

Original Research Article

Conceptual Framework for Measurement of Research Productivity in Communication Sciences and Its Disorders in Indian Context

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Received: 29/02/2016

Revised: 21/03/2016

Accepted: 21/03/2016

ABSTRACT

A meta-analysis of frameworks and articles on research productivity was done to design a conceptual framework for measurement of research productivity in communication sciences and disorders by obtaining feedback from professionals in the field. The meta-analysis covered 12 existing frameworks for assessment of higher education and research institutions, 37 studies in the field of health research for a period covering 1993 to 2013 with respect to performance indicators (metrics) relating to research products and research efforts. A questionnaire was designed and administered to faculty in speech and hearing institutions in India. Based on the feedback to the questionnaire, the contextual relevance, feasibility of measurement and after exclusion of duplicate indicators, a model on research productivity with nine proxies containing 90 performance indicators was evolved.

The results of the study highlight the role of speech and hearing institutions in the nation building by being a part of a nation's mission and vision in the higher education and health sector as well as contributing to the Millennium Development Goals of the WHO. The results of this study are intended to benefit the various stakeholders: the professionals (practitioners), the project funding agencies, the policymakers, the persons involved in governance and leadership of public funded / private funded institutions, and the public community / society on how best to measure and capture the research outcomes, outputs and impact in this discipline.

Keywords: research productivity, communication sciences and disorders, proxies, performance indicators, frameworks.

INTRODUCTION

The term 'Research productivity' is defined and understood in different ways. While Print and Hattie (1997) defined research productivity as 'the totality of research performed by academics in universities and related contents within a given time period' (p.454), ^[1] Williams (2003) noted that research productivity could be defined in terms of research product and research effort, to the extent of which a researcher produces. ^[2] The assessment of research productivity in terms

of its impact, outputs and outcome has always been of immense and immediate interest to the professionals, the policymakers, the principal stakeholders and in equal measure, the public community / society as well.

The discipline of speech, language and hearing sciences and its disorders, also referred alternatively as '*communication sciences and its disorders*' is essentially multi-disciplinary. The disciplines involved include, but not limited to, Speech-Language Pathology, Audiology,

Psychology, Linguistics, Electronics, and Medicine: Otolaryngology and Neurology. It is not only an academic discipline, but also has a pronounced 'clinical practice' component and comes under the realm of health research, and is classified as allied health. The allied health professionals are defined by the United States Association of Schools of Allied Health Professionals (ASAHP) as, "[being] involved with the delivery of health or related services pertaining to the identification, evaluation and prevention of diseases and disorders; dietary and nutrition services; rehabilitation and health systems management, among others. Allied health professionals, to name a few, include dental hygienists, diagnostic medical sonographers, dietitians, medical technologists, occupational therapists, physical therapists, radiographers, respiratory therapists, and speech language pathologists".^[3] The NHS Scotland takes a more holistic view of the allied health role in health care stating that, "allied health professionals are critical to people's ongoing assessment, treatment and rehabilitation throughout their illness episodes. They support people of all ages in their recovery, helping them to return to work and participate in sport and education. They enable children and adults to make the most of their skills and abilities to develop and maintain healthy lifestyles. And they provide specialist diagnostic assessment and treatment services".^[4] And therefore, the research questions in the allied health range from understanding the physiology, pathology, production, expression, comprehension, and perception of speech, language and hearing to the treatment efficacy to name a few.

In defining the "research products" and "research efforts", for evaluation of the individual and institutional research productivity, the performance indicators and parameters are to be relevant, robust and rational, taking into account, the considerations, constraints and the context in which the individual disciplines of study are placed. The assessment of research

