Georgia Clinical & Translational Science Alliance (Georgia CTSA) 2017 Publication Content Evaluation

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Executive Summary

The purpose of this evaluation report is to provide a qualitative and quantitative summary of the content of Georgia CTSA (formerly ACTSI) -supported publications from 2007-2017. Several complementary approaches were utilized to assess the diversity and impact of research areas represented, and how this diversity and impact has evolved over 10 years. This report will aid in characterizing Georgia CTSA's contributions to clinical and translational science and identify content areas of strength and growth, informing strategic management of Georgia CTSA resources.

Method

In May 2017, at the close of ten years and two grant cycles of Georgia CTSA's operations, all Georgia CTSA grant-citing publications were queried from PubMed, and information on research areas and citation impact for those publications was drawn from Web of Science (WoS). Thus far, 2,157 Georgia CTSA-supported articles have been published in 812 journals, ranging across 109 WoS Research Areas. In order to more concisely describe content and ease interpretability, the 109 granular research areas designated by WoS were analyzed for conceptual and functional overlap and merged into 34 Collapsed Research Areas (Appendix 1).

After identifying all Georgia CTSA-supported publications, analyses proceeded in two parts: Part 1 summarizes the *cumulative standing* of Georgia CTSA's publication portfolio after 10 years, including the cumulative research area distribution, inter-disciplinary structure, and rankings and impact by Collapsed Research Area. Part 2 illustrates the *long-term development* of Georgia CTSA's cumulative publication portfolio, retrospectively, including ranking shifts among the most prevalent research areas, and growth of the inter-disciplinary network over time.

Results of Part 1: Defining the Content of Georgia CTSA-Supported Publications

1.1) Frequency and heterogeneity results reveal that Georgia CTSA's publication portfolio is exceptionally varied and diverse with respect to research area distribution (see Figure 1) indicating that Georgia CTSA is achieving the goal of providing unbiased, disease-agnostic support to research fostering a wide and fairly even range of findings.

1.2) Analysis of co-disciplinarity within all publications (which were each designated up to 6 different research areas) reveals a dense interdisciplinary network (see Figure 2). Research content areas are linked to an average of 10 other areas through the Georgia CTSA-supported publication set; links are represented by an average of 6 publications. Areas with the most links to other areas include *Biochemistry, Molecular & Cell Biology, Pediatrics,* and *Neuroscience & Behavioral Sciences.* Areas that are most frequently linked in publications include *Immunology & Allergy* with *Infections Disease & Virology,* and *Neuroscience & Behavioral Sciences* with *Psychology & Psychiatry*. Results indicate that Georgia CTSA is successful in supporting research that bridges a wide breadth of disciplines and audiences.

1.3) Ranking all Collapsed Research Areas in Georgia CTSA's publication portfolio by prevalence shows that the most prevalent areas are *Immunology & Allergy, Cardiovascular & Peripheral Vascular Systems,* and *Infectious Disease & Virology*.

Areas with the most citations include *Immunology & Allergy*, *Psychology & Psychiatry*, and *Neuroscience & Behavioral Sciences*. Top Category Normalized Citation Impact scores for *Pediatrics*, *General/Internal Medicine & Primary Care*, and *Immunology & Allergy* signify exceptional citation influence relative to their fields. Although some areas stand apart across various indicators of impact, it is evident that *many* content areas supported by Georgia CTSA display impressive levels of productivity, impact and inter-disciplinarity (see Table 1).

Results of Part 2: Charting the Development of Georgia CTSA's Publication Portfolio over Time

2.1) Long-term publication trends show that top areas are consistently highly-ranked in their prevalence, but there have been shifts over the years (see Figure 3). Initially, articles designated as *Psychology & Psychiatry* were the most highly represented among Georgia CTSA's publications. Although there have been fewer articles published in this area in recent years, it retains an early lead in citation accumulation and a legacy of cumulative citation influence. In recent years, articles covering *Immunology & Allergy* and *Infectious Disease & Virology* have increased, overtaking the lead in cumulative rankings and promising growth in influence in the future. Articles covering *Public & Environmental Health* and *Endocrinology & Metabolism* have been published at consistently high rates across all years, suggesting a pattern that is likely to continue.

2.2) Network indices drawn cumulatively over time reveal a pattern of increasing co-disciplinarity with ceiling effects emerging (see Table 2). The number of research areas represented in Georgia CTSA's portfolio rose and levelled off quickly, covering all 34 Collapsed Research Areas after the first few years. The number of co-disciplinary links also rose quickly and is gradually leveling-off. Although new inter-disciplinary links are now rare, existing links continue to be reinforced with new publications. The network density, or proportion of possible connections that have been made, rose as the number of links per discipline increased, but is also now plateauing.

Conclusion

In sum, the findings of this evaluation indicate that Georgia CTSA's publication portfolio spans across diverse inter-connected health science research areas. Results shed light on the areas of greatest impact in terms of content addressed, audiences reached, citation impact, and inter-disciplinarity. Results also show that differences among top areas have been modest: rather than being especially concentrated in a few subjects, Georgia CTSA-supported research has been encouragingly productive and impactful across many areas.

Network analyses indicate that inter-connectedness among research areas has grown and levelled-off over 10 years, with Georgia CTSA's publications having covered most relevant health/science fields by this point. Few new content areas and links between them remain to be added, but existing links continue to be renewed, suggesting robust and repeated collaboration across fields. New collaborations in new research areas are now needed to achieve growth in content coverage as the former ACTSI transitions to become the Georgia CTSA.

Introduction

The Evaluation & Continuous Improvement arm of the Georgia Clinical & Translational Science Alliance Institute (Georgia CTSA) serves to chart the progress, identify challenges, and support strategic development for the organization. A specific aim of the Tracking & Evaluation program is to assess the impact of Georgia CTSA on local, regional, and national clinical and translational science. One way of characterizing research impact is by evaluating bibliometrics, or the publication output supported by the institution's resources. Bibliometrics describe a pivotal early stage in the translational process of bringing new scientific discoveries into clinical use.

Thus far, information on Georgia CTSA's overall publication output and citation impact have been reported (Llewellyn & Nehl, 2017; Llewellyn, Carter, Rollins, & Nehl, 2018). This evaluation seeks expand on that research by characterizing the research content of those publications, shedding light on research areas of strength, growth and relative influence. We employ several innovative methodologies, including longitudinal perspectives, to inform our understanding of the scope and range of Georgia CTSA-supported research output from 2007 through 2017. The results of this report will aid in characterizing Georgia CTSA's contributions to clinical and translational science, identifying content areas of strength and growth and informing strategic management of resources as Georgia CTSA transforms to its new role as the Georgia CTSA.

This evaluation was carried out in two complementary parts:

Part 1: Defining the Content of Georgia CTSA-Supported Publications

The aim of Part 1 is to comprehensively define the content of all Georgia CTSA-supported publications at the end of 10 years of operations. Identifying the predominant subjects addressed by Georgia CTSA-supported research, as well as the balance of subjects in the publication portfolio, is key to assessing the extent to which Georgia CTSA is providing evenhanded support to impactful research endeavors. In addition, examining the intersecting research areas designated to the same articles illuminates the degree to which Georgia CTSA is reaching the goal of supporting collaborative, inter-disciplinary research.

Result of Part 1 will first describe the overall, cumulative distribution of research content areas and elucidate the level of heterogeneity and diversity in the publication set. Second, results will elaborate on the inter-disciplinary structure of the publication portfolio, or the relationships between content areas, by examining the co-occurrences of research areas designated within the same publications. Third, results will shed light on the relative impact of all research areas represented by Georgia CTSA's research using several article- and journal-level impact indices to triangulate overall influence.

Part 2: Charting the Development of Georgia CTSA's Publication Portfolio over Time

The aim of Part 2 is to chart the changes in and development of Georgia CTSA's publication portfolio year by year. Given the significant time span available for study, assessing the trajectories of bibliometric indicators among Georgia CTSA-supported publications provides valuable insight about the direction of publication productivity and growth. By understanding

how this publication set was built we can extrapolate the extent to which goals for the future are currently on track.

