-2013	397	1.92	1.95	23%
Amphia	2011-2014	451	1.59	1.58	20%
Amphia	2012-2015	518	1.66	1.64	19%
Amphia	2013-2016	550	1.65	1.64	18%
Amphia	2014-2017	576	1.76	1.67	17%
Amphia	2015-2018	593	2.15	1.94	20%
Canisius-Wilhelmina Ziekenhuis	2009-2012	370	1.68	1.58	18%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Canisius-Wilhelmina Ziekenhuis	2010-2013	419	1.94	1.82	21%
Canisius-Wilhelmina Ziekenhuis	2011-2014	455	1.87	1.69	20%
Canisius-Wilhelmina Ziekenhuis	2012-2015	504	2.15	1.86	22%
Canisius-Wilhelmina Ziekenhuis	2013-2016	540	2.16	1.89	22%
Canisius-Wilhelmina Ziekenhuis	2014-2017	565	2.25	1.68	22%
Canisius-Wilhelmina Ziekenhuis	2015-2018	580	2.24	1.72	21%
Catharina Ziekenhuis	2009-2012	639	1.90	1.78	19%
Catharina Ziekenhuis	2010-2013	728	1.66	1.64	18%
Catharina Ziekenhuis	2011-2014	728	1.57	1.63	17%
Catharina Ziekenhuis	2012-2015	772	1.96	1.95	18%
Catharina Ziekenhuis	2013-2016	806	1.88	1.87	20%
Catharina Ziekenhuis	2014-2017	824	1.88	1.83	19%
Catharina Ziekenhuis	2015-2018	887	1.90	1.87	19%
Deventer Ziekenhuis	2009-2012	140	1.58	1.74	16%
Deventer Ziekenhuis	2010-2013	162	1.61	1.70	20%
Deventer Ziekenhuis	2011-2014	170	1.56	1.65	22%
Deventer Ziekenhuis	2012-2015	167	1.77	1.85	22%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Deventer Ziekenhuis	2013-2016	173	1.84	1.96	23%
Deventer Ziekenhuis	2014-2017	178	1.67	1.90	21%
Deventer Ziekenhuis	2015-2018	199	1.54	1.78	17%
Elisabeth-TweeSteden Ziekenhuis	2009-2012	489	1.52	1.52	19%
Elisabeth-TweeSteden Ziekenhuis	2010-2013	537	1.60	1.52	18%
Elisabeth-TweeSteden Ziekenhuis	2011-2014	562	1.55	1.52	16%
Elisabeth-TweeSteden Ziekenhuis	2012-2015	555	1.78	1.72	15%
Elisabeth-TweeSteden Ziekenhuis	2013-2016	580	1.90	1.75	18%
Elisabeth-TweeSteden Ziekenhuis	2014-2017	577	1.78	1.65	18%
Elisabeth-TweeSteden Ziekenhuis	2015-2018	594	1.94	1.75	19%
Gelre Ziekenhuis	2009-2012	152	1.65	1.53	16%
Gelre Ziekenhuis	2010-2013	166	1.97	1.69	18%
Gelre Ziekenhuis	2011-2014	193	2.01	1.66	18%
Gelre Ziekenhuis	2012-2015	203	2.26	1.79	16%
Gelre Ziekenhuis	2013-2016	227	2.35	2.02	19%
Gelre Ziekenhuis	2014-2017	246	2.00	1.84	18%
Gelre Ziekenhuis	2015-2018	260	2.03	2.04	19%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Haaglanden Medisch Centrum	2009-2012	361	1.54	1.44	18%
Haaglanden Medisch Centrum	2010-2013	382	1.55	1.41	19%
Haaglanden Medisch Centrum	2011-2014	415	1.50	1.37	17%
Haaglanden Medisch Centrum	2012-2015	451	1.77	1.66	15%
Haaglanden Medisch Centrum	2013-2016	500	1.89	1.78	17%
Haaglanden Medisch Centrum	2014-2017	537	1.89	1.77	16%
Haaglanden Medisch Centrum	2015-2018	570	1.91	1.74	18%
HagaZiekenhuis	2009-2012	304	1.73	1.53	22%
HagaZiekenhuis	2010-2013	335	1.94	1.64	22%
HagaZiekenhuis	2011-2014	362	1.81	1.60	21%
HagaZiekenhuis	2012-2015	376	2.05	1.79	20%
HagaZiekenhuis	2013-2016	432	1.98	1.79	20%
HagaZiekenhuis	2014-2017	468	1.74	1.67	18%
HagaZiekenhuis	2015-2018	514	1.74	1.68	19%
Isala	2009-2012	531	1.46	1.46	19%
Isala	2010-2013	577	1.52	1.52	19%
Isala	2011-2014	587	1.50	1.48	17%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Isala	2012-2015	642	1.82	1.70	17%
Isala	2013-2016	709	1.79	1.74	15%
Isala	2014-2017	733	1.73	1.68	16%