productivity needs to take into account the following : (a) value framework of the National Accreditation Agencies for Higher Education aimed at promoting the core values of contributing to national development and fostering global competence and quest for excellence, (b) the regulatory bodies viz., the Rehabilitation Council of India (RCI), the University Grants Commission (UGC) and (c) alignment to the World Health Report,^[5] the National Health Research Policy and Guidelines.^[6] It is pertinent to mention here that metrics for research productivity specific to communication sciences and disorders is not available. In this context, the present study reviewed the research assessment frameworks which are in vogue internationally and nationally in academic, research institutions and health research to critically analyze the adequacy of addressing the dimensions related to communication sciences and disorders by existing research assessment metrics adopted by the accreditation agencies/regulatory agencies in India viz., NAAC RCI and UGC and identified the pertinent research products for developing a comprehensive suite of metrics for measuring research productivity. On the lines of the approach adopted by the UK Research Excellence Framework^[7] 'Research Productivity', for the purposes of this study would include, besides the scholastic outputs : (a) the products and efforts of direct relevance to the needs of industry, to the public and voluntary sectors, (b) the invention and generation of ideas, images, performances, artifacts including design, where these lead to new or substantially improved insights, (c) the use of existing knowledge in experimental development to produce new or substantially improved materials, devices, products and processes, including design and construction, (d) Impacts i.e., having an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life and includes, but is not limited to, an effect

on, change or benefit to, (e) the activity, attitude, awareness, behaviour, capacity, opportunity, performance, policy, practice, process or understanding of an audience, beneficiary, community, organization or individuals, (f) the reduction or prevention of harm, risk, cost or other negative effects, and (g) the professional practice, innovations in diagnostic, management, service delivery leading to improved health care, innovation in public health initiatives having societal impact, policy impact.

The specific objectives of the study were to (a) review the existing frameworks and the pathways adopted for assessment of research productivity, nationally and internationally in academic and healthcare-setting, (b) compare the existing research metrics contained in the accreditation/regulatory agencies viz., National Assessment and Accreditation Council (NAAC), Rehabilitation council of India (RCI), and University Grants commission (UGC) with a view to ascertain whether they address all dimensions of the discipline of communication sciences and disorders, and (c) design a conceptual framework for research metrics for communication sciences and disorders by seeking the views of the professionals for the various proxies proposed, and identify the pertinent research products for developing a comprehensive suite of metrics for measuring research productivity in the field of communication sciences and disorders in India.

MATERIALS AND METHODS

Review of existing frameworks

12 existing frameworks for assessment of higher education and research institutions, 37 studies for a period covering 1993 to 2013 in the field of health research, and reviews were surveyed and reviewed. The review of evaluation of research in academic/ research institutions covered 8 international frameworks selected from the study conducted by Guthrie, Wamae, Diepeveen, Wooding and Grant (2013), RAND Europe - European Commission Funded Project, [8] which synthesized the

frameworks and indicators used to evaluate research: Research Excellence Framework, UK, [7] Excellence in Research for Australia (ERA), Australia, [9] National Institution for Academic Degree and University Evaluation (NIAD-UE), Japan, [10] Evaluation Agency for Research and Higher Education (AERES), France, [11] Standard Evaluation Protocol, Netherlands, [12] Performance Based Research Fund (PBRF), New Zealand, [13] SIAMPI-Productive Interactions, [14] the Canadian Academy of Health Sciences Framework, [15] the study by Louis and Reed (2013) (Research metrics working group on US Research Universities Futures Consortium, U.S.A), [16] and 4 national frameworks [NAAC Self-Study Report, [17] RCI Joint Inspection Report, [18] RCI Proforma for the assessment and accreditation of institutions approved by RCI, [19] UGC (Measures for the maintenance of standards in Higher Education) (2nd Amendment) Regulations. [20] Apart from this, the review of evaluation of research in health research covered 37 primary studies which includes the review undertaken by Milat et al (2015) which covers 31 primary studies and 1 systematic review comprising of assessment of the impacts of a wide-range of health related research, including health service research and public health research, giving a narrative literature review by synthesizing evidence that describes processes and conceptual models for assessing policy and practice impacts of public health research, [21] the Societal Impact framework conducted by Royal Netherland Academy of Arts & Sciences, [22] the Bernard Becker Library Model, [23] study by Zamarripa (1993) which listed 25 measures that could be used in assessing productivity of a mental retardation research centre, [24] and a systematic review by Patel, Ashrafian, Ahmed, Arora, Jiwan, Nicholson, Darzi and Athanasiou (2011) to identify the indicators that have been used to measure healthcare research performance. [25] A meta-analysis of the review was done.