Longitudinal results in Part 2 will first describe shifts in in predominance of the top-ranked research content areas across the years. Second, longitudinal network analyses will illustrate the pattern of growth in interdisciplinarity over time. Together with Part 1, these analyses explain where we are and how we have arrived here, with regard to Georgia CTSA's publication record.

In sum, this evaluation is intended to describe the research areas in which Georgia CTSA-supported research has had the greatest bibliometric impact, how they are inter-connected, and how this has changed and evolved since Georgia CTSA was established.

Methodology

Data Collection

Publication data was collected in May 2017, at the close of ten years and two grant cycles of Georgia CTSA's operations. First, a PubMed (https://www.ncbi.nlm.nih.gov/pubmed/) query was carried out using all past and present Georgia CTSA-specific NIH grant project numbers (UL1 TR000454, UL1 RR025008, KL2 TR000455, KL2 RR025009, TL1 TR000456, TL1 RR025010), as well as their common variants. This generated an approximate list of all Georgia CTSA-supported publications indexed in the U.S. National Library of Medicine's MEDLINE database (Medical Literature Analysis and Retrieval System Online; https://www.nlm.nih.gov/bsd/pmresources.html) to date. The list showed high overlap (approximately 90%) with publications identified by internal records (RAPID database) as being attributable to Georgia CTSA, with some expected discrepancies due to new publications not yet alerted to Georgia CTSA and old publications that did not correctly cite an Georgia CTSA grant. The final PubMed list included 2,157 publications, including ePubs ahead of print; 2,028 (94%) of those publications were publically available at that time as full-text articles indexed in PubMed Central.

A list of the PubMed IDs (PMIDs) was exported and used to create a Web of Science (WoS; https://webofknowledge.com/) advanced search query (by inserting the word 'or' between each PMID in Excel). Using the search syntax 'PMID=(all PMIDs separated by or),' 1,922 indexed publications were found in WoS. The missing 235 PMIDs (11%) were examined and found to most often not appear in WoS because they were too recently published (such as ePubs) or were from newer or less common journals that are not indexed by WoS. In order to retrieve content and citation information, the list of 1,922 articles was exported to WoS's InCites application (https://incites.thomsonreuters.com/). Of the original 2,157 PMIDs, 1,885 (87.39%) publications were indexed in InCites on that date. Some of this attrition is due to recent publications not yet cited and not yet indexed in InCites, which is updated quarterly. In order to export the data at the article level, 'Entity Type = Region' was selected, and WoS documents listed under 'Region = OECD Totals' were exported to a spreadsheet. This yielded a dataset that included: PMID, reference information, WoS Research Area, number of times cited (as of that date), the Category

Normalized Citation Impact (CNCI), the Journal Impact Factor (JIF) and JIF rank percentile (Thomson Reuters, 2014).

The WoS Research Area scheme is the narrowest categorization of research content available from Incites, offering the most granular information on content area. Using such specific subareas allows for the most appropriate comparisons of articles to one another based upon shared classification. The WoS Research Area scheme includes 252 subject categories across science, social science, arts and humanities; not all research areas are expected to be applicable to Georgia CTSA-supported research. The WoS Research Area is assigned based upon the content area of the journal in which the article is published. If the journal is general or multidisciplinary (e.g. New England Journal of Medicine, PlosOne, etc) then the article is assigned based upon its cited reference list and only assigned to the general category if no more specific designation can be made. It is typically not feasible to assign a journal/publication to a single category, therefore, up to six research areas may be assigned to a given journal/article, creating detailed combinations of content areas assigned to each publication (Thomson Reuters, 2014).

In order to enable a more concise and digestible description of the data, we undertook to create collapsed, superordinate categories, qualitatively devised from our journal and article content. In contrast to other content designation schemes offered by WoS, our collapsed categories were individually evaluated to most meaningfully reflect Georgia CTSA's publication catalogue, which requires greater differentiation among clinical sciences and less discrimination among arts, humanities and sciences not relevant to clinical and translational research. We conducted a qualitative analysis to understand conceptual and functional similarity among the 109 WoS Research Areas as represented in our supported publications. Based upon this, we amalgamated the 109 areas into 34 collapsed categories that were found to be substantially overlapping within the context of our publication set. For example, within this publication set, WoS Research Areas *Hematology* and *Oncology* were very often assigned to the same publications and represent the same kinds of research; therefore, we collapsed these two categories into one. We refer to the revised classification as Collapsed Research Areas (see Appendix 1). Included in the 34 categories is a *Miscellaneous* category composed of seldom-occurring WoS Research Areas that were designated to fewer than five journals and fewer than ten publications, and were not closely related to a larger category. Due to multiple, overlapping designations (articles were assigned up to five different research areas after collapsing), frequencies total to greater than 100% of the dataset.

The CNCI, a proprietary metric from InCites, is an adjusted index of citation impact, normalized to the publication year and research category. For instance, a CNCI score of 5 means that the article was cited 5 times more frequently than average, or 5 times more frequently than would be predicted, for a similar document from the same year and discipline.

The JIF, another InCites metric, is an unadjusted measure of typical citation rates for the journals in which each article was published. A JIF of 5, for instance, means that the articles published in that journal in the past two years have been cited, on average, 5 times. The JIF rank percentile

reflects the percentile ranking of each journal within its field of research. The JIFs and JIF percentiles were available for 1,836, or 97.4%, of the InCites dataset.

Data Analysis

Part 1: Summative Analysis

1.1. In order to characterize the content of the articles arising from Georgia CTSA support, we began with a cursory examination of the total number and frequencies of WoS Research Area classifications an their combinations, before continuing our analyses using the Collapsed Research Areas defined in Appendix 1. We then examined the total number and frequency distribution of the Collapsed Research Areas, and calculated several heterogeneity indices for the distribution. We calculated the Blau's Heterogeneity index (Blau, 1977) by subtracting the sum of the squared proportions of each category from 1, providing an index of diversity between 0-1, with numbers closer to 1 indicating greater diversity. We calculated the Shannon Diversity Index (Shannon, 1948) by summing the proportion of publications in each category area, multiplied by the natural log of that proportion, across all research areas. Scores on this index usually range between 1.5-3.5, but no fixed range exists; higher values indicate higher diversity of research areas. We calculated the Shannon Equitability Index by dividing the Shannon Diversity Index by the logarithm of the total number of categories, providing an index of equitability between 0 and 1, with 1 being a completely even distribution (Shannon, 1948). Together, these indices provide quantitative measures of the relative diversity and even distribution of the publication portfolio, with regard to research area content.

1.2. Next, in order to understand the inter-disciplinary structure of the cumulative set of publications supported by Georgia CTSA we created a network representing the disciplinary co-occurrences within publications. The nodes in these networks represented Collapsed Research Areas, and the edges, or links between nodes represent co-occurrence of two disciplines within one or more publications. In other words, because each article was assigned up to five Collapsed Research Areas, we were able to assess the co-occurrences of different pairs of research areas assigned to the same article to construct a network map. Using Sci2 network analytics software (Sci2 Team., 2009) we first extracted the co-occurrence network, which delineates all instances where two disciplines co-occur. We then used Sci2 to visualize the network by creating a network diagram using the Kamada-Kawai layout which uses a simple and parsimonious force-directed graphing method (Kamada & Kawai, 1989). Finally, we obtained network-level quantitative indices calculated in Sci2, including: number of research areas/disciplines, number of co-disciplinary links, mean number of articles per link (link strength), mean number of links per discipline (degree strength), and the proportion of possible connections that have been made across the network (network density).

1.3. Finally, in order to characterize the relative influence of the content areas in Georgia CTSA's publication set, we examined a selection of impact indices for each Collapsed Research Area, (excluding the *Miscellaneous* category), ranking them based on total number of representative publications. For each area we provide: the number of articles with that designation, the number of journals with that designation, number of articles with that

designation that were published in multi-disciplinary journals, percent of the Georgia CTSA portfolio represented by the area, total number of citations garnered by articles representing the area, percent of the all citations represented by the area, mean CNCI score, mean JIF and JIF percentiles of journals represented by the area, weighted by the number of Georgia CTSA articles in those journals, and number of inter-disciplinary links to other Collapsed Research Areas (from the network analysis).