Isala	2015-2018	778	1.95	1.87	17%
Jeroen Bosch Ziekenhuis	2009-2012	325	1.78	1.76	21%
Jeroen Bosch Ziekenhuis	2010-2013	347	1.50	1.48	19%
Jeroen Bosch Ziekenhuis	2011-2014	368	1.28	1.30	17%
Jeroen Bosch Ziekenhuis	2012-2015	359	1.48	1.42	18%
Jeroen Bosch Ziekenhuis	2013-2016	349	1.77	1.59	20%
Jeroen Bosch Ziekenhuis	2014-2017	370	1.73	1.51	20%
Jeroen Bosch Ziekenhuis	2015-2018	402	1.73	1.66	18%
Maasstad Ziekenhuis	2009-2012	239	2.01	1.81	21%
Maasstad Ziekenhuis	2010-2013	260	1.93	1.82	21%
Maasstad Ziekenhuis	2011-2014	291	1.69	1.62	21%
Maasstad Ziekenhuis	2012-2015	279	1.80	1.77	21%
Maasstad Ziekenhuis	2013-2016	297	1.67	1.76	20%
Maasstad Ziekenhuis	2014-2017	337	1.76	1.70	20%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Maasstad Ziekenhuis	2015-2018	370	1.94	1.88	21%
Martini Ziekenhuis	2009-2012	155	1.17	1.34	14%
Martini Ziekenhuis	2010-2013	169	1.11	1.32	13%
Martini Ziekenhuis	2011-2014	190	1.04	1.23	12%
Martini Ziekenhuis	2012-2015	214	1.26	1.46	12%
Martini Ziekenhuis	2013-2016	242	1.45	1.64	14%
Martini Ziekenhuis	2014-2017	252	1.44	1.62	14%
Martini Ziekenhuis	2015-2018	256	1.73	1.85	16%
Meander Medical Center	2009-2012	256	1.48	1.53	16%
Meander Medical Center	2010-2013	266	2.01	1.65	16%
Meander Medical Center	2011-2014	265	1.89	1.55	15%
Meander Medical Center	2012-2015	280	2.45	1.95	15%
Meander Medical Center	2013-2016	304	2.58	2.15	19%
Meander Medical Center	2014-2017	337	2.16	2.10	20%
Meander Medical Center	2015-2018	372	2.28	2.26	21%
Medisch Centrum Leeuwarden	2009-2012	214	1.47	1.55	17%
Medisch Centrum Leeuwarden	2010-2013	230	1.90	1.72	20%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Medisch Centrum Leeuwarden	2011-2014	242	1.72	1.53	19%
Medisch Centrum Leeuwarden	2012-2015	272	1.68	1.52	18%
Medisch Centrum Leeuwarden	2013-2016	313	1.81	1.61	20%
Medisch Centrum Leeuwarden	2014-2017	379	1.59	1.58	17%
Medisch Centrum Leeuwarden	2015-2018	443	1.68	1.64	18%
Medisch Spectrum Twente	2009-2012	362	1.55	1.59	16%
Medisch Spectrum Twente	2010-2013	415	1.59	1.58	19%
Medisch Spectrum Twente	2011-2014	469	1.45	1.40	18%
Medisch Spectrum Twente	2012-2015	508	1.63	1.49	19%
Medisch Spectrum Twente	2013-2016	544	1.75	1.60	20%
Medisch Spectrum Twente	2014-2017	561	1.78	1.64	20%
Medisch Spectrum Twente	2015-2018	562	1.91	1.82	21%
Máxima Medical Center	2009-2012	363	1.39	1.43	15%
Máxima Medical Center	2010-2013	390	1.39	1.48	17%
Máxima Medical Center	2011-2014	396	1.30	1.38	17%
Máxima Medical Center	2012-2015	423	1.43	1.55	17%
Máxima Medical Center	2013-2016	427	1.37	1.48	17%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Máxima Medical Center	2014-2017	487	1.34	1.47	15%
Máxima Medical Center	2015-2018	547	1.45	1.56	16%
Noordwest Ziekenhuisgroep	2009-2012	267	1.80	1.76	21%
Noordwest Ziekenhuisgroep	2010-2013	316	1.92	1.90	21%
Noordwest Ziekenhuisgroep	2011-2014	344	1.72	1.74	19%
Noordwest Ziekenhuisgroep	2012-2015	364	2.09	1.98	19%
Noordwest Ziekenhuisgroep	2013-2016	391	2.14	2.00	18%
Noordwest Ziekenhuisgroep	2014-2017	389	2.42	1.98	20%
Noordwest Ziekenhuisgroep	2015-2018	407	2.50	2.17	20%
Onze Lieve Vrouwe Gasthuis	2009-2012	584	1.78	1.69	18%
Onze Lieve Vrouwe Gasthuis	2010-2013	645	1.82	1.77	20%