Comparison of existing research metrics by national agencies

Research metrics contained in the accreditation/ regulatory agencies viz., National Assessment and Accreditation Council, Rehabilitation Council of India and University Grants Commission were compared for proxies, dimensions and sub-dimensions of research productivity.

Design of a conceptual framework and Identification of pertinent research products for developing a comprehensive metrics for communication sciences and disorders

The Speech and Hearing institutions in India cannot function as islands and have to be an integral part of the national agenda in Higher Education and Health sector. In the above context, the metrics/ questions that need to be satisfactorily answered included the following questions: (a) Can the list of research products and metrics be limited to academic or scholastic outputs alone? (b) Do the existing metrics capture research products having health/clinical impact and the contribution of scientific / research activities that extend social and economic benefits? (c) Even, while these dimensions are captured, is it being done just in passing? (d) Are the dimensions relating to practice, policy and societal impact being measured along with pertinent indicators at the desired level commensurate with the intensity and depth as is being done for the scholastic outputs? (e) How to make the gamut of research products comprehensive to cover the aspects of knowledge production, knowledge usage, knowledge exchange, knowledge dissemination, innovations covering all dimensions of research, that aid in the professional practice, say diagnostics, service delivery, including outreach and extension activities having impact on society and those involving policy formulation?

Based on the domains, which will be referred as proxies, that were studied under the various frameworks and taking into account, the approach of this paper to cover

all principal stakeholders, a tentative conceptual framework for Research Assessment Metrics in communication sciences and disorders, covering nine proxies, was arrived at.

Questionnaire

A questionnaire containing the relevant portions along with the tentative Model, which included the proxies and performance indicators (metrics) was sent to 30 faculty working in Speech and Hearing institutions in India having a doctorate degree in speech, language and hearing discipline and currently holding the post of Associate Professor/Reader and above in the speech and hearing institutions in the country. The questionnaire sought the agreement/ views or otherwise of the participants on the proposed nine proxies for measuring the research productivity in the discipline of communication sciences and disorders, asking them to accord weight age to the proxies and also indicate additional performance indicators, if any, in Indian context. The mean % weight age for each proxy was calculated by using the following formula:

Mean % Weight age for a proxy = (Total of weight age assigned by the professionals for each proxy / Total number of professionals) * 100

The data so obtained was analyzed qualitatively. The research metrics extracted from the full text by the first author was reviewed by the other two authors and final decision was made by consensus and agreement of all authors. After review of the various performance indicators relating to research products and research efforts (N=608), taking into account, the contextual relevance, usefulness for the study, feasibility of measurement and after exclusion of duplicate indicators, the Research Assessment Metrics Model for communication sciences and disorders (RAM CD Model) suiting Indian context was arrived at.

RESULTS

Review of existing frameworks

A meta-analysis of the existing frameworks for assessment of higher education and research institutions and the 37 studies for the period covering 1993-2013 in the field of health research, and reviews yielded 608 performance indicators (metrics) relating to research products and research efforts and covered 18 areas which included (a) Advancing knowledge (b) Knowledge production (c) Knowledge translation, (d) Research Capacity building, (e) Informing Policy and Decision making, (f) Societal impact (g) payback, (h) Socio-economic benefits, (i) public engagement in research, (j) Practice impact, (k) Potential health care benefits, (l) Service impact, (m) Procurement of research grants, (n) Attracting R&D investments, (o) Products, (p) Applications, (q) Esteem measures, and (r) Collaboration and Networking. Keeping in view the major domains of impact that the above areas cover, 9 proxies were identified and the above 18 areas were grouped as follows:

Proxy 1 : Knowledge products including use and exchange

Proxy 2 : Attractiveness to procure projects, consultancies

Proxy 3 : Knowledge Networking, Collaboration

Proxy 4 : Esteem measures

Proxy 5 : Research targeting and capacity building

Proxy 6 : Product / applications

Proxy 7 : Innovation in diagnostic, management, service delivery impacting health care, economic benefits to persons with communication disorders

Proxy 8 : Policy impact

Proxy 9 : Innovation in public health initiatives having societal impact

The results of meta-analysis after grouping the existing frameworks and the primary studies on the subject are in [Appendix-1](#).