Part 2: Longitudinal analysis

2.1. In the second set of analyses, articles were stratified by publication date in order to understand the development of content characteristics over time, and facilitate inferences about likely future trends. First, in order to understand change and stability in research area prevalence, we calculated the longitudinal trends in publication totals for the top ten most frequently represented Collapsed Research Areas.

2.2. Then, we conducted a series of network analyses to assess the changing inter-disciplinary structure of the growing publication set. As in Part 1, we extracted co-occurrence networks, created network diagrams using the Kamada-Kawai layout, and obtained network-level quantitative indices, but for cumulative two-year increments of publication information: 2007-2008; 2007-2010; 2007-2012; 2007-2014; 2007-2016. As in Part 1, network indices for each increment included: number of research areas/disciplines, number of co-disciplinary links, mean number of articles per link (link strength), mean number of links per discipline (degree strength), and the proportion of possible connections that have been made across the network (network density).

Results

Part 1: Defining the Content of Georgia CTSA-Supported Publications

1.1. Georgia CTSA has supported the research behind 2,157 articles, published in 812 different journals, thus far; 1885 of the articles and 685 of the journals were indexed in WoS Incites and able to be analyzed for content area and citation impact. Top journal titles most frequently publishing Georgia CTSA-supported research, and their associated impact indices have been reported previously (See Llewellyn & Nehl, 2017).

The 1885 articles indexed in Incites span 109 of WoS's 252 Research Areas, including 42 out of 47 (89.4%) of the areas defined as *Clinical, Pre-Clinical & Health* according to WoS's Global Institutional Profiles Project (GIPP) Research Area Scheme (Thomson Reuters, 2014), which is the broadest research area classification available. Under the GIPP Research Area Scheme, 1565 (83%) of articles include the *Clinical, Pre-Clinical & Health* classification. Examining the patterns of multiple classification (up to six classifications per article), 368 unique combinations of areas were found. The Blau's Heterogeneity index (Blau, 1977) score of .97 and the Shannon Diversity index score (Shannon, 1948) of 3.92 confirm the exceptional diversity of this portfolio with regard to WoS Research Areas distribution. Together with the Shannon Equitability index (Shannon, 1948) of .49, these indicators show that coverage is wide, and fairly even. Although

many content areas have very low or singular occurrences, no one WoS Research Area is represented by more than 9% of articles.

The 109 WoS Research Areas were then manually merged into one of 34 Collapsed Research Areas (Appendix 1). In order to understand the distribution of Collapsed Research Areas represented by all Georgia CTSA-supported publications, Figure 1. presents a pie chart of all areas represented at the end of 10 years. This pie-chart shows the areas that are most and least prevalent, but overall there is reasonable coverage across many disciplines without heavy concentration in any particular area.

1.2. Next, in order to depict the inter-disciplinary network structure of the Collapsed Research Areas represented by all Georgia CTSA-supported publications, Figure 2 presents a network diagram of all connections made at the end of 10 years. This network diagram shows that 166 co-disciplinary links currently exist between the 34 research areas. The mean link strength is 5.61 meaning that, on average, nearly six articles represent each co-disciplinary link. The mean degree strength is 9.77 meaning that, on average, research areas are linked to nearly 10 other areas. The network density is .30, meaning that 30% of all possible linkages have currently been forged. Research areas that are most frequently linked by Georgia CTSA publications include *Infections Disease & Virology* with *Immunology & Allergy*, and *Neuroscience & Behavioral Sciences* with *Psychology & Psychiatry*.

1.3. Finally, in order to quantify the relative impact of different research areas, Table 1 presents impact indices for all Collapsed Research Areas (excepting *Miscellaneous*), ranked by number of articles representing each area. In terms of publication productivity, rankings reveal that the most prevalent content areas in the Georgia CTSA publication portfolio are *Immunology & Allergy* (11% of the total publication portfolio), *Cardiovascular & Peripheral Vascular Systems* (11%), and *Infectious Disease & Virology* (10%). Areas that are published across the largest number of journals include *Psychology & Psychiatry* (79 different journals), *Neuroscience & Behavioral Sciences* (66), and *Cardiovascular & Peripheral Vascular Systems* (56). Most articles are published in subject-specific journals reaching audiences within their own disciplines, but the (non-general) research areas most frequently published in the more widely-reaching general and multi-disciplinary journals include *Public & Environmental Health* (18 articles) and *Immunology & Allergy* (16).

In terms of citation influence, areas with highest citation footprints include *Immunology & Allergy* (18% of the total citation portfolio), *Psychology & Psychiatry* (16%), and *Neuroscience & Behavioral Sciences* (12%). Areas with the highest mean CNCI scores include *Pediatrics* (3.96), *General/Internal Medicine & Primary Care* (3.43), and *Immunology & Allergy* (3.23), indicating especially high citation rates relative to their fields (more than 3 times the expected number). However, almost all of the research areas have mean CNCI's greater than 1, indicating above average citation rates for their disciplines.

Research areas with the highest weighted JIF/JIF percentiles averages include *Microbiology* (6.53, 89th percentile), *General/Internal Medicine & Primary Care* (21.12, 82nd percentile), *Critical Care & Emergency Medicine* (6.95, 82nd percentile), and *Nephrology & Urology* (4.86,

82nd percentile), but all areas ranking in the top 20 (and representing the majority (85%) of publications) have high average JIFs and rank in the top third of their fields (> 66th percentile).

In terms of inter-disciplinarity and potential cross-pollinating influence, areas with the most links to other areas (i.e. highest degree from network analysis) include *Biochemistry, Molecular & Cell Biology* (20 links to other areas), *Pediatrics* (18 links), *Neuroscience & Behavioral Sciences* (16 links), and *Pharmacology & Toxicology* (16 links). **Table/Figures for Part 1 below:**