Onze Lieve Vrouwe Gasthuis	2011-2014	739	1.66	1.65	18%
Onze Lieve Vrouwe Gasthuis	2012-2015	797	1.90	1.79	18%
Onze Lieve Vrouwe Gasthuis	2013-2016	852	1.93	1.79	19%
Onze Lieve Vrouwe Gasthuis	2014-2017	920	1.90	1.78	19%
Onze Lieve Vrouwe Gasthuis	2015-2018	976	2.04	1.94	22%
Reinier de Graaf Groep	2009-2012	224	1.53	1.41	17%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Reinier de Graaf Groep	2010-2013	254	1.75	1.61	20%
Reinier de Graaf Groep	2011-2014	284	1.69	1.55	19%
Reinier de Graaf Groep	2012-2015	303	2.55	2.24	21%
Reinier de Graaf Groep	2013-2016	323	2.61	2.29	21%
Reinier de Graaf Groep	2014-2017	328	2.35	2.09	18%
Reinier de Graaf Groep	2015-2018	336	2.64	2.36	20%
Rijnstate Ziekenhuis	2009-2012	321	1.95	1.80	21%
Rijnstate Ziekenhuis	2010-2013	361	1.89	1.82	21%
Rijnstate Ziekenhuis	2011-2014	393	2.00	1.78	21%
Rijnstate Ziekenhuis	2012-2015	425	2.30	2.08	21%
Rijnstate Ziekenhuis	2013-2016	473	2.05	1.87	21%
Rijnstate Ziekenhuis	2014-2017	507	1.93	1.79	20%
Rijnstate Ziekenhuis	2015-2018	556	1.87	1.89	19%
Sint Franciscus Vlietland Groep	2009-2012	155	1.36	1.34	17%
Sint Franciscus Vlietland Groep	2010-2013	179	1.65	1.58	16%
Sint Franciscus Vlietland Groep	2011-2014	203	1.46	1.51	13%
Sint Franciscus Vlietland Groep	2012-2015	228	2.23	2.06	17%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
Sint Franciscus Vlietland Groep	2013-2016	241	2.30	2.11	17%
Sint Franciscus Vlietland Groep	2014-2017	270	1.95	1.93	16%
Sint Franciscus Vlietland Groep	2015-2018	277	2.32	2.32	20%
Spaarne Gasthuis	2009-2012	263	1.89	1.81	23%
Spaarne Gasthuis	2010-2013	294	1.78	1.68	24%
Spaarne Gasthuis	2011-2014	333	1.63	1.55	23%
Spaarne Gasthuis	2012-2015	355	1.91	1.92	22%
Spaarne Gasthuis	2013-2016	356	1.87	1.95	20%
Spaarne Gasthuis	2014-2017	359	1.85	1.94	19%
Spaarne Gasthuis	2015-2018	330	2.03	2.07	18%
St. Antonius Ziekenhuis	2009-2012	856	1.63	1.60	18%
St. Antonius Ziekenhuis	2010-2013	926	1.80	1.66	19%
St. Antonius Ziekenhuis	2011-2014	956	1.73	1.55	19%
St. Antonius Ziekenhuis	2012-2015	955	2.00	1.76	19%
St. Antonius Ziekenhuis	2013-2016	1,039	2.01	1.77	21%
St. Antonius Ziekenhuis	2014-2017	1,130	1.88	1.70	21%
St. Antonius Ziekenhuis	2015-2018	1,196	2.06	1.96	21%

STZ Hospital	Period	p	mncs	mnjs	PP(top 10%)
VieCuri Medisch Centrum	2009-2012	111	1.23	1.41	14%
VieCuri Medisch Centrum	2010-2013	129	1.31	1.61	17%
VieCuri Medisch Centrum	2011-2014	157	1.26	1.50	13%
VieCuri Medisch Centrum	2012-2015	188	1.35	1.40	15%
VieCuri Medisch Centrum	2013-2016	214	1.37	1.40	16%
VieCuri Medisch Centrum	2014-2017	261	1.94	1.58	16%
VieCuri Medisch Centrum	2015-2018	276	2.07	1.85	17%
Zuyderland Medisch Centrum	2009-2012	431	1.32	1.30	16%
Zuyderland Medisch Centrum	2010-2013	453	1.37	1.30	16%
Zuyderland Medisch Centrum	2011-2014	514	1.54	1.34	17%
Zuyderland Medisch Centrum	2012-2015	567	2.06	1.73	18%
Zuyderland Medisch Centrum	2013-2016	633	2.17	1.87	17%
Zuyderland Medisch Centrum	2014-2017	705	2.24	1.81	18%
Zuyderland Medisch Centrum	2015-2018	745	2.17	1.82	18%

Annex C: Full research profile STZ hospitals (2009-2018)

It can be found in a separate excel file due to the size of the table.