Comparison of existing research metrics

A comparison of existing research metrics at the national level indicated 7 proxies, 5 dimensions, 11 sub-dimensions, and 31 metrics. UGC included 6 proxies -

[(a) knowledge products including use and exchange, (b) attractiveness to procure projects, consultancies, (c) knowledge networking, collaboration, (d) research targeting and capacity building, (e) product / applications, and (f) innovation in public health initiatives having societal impact], 5 dimensions [(a) publication, presentation, participation, (b) procurement of projects, consultancy, (c) partnerships, (d) Ph.D./PG, UG students mentoring and guidance, and (e) public education / public health initiatives], and 10 sub-dimensions [(a) publications in journals, (b) publications (others), (c) sciento-metrics, (d) professional updation, (e) project grants: procurement, (f) project grants : evaluation, (g) Ph.D. / Post-Doc Guidance, (h) PG dissertation / projects for UG students, (i) products, and (j) public health initiatives / public education].

NAAC included 7 proxies [(a) knowledge products including use and exchange, (b) attractiveness to procure projects, consultancies, (c) knowledge networking, collaboration, (d) esteem measures, (e) research targeting and capacity building, (f) product / applications, and (g) innovation in public health initiatives having societal impact], 6 dimensions [(a) publication, presentation, participation, (b) procurement of projects, consultancy, (c) partnerships, (d) Prestige, (e) Ph.D./PG, UG students mentoring and guidance, (f) public education / public health initiatives], and 12 sub-dimensions [(a) publications in journals, (b) publications (others), (c) sciento-metrics, (d) professional updation, (e) project grants : procurement, (f) faculty serving as members in editorial / panel, (g) membership in professional bodies, (h) awards and honors, (i) Ph.D. / Post-Doc Guidance, (j) PG dissertation / projects for UG students, (k) products, and (l) public health initiatives / public education].

RCI included 6 proxies [(a) knowledge products including use and exchange, (b) attractiveness to procure projects, consultancies, (c) knowledge

networking, collaboration, (d) esteem measures, (e) research targeting and capacity building, and (f) innovation in public health initiatives having societal impact], 6 dimensions [(a) publication, presentation, participation, (b) procurement of projects, consultancy, (c) partnerships, (d) prestige (e) Ph.D./PG, UG students mentoring and guidance, (f) public education / public health initiatives], and 6 sub-dimensions [(a) publications in journals, (b) project grants : procurement, (c) faculty serving as resource persons (d) Ph.D. / Post-Doc Guidance, (e) PG dissertation (f) public health initiatives / public education]. A total of 31 metrics were employed by these 3 national agencies. [Appendix-1](#) shows the proxies under these three national agencies under serial numbers 9-12, while the dimensions, and sub-dimensions included under each of the proxies is indicated in [Appendix-2](#).

It was noticed that the NAAC covered 7 proxies and did not include the

proxies relating to Informing Policy and Decision making and Products/ Applications. The Rehabilitation Council of India Inspection Report (2014) covered only 4 proxies and did not include the proxies relating to Informing Policy and Decision making, Practice impact /Potential health care benefits / Service impact, Products/ Applications, Esteem measures, Collaboration and Networking. The RCI proforma for the assessment and accreditation of institutions approved by RCI , India covered 6 proxies and did not include the proxies relating to Informing Policy and Decision making, Practice impact /Potential health care benefits / Service impact and Esteem measures. The UGC covered 6 proxies and did not include the proxies relating to Informing Policy and Decision making, Practice impact /Potential health care benefits / Service impact and Collaboration and Networking.

Table 1: Assignment of weight ages for the proposed nine proxies by the respondents.