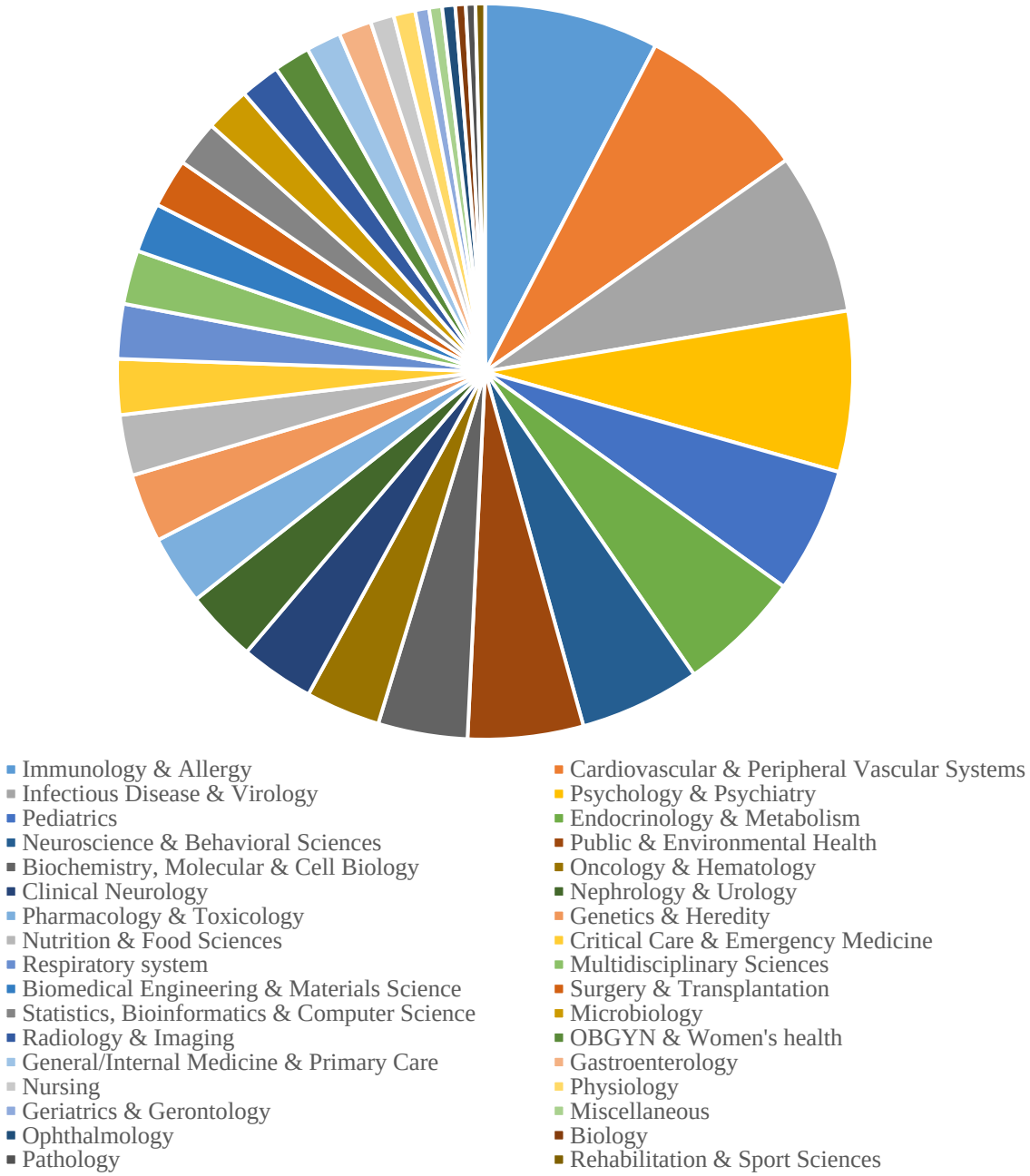


Figure 1. Content Distribution: Research Areas Represented by Georgia CTSA-supported Publications

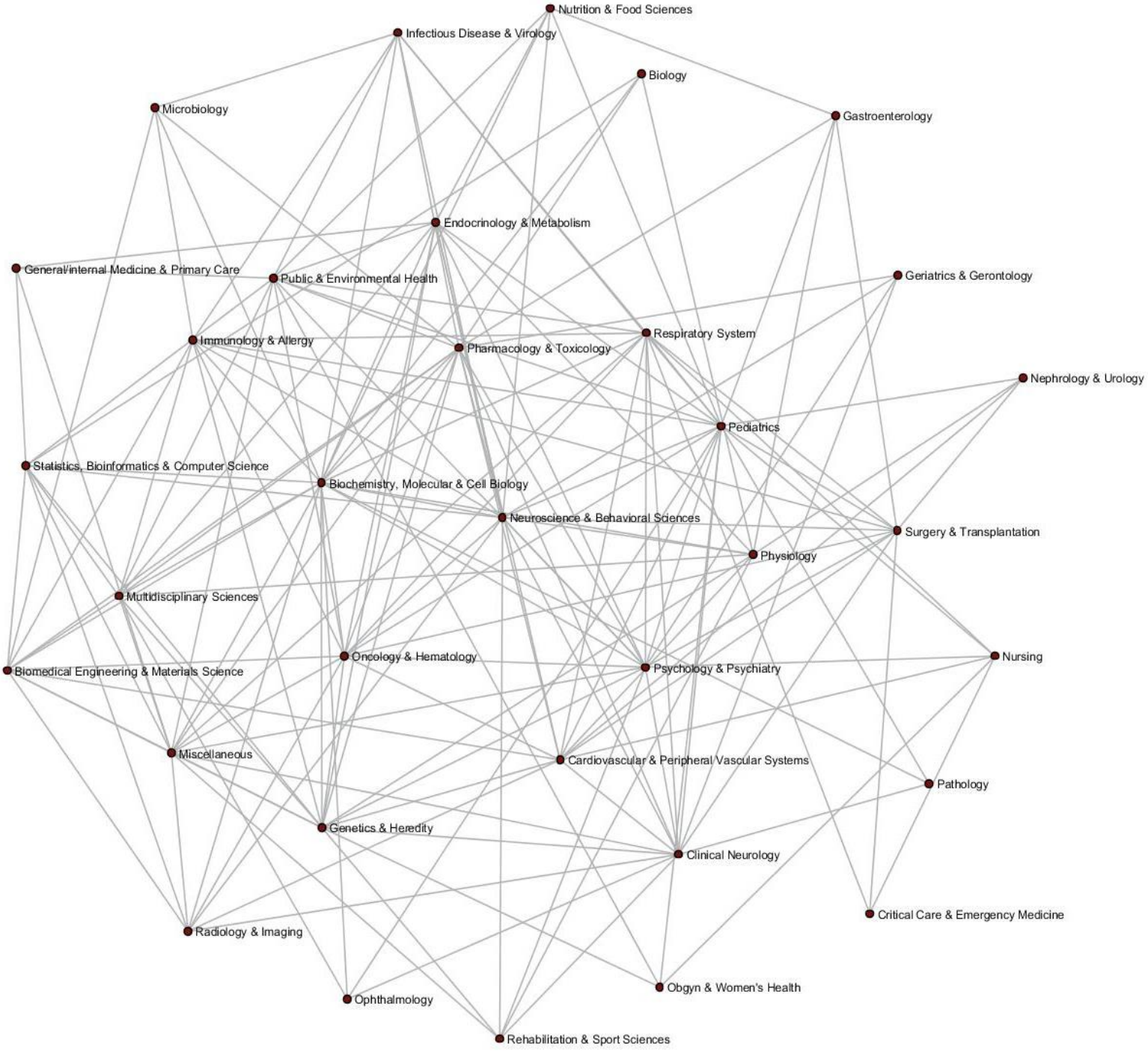


Figure 2. Content Structure: Inter-disciplinarity Network of Research Areas Represented by Georgia CTSA-supported Publications.

Rank	Collapsed Research Area	Number of Articles	Number of Journals	Articles in Multi-disciplinary Journals	% of Georgia CTSA Publications	Number of Citations	% of Georgia CTSA Citations	Mean CNCI	Weighted Mean JIF	Weighted Mean JIF percentile	Number of Inter-disciplinary Links
1	Immunology & Allergy	**201**	43	**16**	**11%**	**10,086**	**18%**	**3.23**	6.51	77.55	11
2	Cardiovascular & Peripheral Vascular Systems	**199**	**56**	9	**11%**	3,743	7%	1.62	5.56	76.89	13
3	Infectious Disease & Virology	**186**	39	**13**	**10%**	3,342	6%	1.52	4.57	72.06	8
4	Psychology & Psychiatry	185	**79**	6	10%	**9,270**	**16%**	2.76	4.82	74.06	15
5	Pediatrics	145	36	8	8%	5,241	9%	**3.96**	3.33	75.22	**18**
6	Endocrinology & Metabolism	143	41	7	8%	3,572	6%	1.72	5.45	74.50	12
7	Neuroscience & Behavioral Sciences	139	**66**	6	7%	**6,799**	**12%**	2.77	6.06	77.45	**16**
8	Public & Environmental Health	133	38	**18**	7%	1,429	2%	1.25	2.69	66.51	13
9	Biochemistry, Molecular & Cell Biology	103	**56**	8	5%	3,544	6%	1.84	5.87	72.66	**20**
10	Oncology & Hematology	86	35	4	5%	1,833	3%	1.55	6.44	80.55	15
11	Clinical Neurology	85	48	7	5%	2,588	5%	1.88	4.41	67.79	14
12	Nephrology & Urology	83	20	6	4%	2,656	5%	2.99	4.86	**82.16**	4
13	Pharmacology & Toxicology	80	44	0	4%	1,652	3%	1.40	3.78	69.35	**16**
14	Genetics & Heredity	79	38	5	4%	2,343	4%	1.64	4.95	66.73	15
15	Nutrition & Food Sciences	70	24	3	4%	1,646	3%	1.61	3.77	70.58	6
16	Critical Care & Emergency Medicine	64	14	1	3%	2,038	4%	2.23	**6.95**	81.95	3
17	Respiratory system	63	21	**13**	3%	2,229	4%	2.52	6.03	73.07	13
18	Multidisciplinary Sciences	62	28	*n/a*	3%	1,422	2%	1.60	6.03	73.19	11
19	Biomedical Engineering & Materials Science	57	29	2	3%	1,361	2%	1.63	4.81	74.24	11
20	Surgery & Transplantation	56	28	0	3%	918	2%	2.37	3.84	76.30	11
21	Statistics, Bioinformatics & Computer Science	53	24	0	3%	464	1%	1.00	1.87	54.00	10
22	Microbiology	52	10	3	3%	1,854	3%	2.66	**6.53**	**88.48**	5
23	Radiology & Imaging	46	20	0	2%	1,046	2%	2.30	3.02	62.05	8
24	ObGyn & Women's health	42	15	10	2%	531	1%	1.86	2.53	66.23	4
25	General/Internal Medicine & Primary Care	40	35	*n/a*	2%	1,370	2%	**3.43**	**21.12**	**82.38**	4
26	Gastroenterology	38	15	0	2%	600	1%	2.70	**6.53**	77.70	5
27	Nursing	27	12	0	1%	234	0%	1.54	1.92	72.93	6
28	Physiology	25	14	0	1%	318	1%	0.95	3.11	65.43	10
29	Geriatrics & Gerontology	16	10	1	1%	180	0%	0.93	3.83	78.06	4
30	Ophthalmology	15	7	1	1%	182	0%	2.75	2.40	48.08	4
31	Biology	12	8	0	1%	112	0%	0.52	2.26	58.03	4
32	Rehabilitation & Sport Sciences	11	8	0	1%	185	0%	1.52	2.13	68.12	6
33	Pathology	11	7	0	1%	233	0%	1.73	3.31	69.23	3