Proxy	Details	Percent response	
		Mean	SD
1.	Publications strengths	17.57	8.55
2.	Procurement of research project grants	16.18	5.12
3.	Ph.D. supervision /PG dissertation guidance	12.29	2.40
4.	Professional practice	9.71	3.53
5.	Product development	9.36	2.61
6.	Partnerships with academia / industry /NGOs	9.29	3.78
7.	Policy contribution	9.18	4.45
8.	Prestige	8.86	2.77
9.	Public Education/Public Health initiatives	7.56	3.72
	Total	100.00	

Design of a conceptual framework and Identification of pertinent research products for developing a comprehensive metrics for communication sciences and disorders

Out of the total 30 faculty who fulfilled the criteria from among the speech and hearing institutions in the country, responses were received from 20 respondents who had given their views on the model. Fifteen out of the 20 (66.66%) respondents agreed with the proposed nine proxies, but the questionnaire seeking assignment of weight ages was filled by only 14 respondents. Three out of the 20

respondents broadly agreed to the proposed nine proxies, but desired a focal group discussion for determining the weight ages; the remaining 2 respondents had reservations about measurement of the proxies and had also not assigned the weight ages. The highest and the lowest weight age were accorded respectively to publication strengths (17.57%) and publication education / public health initiatives (7.57%). The second highest weight age was accorded to procurement of research projects (16.18%). The third highest weight age was accorded to Ph.D. Supervision / PG dissertation guidance (12.29%). While the

other proxies viz., partnership with academia / industry/ NGOs, prestige, professional practice, product development and policy contribution are accorded equal weight age of about 9%. Table 1 shows the weight ages assigned by the 14 respondents for the proposed nine proxies.

Proposed New Metrics in Indian context

Based on the suggestions received from the respondents, the frameworks studied and in keeping with the proxies, the new metrics proposed include the following:

Proxy 1: Keeping in view, the differences in publication and citation pattern in a multidisciplinary subject of study as the communication sciences and disorders, and to keep up with the emerging trends in citation practices new indicators for scientometrics - *Qualitative Indices based on discipline specific Journal Rankings, and Inclusion of altmetrics* - were proposed.

Proxy 2: Taking into account, the need for dissemination of the results of the research projects, *Peer reviewed publications per project* was suggested.

Proxy 3: With a view to have more qualitative features and ultra-defined and precise measurables, *Internal collaborative efforts in terms of number of collaborations, departments or disciplines represented, External collaborative efforts in terms of No. of collaborations, No. of depts. or disciplines represented, No. of institutions represented, Scientific consultation with other universities, Staff movement between academia and industry, and Collaborative research with industry measurement through co-authored outputs* were included.

Proxy 4: With a view to expand the existing metrics which are very broad and vague, *Requests for assistance in problem solving, Research scholarships (Post doctoral scholarships, Serving in Peer review process, Serving in Research granting bodies as expert / panel member, Serving as Reviewer of Research Projects, Membership in professional bodies with official positions, Membership in research committees of other institutions, and Translations into foreign language of*

publications (of an institute / individual) were included to capture the various indicators of professional esteem and recognition measures.

Proxy 5: No new metrics proposed, but only modifications to the existing metrics such as inclusion of post doctoral mentoring, inclusion of no. of UG students guided for research projects/summer internships.

Proxy 6: There is need to recognize the research efforts and the research products beyond the traditional metrics and should take into account the various intellectual processes and products including products generated at the intermediary stages. Keeping this in mind, *Audio visuals / Documentaries, films, Research data generated, Databases resulting from research study / Meta data from research data, Research data deposited with shared depository, Theoretical Constructs / Models based on research study, Conceptual Frameworks / Systematic Reviews, Research study findings lead to new direction and / or field of research, and Income from intellectual property/ technology know-how / license agreement patents copyrights etc.* were included.

Proxy 7: The health gains and advancements / enhancements in clinical practice have not received due attention in a practicing discipline like speech, language and hearing sciences. Therefore, *Evidence based practice, Number of new guidelines, standards and protocols developed, Number of new manuals / training materials developed, Diagnostic application for identification of a disease, disorder or condition developed as a result of the research study, Screening tool for identification of a disease, disorder or condition developed as a result of the research study, Intervention strategies, Tele-rehabilitation initiatives / measures, Mobile Rehabilitation, Applications, Websites on rehabilitation, Cost savings in aids and devices: low cost hearing aids, low cost-alternate substituted implants, Reported health service benefit, and*

Adoption of research and / or results used to inform a change in health policy, program , or service delivery, recommendation for the health system, etc. were included.