Table 1. Relative Influence: Ranking of Research Areas Represented by Georgia CTSA-supported Publications & Their Impact. The top three ranked indices in each column are in bold. CNCI= Category Normalized Citation Index, JIF= Journal Impact Factor.

Part 2. Charting the Development of Georgia CTSA's Publication Portfolio over Time

2.1. First, to understand shifts in prevalence in top research areas, Figure 3 displays the publication counts of the top ten most frequently represented research areas from 2008 to 2016 (excluding 2007 and 2017 due to truncated calendar years). This chart illustrates the productivity ranking of each research area for each year in absolute and relative terms, and shows how some areas have risen and fallen in the rankings. Areas such as *Immunology & Allergy* and *Infectious disease & Virology* have climbed in the publication rates and rankings over the years, whereas areas like *Psychology & Psychiatry* and *Biochemistry, Molecular & Cell Biology* started higher in publication rates and rankings, but have fallen over time. *Public & Environmental Health* and *Neuroscience & Behavioral Sciences* have been particularly stable over the years in their publication output. Importantly, although this chart depicts only the top ten ranked areas (corresponding to 58% of the total designations), we assessed all of the collapsed research areas for notable longitudinal trends. We found that, for example, *Surgery & Transplantation* and *Gastroenterology* are exhibiting increases in publication rates such that they may be expected to rise in cumulative ranking in the future. In contrast, *Clinical Neurology* is exhibiting a decreasing publication rate. Of note, Figure 3 also provides the ranking for the most recent full calendar year, 2016, which describes which areas are *currently* predominant, in isolation from the cumulative rankings.

2.2. Finally, in order to depict growth in inter-disciplinarity over time, Table 2 presents a series of network diagrams reflecting two-year cumulative increments from 2007 to 2016 (the full 2007-2017 range is depicted in Figure 2 of Part 1). Sequential diagrams in Table 2 reflect the expanding publication set, adding new research areas and new co-disciplinary links over time. We summarize network indices for each increment below the diagrams.

Results revealed a pattern of growing inter-disciplinarity over the past ten years, with ceiling effects emerging. The number of disciplines represented in Georgia CTSA's publication portfolio rose and levelled-off quickly such that after the first few years, no new content areas were added to the cumulative publication record (all 34 Collapsed Research Areas were represented in the publication set by the second time increment, no later than 2010). The number of new co-disciplinary links between areas rose even more sharply and is leveling-off more slowly. Although new inter-disciplinary links are now becoming rare, existing links continue to be reinforced as new articles representing those links are published. The average number and the maximum number of articles per link continues to rise steadily.

The average number and the maximum number of links per discipline, or the number of linkages that any given discipline has to any others, rose quickly and has begun to level-off. The minimum number of links per discipline shows that there have been no isolated disciplines since the initial 2007-2008 time increment. That is, since that time, there have been no disciplines that are not connected to at least one other, and the minimum links per discipline continues to increase. The overall proportion of all possible connections that have been made, or network density, has risen as the number of links per discipline has increased, but is now plateauing at approximately 30%, or 166 of the 595 potential connections. **Table/Figures for Part 2 below:**

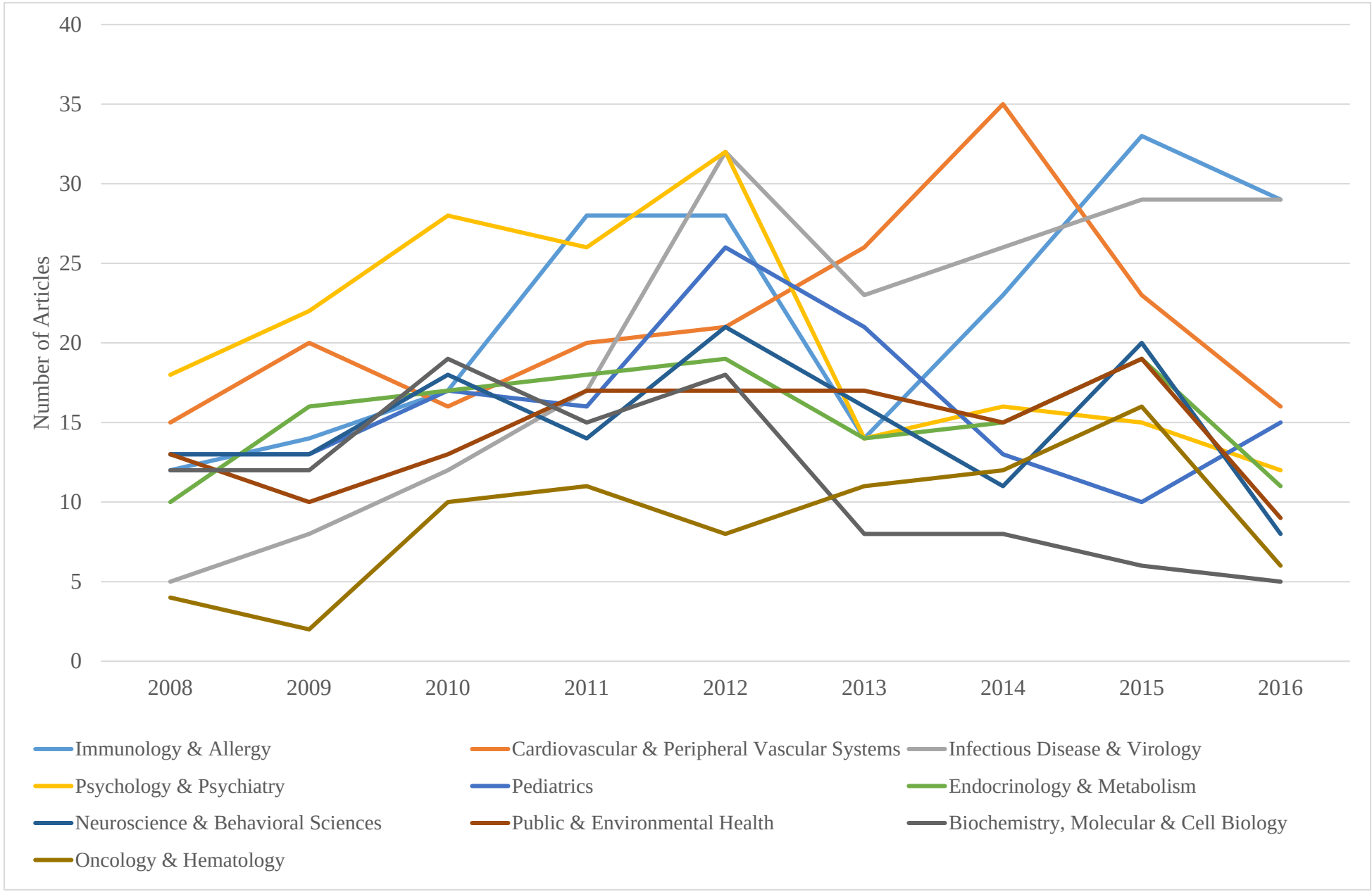


Figure 3. Shifting Content Rankings: Top Ranking Research Areas Represented by Georgia CTSA-supported Publications by Year