Proxy 8 : With a view to acknowledge and merit the importance of research outcome to policy making, *Guidelines and documents addressing policies, Awareness of research results in policy making, Invitation to serve on Policy Advisory Boards/Committees for policy development, and Research study cited in Legislation/ Acts/ National/ State Policies/Guidelines/Quality Standards* were included in the model.

Proxy 9: The Speech and Hearing institutions have a vital role in the public health initiatives by the Government at the national / state / local level. Keeping the above in view, the metrics - *Social media initiatives: Twitter, blogs, Face book etc, Presentations to community groups and organization, Number and description of social benefits and well-being outcomes reported as achieved by grantees by type, and target group, Total value of the Quality Added Life Years (QALYs), Mean lag between research and impact, Health literacy, Health status, Social capital and empowerment, Increased level of public engagement with science and research, Pre-and during - research process liaison with potential users, Reported economic benefits, Press release for creating awareness among Society, Innovations in Public Health / Public Education Initiatives, No. of street plays in rural / remote areas for creating awareness, No. of walkathons for creating awareness, No. of public education pamphlets prepared/ translated in local languages, No. of public lectures in local languages, No. of Radio Shows in local channels on awareness, prevention, No. of TV Shows in local channels on awareness, prevention, and No. of articles in popular vernacular newspapers/ magazines* - were included.

The meta-analysis yielded 608 performance indicators (metrics) relating to research products and research efforts. Taking into account, the contextual

relevance, usefulness for the study, feasibility of measurement and after exclusion of duplicate indicators, 90 performance indicators were finally included. These performance indicators were classified under nine proxies. A total of 8 dimensions - (a) publication, presentation, participation, (b) procurement of projects, consultancy, (c) partnerships, (d) prestige, (e) Ph.D./PG, UG students mentoring and guidance,(f) professional practice enhancement, (g) policy formulation laws, regulations, (h) public education / public health initiatives - were identified. The dimensions were further classified under 13 sub-dimensions - (a) publications in journals, (b) publications (others), (c) sciento-metrics, (d) professional updation, (e) project grants : procurement, (f) project grants : evaluation, (g) faculty serving as members in editorial / panel, (h) membership in professional bodies, (i) awards and honors, (j) Ph.D. / Post-Doc Guidance, (k) PG dissertation / projects for UG students, (l) products, and (m) public health initiatives / public education . [Appendix-2](#) shows the final RAMCD model under the 9 proxies, 7 dimensions, 15 sub-dimensions, and 90 performance indicators. While the existing metrics adopted by the various national agencies, currently are presented on the left hand side of the table, the modifications suggested to the existing metrics and the proposed new metrics are presented on the right hand side of the table in [Appendix-2](#).

DISCUSSION

This study illustrates a conceptual framework / model for measurement of research productivity in speech, language, hearing sciences and its disorders in Indian context, in terms of the various domains encompassing the expectations/ standards of excellence that is required of Higher Education Institutions as well as the health research outcomes, especially those related to practice and public health. First of all, it was interesting to note that the research productivity dimensions used internationally

and nationally were almost similar though less in number at the national level. The number of metrics used at the international level was more in number compared to those used at the national level. The highest percent weight age was for research publication strength and the lowest for Public Education/Public Health initiatives. Second, quantitatively, in terms of the number of proxies covered, the NAAC and UGC fared favorably in terms of their international counterparts, Qualitatively, though, additional metrics seems to be needed to match the research metrics as at US universities. Third, the responses of the participants were interesting in that they thought of several metrics apart from those existing in the NAAC, RCI, or UGC. These metrics were suggested in almost all dimensions more so in Public Education/Public Health initiatives. As such Social media initiatives: Twitter, blogs, Face book etc, Presentations to community groups and organization, Number and description of social benefits and well-being outcomes reported as achieved by grantees by type, and target group, Total value of the Quality Added Life Years (QALYs), Mean lag between research and impact, Health literacy, Health status, Social capital and empowerment, Increased level of public engagement with science and research, Pre- and during - research process liaison with potential users, Reported economic benefits, Press release for creating awareness among Society, Innovations in Public Health / Public Education Initiatives, No. of street plays in rural / remote areas for creating awareness, No. of walkathons for creating awareness, number of public education pamphlets prepared/ translated in local languages, public lectures in local languages, Radio Shows in local channels on awareness, prevention, and TV Shows in local channels on awareness, prevention, and No. of articles in popular vernacular newspapers/ magazines cannot be considered as research productivity unless documented with evidence base and research studies. However, they have been

included in the RAMCD model, though with lower percent weight age.

One of the strengths of this study is that while aiming to be comprehensive, it does not lose its specificity with respect to each of the domains of impact and while suggesting the suite of metrics that are relevant to each domain, keeping in mind the measurability in terms of clearly defined quantifiables. The metrics can also be applied across various levels and units of assessment viz., individual, institutional, departmental, inter-institutional and also for comparative studies between various geographies.

This study was limited to faculty working in speech and hearing institutions in India having a doctorate degree in the area of speech and hearing and currently holding a position of Associate Professor / Reader and above. Being a highly specialized and non-traditional discipline, 30 faculties fulfilled the above criteria and were sent the questionnaire. The questionnaire was returned by 20 faculties. Although, the respondents represent faculty across different academic setups comprising of public / private funded colleges and universities, a still higher response might have resulted in additional suggestions, inclusion of additional metrics. Further, no previous study in the field of communication sciences and disorders exist.

Though focused on the discipline of communication sciences and disorders, it can be applied to any health/allied health setting. The model may serve as a valid basis for evidence-based policy making and can be used as a guideline and resource by research funding agencies, educational administrators and the policy makers.

CONCLUSIONS

The study did a Meta-analysis of review in the field of research productivity and designed questionnaire which was administered to professionals in the field of communication sciences and disorders. Based on the feedback to the questionnaire a model on research productivity named

RAMCD was evolved. The results of the study highlights the role of speech and hearing institutions, be it public funded or a private institutions in the nation building by being a part of a nations' mission and vision in the higher education and health sector and also contribute globally towards the Millennium Development Goals (MDGs) of the WHO. The results of this study may also trigger a debate and deliberations among the various stakeholders: the professionals (practitioners), the project funding agencies, the policymakers, the persons involved in governance and leadership of public funded / private funded institutions, and the public community / society, all the principal stakeholders on how best to measure and capture the research outcomes, outputs and impact in this discipline.

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**Appendix-1: Frameworks / studies focusing on assessing research impact in terms of domains of impact in Academic /
Research Institutions & Health Research**

Framework / Studies	Type of research assessed	Knowledge products, use and exchange Proxy 1	Attractiveness to procure projects, consultations Proxy 2	Knowledge Networking, Collaboration Proxy 3	Esteem measures Proxy 4	Research targeting , capacity building Proxy 5	Products/ Applications Proxy 6	Innovation in diagnostic, management, service delivery Proxy 7	Policy impact Proxy 8	Innovation in public health initiatives Proxy 9
EVALUATION OF RESEARCH IN ACADEMIC / RESEARCH INSTITUTIONS										
INTERNATIONAL										
1	Research metrics working group, US Research Universities Futures Consortium ^[16]	Evaluation of academic research in American Universities	✓	✓	✓	✓	✓	✓	✓	✓
2	Research Excellence Framework, UK ^[7]	Framework for assessment of higher education institutions in UK	✓				✓	✓	✓	✓
3	Excellence in Research for Australia ^[9]	Evaluation of the quality of research in Higher Education Institutions in Australia	✓	✓		✓	✓			
4	National Institution for Academic Degree and University Evaluation (NIAD-UE), Japan ^[10]	Evaluation of education and research at Japanese Higher Education Institutions	✓	✓	✓	✓	✓			✓
5	Performance Based Research Fund (PBRF), New Zealand ^[13]	Evaluation of research excellence in New Zealand's degree granting institutions	✓	✓		✓	✓			
6	Standard Evaluation Protocol, Netherlands ^[12]	Evaluation of public funded research	✓	✓	✓	✓	✓		✓	✓
7	SIAMPI, Productive Interactions European Commission Funded Project ^[14]	Social Impact Assessment Methods for research and funding instruments through the study of Productive Interactions (SIAMPI) between science and society	✓	✓	✓				✓	✓
8	Evaluation Agency for Research and Higher Education (AERES), France ^[11]	Evaluation of French research and higher education institutions	✓							✓
NATIONAL										
9	National Assessment and Accreditation Council (NAAC) Self-Study Report (2013), India ^[17]		✓	✓	✓	✓	✓	✓		✓
10	Rehabilitation Council of India (RCI) Inspection Report (2014)		✓	✓			✓			✓