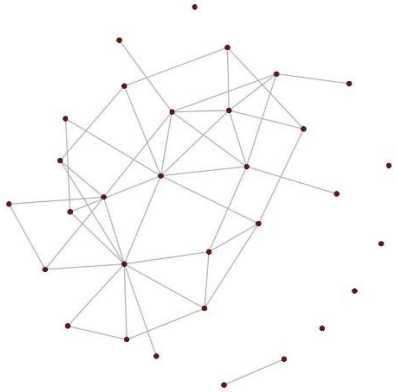
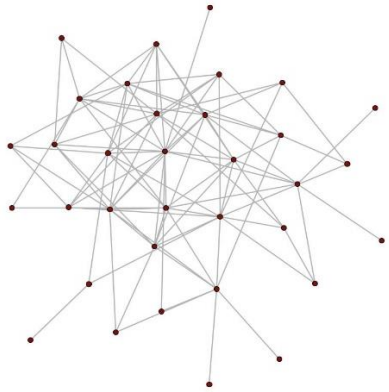
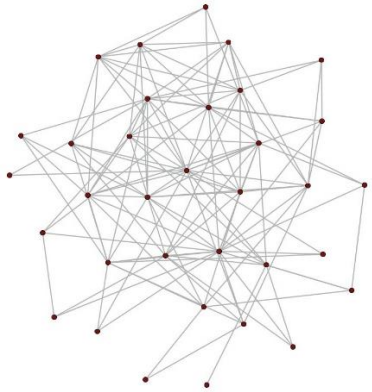
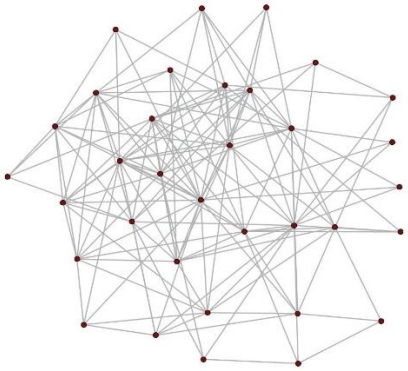
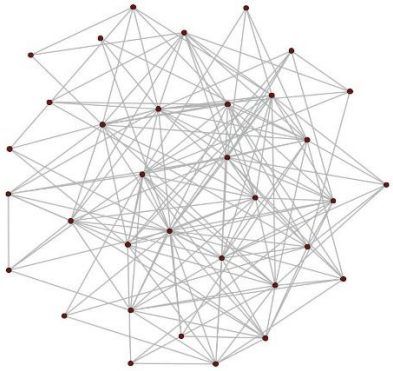
Cumulative Network Characteristics	**2007-2008**	**2007-2010**	**2007-2012**
Network Diagram			
Number of Publications	168	543	1,073
Number of Disciplines	31	34	34
Number of Co-disciplinary Links	45	99	130
Mean Articles per Link (strength)	1.51 (Range: 1-6)	2.49 (Range: 1-20)	3.90 (Range: 1-33)
Mean Links per Discipline (degree)	2.90 (Range: 0-10)	5.82 (Range: 1-15)	7.65 (Range: 1-18)
Proportion of Possible Links Made (density)	.10	.18	.23
	2007-2014	**2007-2016**	
Network Diagram			
Number of Publications	1,494	1,864	
Number of Disciplines	34	34	
Number of Co-disciplinary Links	150	166	
Mean Articles per Link (strength)	4.69 (Range: 1-56)	5.6 (Range: 1-95)	
Mean Links per Discipline (degree)	8.82 (Range: 3-19)	9.8 (Range: 3-20)	
Proportion of Possible Links Made (density)	.27	.30	

Table 2. Growing Content Networks: Cumulative Inter-disciplinarity Networks over Time

Discussion & Conclusions

The purpose of this evaluation was to detail the past and present content of the Georgia CTSA publication portfolio. Using complimentary inventive methods, we described the overall picture of research content encompassed by Georgia CTSA-supported publications, and we have shed light on the areas of greatest impact. We have placed this summary within the context of 10 years of publication data in order to describe trajectories of prevalence and interconnectedness over time. This evaluation delivers a comprehensive and nuanced understanding of how the publication compendium has evolved to its current state and allows for inferences about likely future paths.

Summary of Part 1. The Current State of Georgia CTSA's Publication Portfolio

Initial examination of the WoS Research Areas covered by Georgia CTSA-supported research revealed the extensive heterogeneity of the publication set, indicating that Georgia CTSA is achieving the goal of providing broad, disease-agnostic support to research endeavors that foster a wide and relatively even range of findings. Collapsing the WoS Research Areas into 34 Collapsed Research Areas allowed for a comparison of results across slightly less specific, but more comprehensible and meaningful categories, customized to be most relevant to the clinical and translational focus of Georgia CTSA-supported research.

Due to the overlap in research area designations, our next step was to clarify the interconnected structure of the research content represented within Georgia CTSA-supported publications. Articles and journals cannot often be accurately categorized into single fields, even after collapsing those fields into broader designations (although this did reduce the number of designations). However, network analyses of the links between disciplines, represented by co-designations assigned to articles, provided an understanding of the inter-disciplinary layout of the publication set. We found that the overall network was dense in terms of linkages among the 34 Collapsed Research Areas and we were able to discriminate the areas that were the most and the least connected to other areas. Although there was significant and expectable variability in inter-connectedness, there were no research areas that were completely unconnected to others, as isolated silos. These findings suggest that Georgia CTSA is meeting the goal of supporting research that bridges interdisciplinary divides, fostering the translational process through cross-pollination across disciplines and journal audiences.

With an understanding of the general distribution and network structure of research areas in the Georgia CTSA publication portfolio, we next calculated a series of indices of research impact for each Area. Taking all of these metrics into consideration, converging results illuminated some research areas that stand out in terms of productivity, citation impact, scope, and wide-ranging influence. We summarize several of these outstanding areas here:

> **Immunology & Allergy** is a clear front-runner for overall impact. Created as an amalgamation of WoS's *Allergy*, *Immunology* and *Rheumatology* Research Areas, *Immunology & Allergy* is the Collapsed Research Area that is represented in the largest number of Georgia CTSA publications, which, in turn, have the largest citation footprint. It has one of the largest numbers of articles published in generally higher impact multi-

disciplinary journals, and one of the highest relative citation impact scores, indicating exceptional impact even adjusting for publication year and content area. Research in the area of *Immunology & Allergy* has been Georgia CTSA's most prolific and influential, with longitudinal findings signifying that the prominence of *Immunology & Allergy* is only increasing in magnitude.

Neuroscience & Behavioral Sciences, an amalgamation of WoS's *Neuroscience*, *Behavioral Sciences*, and *Neuroimaging* Research Areas, is another clear leader in impact rankings. This area is highly ranked for number of articles, is published in one of the highest diversities of journals, indicative of an exceptionally wide audience reached, with among the highest journal impact indices, and has a high number of articles in multi-disciplinary journals. *Neuroscience & Behavioral Sciences* also has one of the largest sums of citations, a high relative citation impact score and one of the highest numbers of inter-disciplinary links to other areas, reflecting exceptional collaborative/cross-disciplinary connectedness.

Cardiovascular & Peripheral Vascular Systems, a combination of WoS's *Cardiac & Cardiovascular Systems* and *Peripheral Vascular Systems* Research Areas, is another clear leader. This area is represented by the second largest number of articles and is highly ranked for numbers of citations. It is published in one of the highest diversities of journals, with among the highest journal impact indices, including a high number of articles in multi-disciplinary journals. Promising longitudinal results indicate that *Cardiovascular & Peripheral Vascular Systems* is currently increasing in publication prominence.

Psychology & Psychiatry, a combination of WoS's *Psychology*, *Psychiatry*, and *Substance Abuse* Research Areas, was an early leader in publication influence and retains high cumulative impact despite a pattern of modest decline in recent years. *Psychology & Psychiatry* has a legacy of one of the largest cumulative numbers of publications and citations, with a high ranking for relative impact score. Articles are published in the largest diversity of different journals, indicating a particularly broad audience, and *Psychology & Psychiatry* has one of the highest numbers of inter-disciplinary links to other areas.

Biochemistry, Molecular & Cell Biology, which combines WoS's *Biochemical Research Methods*, *Cell Biology* and *Biochemistry & Molecular Biology* Research Areas, was another early leader in research influence that is exhibiting a slight pattern of decline. This area is highly-ranked for numbers of cumulative publications and citations, is published in one of the largest diversities of journals, with a high mean JIF, and a high number of articles in multi-disciplinary journals. *Biochemistry, Molecular & Cell Biology* also has the most links to other research areas, indicating superior inter-disciplinarity and broadly-branching impact.

Summary of Part 2. The Evolving Picture of Georgia CTSA's Publication Record

In the second part of this evaluation, we charted publication patterns over time in order to understand the longitudinal contexts in which the portfolio developed. Shifting rankings of Collapsed Research Areas over time shed light on how current cumulative rankings came to be, including patterns of accelerating publication productivity, patterns of early productivity prompting a legacy of influence, and patterns of steady, consistent productivity. With such a long

time interval available for consideration, these patterns provide reasonable grounds for inference about future productivity. For instance, we see that *Immunology & Allergy* currently tops the leaderboard and, given its longstanding pattern of increasing publication numbers, is likely to remain in this position, at least for the foreseeable future. Longitudinal patterns also show that some lower-ranked areas are perhaps exhibiting gains in momentum that may allow them to rise in the rankings in the future.

Finally, we utilized publication year in another way to characterize growth in overall inter-disciplinarity over time. By conducting network analyses over five cumulative 2-year increments, we were able to understand the progressive trends in network indices that bring us to the current inter-disciplinarity structure depicted in Part 1, Figure 2. Several different indices revealed that the network expanded quickly to connect all 34 Collapsed Research areas with increasing inter-connectivity. However, the rate of growth in inter-disciplinarity indices such as number of edges, links per discipline, and network density, has slowed in recent years. Growth in the number of overall publications has been relatively constant, and the link strength, which indexes repeated connections rather than growth in new connections, is still rising steadily. The larger pattern suggests that this network is likely approaching its capacity, and we do not expect future growth to be commensurate with past growth. The implication is that if interdisciplinary expansion is desired, intentional action is needed to foster avenues for novel collaborations and support for new areas of research.

Strengths & Limitations

A strength of this evaluation is the comprehensiveness of the perspectives on research area content, from a simple snapshot of the current portfolio to a longitudinal framing over a long period. This report describes what, when, how much, and with whom research has been published. The impressions and conclusions reached here inform the extent to which Georgia CTSA has reached certain aims and the likely future pathways to expect and plan for. Research areas of strength may warrant more detailed investigation of how their influence has manifested. Research areas of less strength may present opportunities for growth and targeted support.

Another strength is our novel use of network analysis to analyze co-occurrences of research areas within papers, which has not been performed before to the authors' knowledge. This innovative methodology makes informative use of what could otherwise be considered a complication in the multiple research area designations to provide a more accurate depiction of the dimensional nature of the content distribution. The reality of research content areas are that they are overlapping and interconnected, rather than discrete, separate areas of study. Elucidating the interconnected structure and the evolution of network indices, is an important step toward understanding the patterns of dynamic collaboration that may underlie these relationships.

Another strength of this evaluation methodology is the largescale reproducibility of this research, which is able to be carried out in updated publication sets, or other portfolios of interest with relative ease. In the future, it will be possible to efficiently track content changes and growth by adding new longitudinal data points, and this method can be either narrowed or broadened in scope by replicating this analytic strategy in either smaller and more focused or broader and

more comprehensive publication portfolios (i.e. single Georgia CTSA program/set of CTSA hubs).

A limitations of our method is the inherent loss of specificity when examining such largescale bibliometric data. The designations made by WoS entail a heuristic for assigning research areas to the almost 2000 publications under consideration; because designations are assigned based upon the journal in which they are published, they do not necessarily coincide fully with the content of the particular article. However, it is probable that a *set* of publications in a given journal are collectively reflective of the multiple designations given to journals by WoS. Further, it is important that the multiple designations given to a journal do generally reflect the general readership of that journal. The implication for our network analyses is that although the research in a specific article may not cut across the interdisciplinary link made by the journal, the targeted audience that gives their attention to this article should reasonably represent that link. Additionally, the many Georgia CTSA-supported articles that are published in multidisciplinary and general science journals (9% of the publication set) *are* individually categorized into their own specific research areas.

A second limitation of our approach is in the multiple domains used to categorize articles, which may, at times, be mutually exclusive. For instance, the same kinds of research may be published based on disease, anatomical focus, methodology, or patient population. This can be especially problematic for research carried out in a defined clinical field but in specific key populations. For example, if an article on childhood cancer is published in a pediatric journal, it will be designated as *Pediatric* by WoS, losing the information that it is related to cancer. If it is instead published in a cancer journal, then it will be classified as *Oncology*, and the fact that it is pediatric will be obscured. The reasons for publishing in one journal versus the other may be somewhat arbitrary and not necessarily due to the best conceptual fit. To address this limitation, we carried out a brief supplemental analysis of keywords based on deductive, top-down understanding of Georgia CTSA's research scope, as well as an analysis of the most frequently-represented words among all article and journals titles. Other topics were selected based upon areas of specific interest and relevance to Georgia CTSA's partner institutions. Searches were divided into categories for diseases, populations, and 'other' (Appendix 2).

In the disease category we conducted exhaustive searches for terms related to HIV/AIDS, Depression, Asthma, Diabetes and Opioid use. Not all diseases are necessarily suitable to this search approach, which relies upon there being a reasonably small list of exclusively utilized, non-overlapping search terms that would be expected to be included in most titles addressing that content area. For that reason, this approach is not appropriate for an exhaustive content analysis that describes a large and varied publication set, such as ours. It is, however, useful for identifying articles related to certain limited areas of interest. For each disease listed, we searched terms in both the article and journal titles. For example, because we know that HIV/AIDS research is very prevalent at Emory University, we queried every incidence of the terms 'HIV', 'AIDS', 'immunodeficien-' and 'serodiscordan-' and subsequently deleted duplicate search results. The resulting list of articles was manually inspected for unintended inclusions, such as longer words that include the search term but are unrelated (e.g. 'NSAIDS').

Once a list of articles related to the topic area was compiled, the average CNCI was calculated as a summary index of impact in that area. This procedure was carried out for the following populations: Pediatric/Youth Health, Women's Health, African American Health, Local Populations, and Geriatrics. Two further categories of interest were Translational Research and Engineering/Technology Research. The latter search was also based upon the GIPP classification for *Engineering & Technology*.

Most topic areas of interest did not map onto the WoS Research Areas, or consequently the Collapsed Research Areas, (e.g. HIV/AIDS cuts across WoS areas such as Immunology, Infectious Disease and Public Health), but we were able to compare results for areas such as Pediatrics and Women's Health, which do exist on their own in WoS. Of note, we were able to attribute significantly more articles to these population-based categories using the search term method rather than the WoS designations based upon journals. Close examination of these reveals that some articles that we attributed to Pediatrics based upon the age under study were published in journals that cover diseases or outcomes without respect to patient population. Interestingly, the mean CNCI for the larger number of pediatric-termed articles was not significantly different from the smaller subset identified as *Pediatrics* by WoS, indicating a somewhat consistent picture of impact using either method. These supplemental results suggest that certain topic areas of interest may be better served by a multi-method approach to identifying relevant articles.

Conclusion

In sum, the results of this research content evaluation inform our understanding of the areas of most prolific influence and inter-connectedness among Georgia CTSA's publication portfolio, and how these came to be across 10 years of activity. Georgia CTSA is achieving the goal of supporting a diverse, disease-agnostic array of research areas, and Georgia CTSA-supported publications are impactful across a variety of areas. Research areas are strongly inter-connected, but under current circumstances, capacity for growth in inter-disciplinarity is limited. For expansion to occur, it will be necessary to push into novel content areas and collaborations as Georgia CTSA moves forward with strategic initiatives.

In the future, it would be useful to delve into co-authorship as an even more in-depth method of examining collaboration and inter-disciplinarity. In addition, it would be valuable to use similar methods to examine the content of later phases of translation such as grants and patents, although these are less comparable and less systematic. This exportable method of content analysis can also be utilized to understand the content of publications sets arising from specific Georgia CTSA investments or from the wider CTSA award program. This report provides a fortuitous baseline for Georgia CTSA's publication content and influence ahead of a major expansion to incorporate the University of Georgia in the forthcoming grant renewal. With this summary in hand, we will continue to track progress within and across research disciplines as we transition to become the Georgia CTSA.

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Acknowledgements

We would like to thank Kimberly Powell, MLIS[1], Life Sciences Informationist, for her invaluable assistance in collecting and interpreting publication and citation data.

In addition, we would like to thank Dorothy Carter, PhD[1], Clara Pelfrey, PhD[2], Latrice Rollins, PhD, MSW[3], Elizabeth Pittman Thompson[4], Boris Volkov, PhD[5], and Andrew West, MBA, MHA[4] for their much appreciated feedback on this report.

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This evaluation was supported by the National Center for Advancing Translational Sciences of the National Institutes of Health under Award Number UL1TR000454. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health

Appendix 1. Collapsed Research Areas & Corresponding Web of Science (WoS) Research Areas

Collapsed Research Area	**Combining the following WoS Research Areas**
Biochemistry, Molecular & Cell Biology	• BIOCHEMICAL RESEARCH METHODS • CELL BIOLOGY • BIOCHEMISTRY & MOLECULAR BIOLOGY
Biology	• BIOLOGY • MYCOLOGY • DEVELOPMENTAL BIOLOGY
Biomedical Engineering & Materials Science	• BIOTECHNOLOGY & APPLIED MICROBIOLOGY • NANOSCIENCE & NANOTECHNOLOGY • ENGINEERING, BIOMEDICAL • MATERIALS SCIENCE, BIOMATERIALS • MATERIALS SCIENCE, MULTIDISCIPLINARY • CELL & TISSUE ENGINEERING
Cardiovascular & Peripheral Vascular Systems	• CARDIAC & CARDIOVASCULAR SYSTEMS • PERIPHERAL VASCULAR DISEASE
Clinical Neurology	• CLINICAL NEUROLOGY
Critical Care & Emergency Medicine	• EMERGENCY MEDICINE • CRITICAL CARE MEDICINE
Endocrinology & Metabolism	• ENDOCRINOLOGY & METABOLISM
Gastroenterology	• GASTROENTEROLOGY & HEPATOLOGY
General/Internal Medicine & Primary Care	• MEDICINE, GENERAL & INTERNAL • HEALTH CARE SCIENCES & SERVICES • PRIMARY HEALTH CARE
Genetics & Heredity	• GENETICS & HEREDITY
Geriatrics & Gerontology	• GERIATRICS & GERONTOLOGY • GERONTOLOGY
Immunology & Allergy	• ALLERGY • RHEUMATOLOGY • IMMUNOLOGY
Infectious Disease & Virology	• INFECTIOUS DISEASES • VIROLOGY • PARASITOLOGY • TROPICAL MEDICINE
Microbiology	• MICROBIOLOGY
Multidisciplinary Sciences	• MULTIDISCIPLINARY SCIENCES • MEDICINE, RESEARCH & EXPERIMENTAL

Nephrology & Urology	• UROLOGY & NEPHROLOGY
Neuroscience & Behavioral Sciences	• BEHAVIORAL SCIENCES • NEUROIMAGING • NEUROSCIENCES
Nursing	• NURSING
Nutrition & Food Sciences	• FOOD SCIENCE & TECHNOLOGY • NUTRITION & DIETETICS
OBGYN & Women's health	• OBSTETRICS & GYNECOLOGY • REPRODUCTIVE BIOLOGY • Women's Studies
Oncology & Hematology	• HEMATOLOGY • ONCOLOGY
Ophthalmology	• OPHTHALMOLOGY
Pathology	• PATHOLOGY
Pediatrics	• PEDIATRICS
Pharmacology & Toxicology	• PHARMACOLOGY & PHARMACY • CHEMISTRY, MEDICINAL • TOXICOLOGY
Physiology	• PHYSIOLOGY
Psychology & Psychiatry	• PSYCHIATRY • SUBSTANCE ABUSE • PSYCHOLOGY • PSYCHOLOGY, BIOLOGICAL • PSYCHOLOGY, CLINICAL • PSYCHOLOGY, DEVELOPMENTAL • PSYCHOLOGY, EXPERIMENTAL • PSYCHOLOGY, SOCIAL • PSYCHOLOGY, MULTIDISCIPLINARY
Public & Environmental Health	• ENVIRONMENTAL SCIENCES • PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH • FAMILY STUDIES • HEALTH POLICY & SERVICES • SOCIAL WORK
Radiology & Imaging	• OPTICS • RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING
Rehabilitation & Sport Sciences	• REHABILITATION

	• SPORT SCIENCES
Respiratory system	• RESPIRATORY SYSTEM
Statistics, Bioinformatics & Computer Science	• COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE • COMPUTER SCIENCE, INFORMATION SYSTEMS • COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS • COMPUTER SCIENCE, THEORY & METHODS • INFORMATION SCIENCE & LIBRARY SCIENCE • STATISTICS & PROBABILITY • MATHEMATICAL & COMPUTATIONAL BIOLOGY • MEDICAL INFORMATICS
Surgery & Transplantation	• SURGERY • ANESTHESIOLOGY • ORTHOPEDICS • TRANSPLANTATION
Miscellaneous	• BUSINESS • OPERATIONS RESEARCH & MANAGEMENT SCIENCE • DERMATOLOGY • MATHEMATICS, INTERDISCIPLINARY APPLICATIONS • EDUCATION & EDUCATIONAL RESEARCH • EDUCATION, SCIENTIFIC DISCIPLINES • EDUCATION, SPECIAL • ENGINEERING, ELECTRICAL & ELECTRONIC • ETHICS • SOCIAL ISSUES • MEDICAL ETHICS • INSTRUMENTS & INSTRUMENTATION • MEDICAL LABORATORY TECHNOLOGY • OTORHINOLARYNGOLOGY • CHEMISTRY, ANALYTICAL • CHEMISTRY, MULTIDISCIPLINARY • CHEMISTRY, ORGANIC • ENGINEERING, CHEMICAL • BIOPHYSICS • PHYSICS, APPLIED • PHYSICS, CONDENSED MATTER • CHEMISTRY, PHYSICAL • SOCIAL SCIENCES, BIOMEDICAL • SOCIAL SCIENCES, INTERDISCIPLINARY

Appendix 2. Deductive Topic Search Results

Topic	Terms Searched in Article and Journal Titles	Number of Articles	Mean CNCI
Disease-Specific			
HIV/AIDS	HIV; AIDS; immunodeficien-	191	1.84
Diabetes	Diabet-; insulin; blood sugar; glycemic-	116	1.92
Depression	Depressi-; anhedonia-; dysthymi-	88	2.91
Asthma	Asthma; bronchodialat-; -albut-; inhale	48	2.57
Opioids	Opioid, opium, opiate, narcotic, -codone, -morphone, -xone, pain, drug, & list of opiates	3	.87
Populations			
Pediatric/Youth Health	Pediatric; child; infan-; youth; adolescen-; nat-; birth; gestat-; fet-	249	3.65
Women's Health	Women; girl; female; gynecolog-; obstetric-; matern-; pregnan-; cervi-; vagin-; ovar-; endometri-; uter-; estr-; progest-; menstrua-; menarche; menopaus-; breast; mast-; lactat-	160	1.66
African American Health	African; black	92	1.29
Local Populations	Rural; urban; south-; Atlanta; Georgia (USA)	54	1.45
Geriatrics	Geriatric; gerontolog-; older; old; age; aging; elder-; senesc-	37	1.76
Other			
Engineering & Technology	GIPP classification, engineer-; techn-	58	1.8
Translational Research	Translat-	28	1.97