	[18]										
11	Rehabilitation Council of India Proforma for the assessment and accreditation of institutions approved by RCI, India [19]		✓	✓	✓		✓	✓			✓
12	University Grants Commission (Minimum qualifications for appointment of teachers and other academic staff in universities and colleges and measures for the maintenance of standards in Higher Education) (2 nd Amendment) Regulations, 2013, India [20]		✓	✓		✓	✓	✓			✓
HEALTH RESEARCH											
13	Edward J. Zamarripa (1993) [24]	Mental Retardation - Research Productivity: A Definition	✓	✓	✓	✓	✓	✓			
14	National Institutes of Health (1993) [26]	Biomedical Research							✓		✓
15	Canadian Academy of Health Sciences Framework [15]	Outcomes under health research	✓	✓			✓	✓	✓	✓	✓
16	Landry et al (2001) [27]	Research	✓					✓	✓	✓	
17	Lavis et al (2003) [28]	Health research	✓							✓	
18	Wooding et al (2004) [29]	Arthritis research campaign (arc) funded research in the UK	✓				✓		✓	✓	✓
19	Franks et al (2006) [30]	Prevention research									✓
20	Kuruvilla et al (2006) [31]	Health research	✓		✓	✓	✓	✓	✓	✓	✓
21	Kuruvilla et al (2007) [32]	Health services research	✓		✓	✓	✓	✓	✓	✓	✓
22	Barker (2007) [33]	Research in the United Kingdom (UK)	✓	✓	✓		✓	✓			
23	Hanney et al (2007) [34]	NHS Health Technology Assessment Programme	✓						✓	✓	
24	Kwan et al (2007) [35]	Hong Kong Health and Health Services Research Fund (HHSRF)	✓				✓	✓	✓	✓	
25	Weiss (2007) [36]	Medical research	✓						✓	✓	✓
26	Buxton et al (2008) [37]	Medical Research in the United Kingdom (UK) (cardiovascular health and mental health)									✓
27	Kalucy et al	Primary Care	✓				✓		✓	✓	✓

	(2009) ^[38]	Research									
28	Liebow et al (2009) ^[39]	National Institute of Environmental Health Sciences (NIEHS) Extramural Asthma Research Program	✓	✓			✓	✓	✓	✓	✓
29	Bernard Becker Medical Library (2010) ^[23]	Washington University Model	✓					✓	✓	✓	✓
30	Banzi et al (2011) ^[40]	Health research	✓				✓	✓	✓	✓	✓
31	Boyack & Jordan (2011) ^[41]	National Institutes of Health (NIH) grants	✓	✓							
32	Derrick et al (2011) ^[42]	Australian Researchers in Six Fields of Public Health	✓								
33	Higher Education Funding Council for England (2011) ^[43]	High education funding in England	✓								✓
34	Spoth et al (2011) ^[44]	Family-Focused Prevention Science						✓			✓
35	Sullivan et al (2011) ^[45]	United Kingdom cancer centres (UKCC)	✓		✓						
36	Taylor & Bradbury-Jones (2011) ^[46]	Nursing research	✓					✓			✓
37	Patel, V.M. et al., (2011) ^[25]	Systematic review to identify the indicators to that have been used measure healthcare research performance	✓	✓		✓	✓	✓	✓		
38	Aymerich et al (2012) ^[47]	Spanish network center for research in epidemiology and public health	✓		✓		✓	✓	✓		✓
39	Barber et al (2012) ^[48]	Public involvement (community engagement) in research									✓
40	Buykx et al (2012) ^[49]	Health Services Research	✓	✓			✓	✓	✓	✓	✓
41	Deloitte Access Economics (2012) ^[50]	National Health and Medical Research Council (NHMRC) Research in Australia									✓
42	Graham et al (2012) ^[51]	Health research: Alberta Heritage Foundation for Medical Research	✓				✓	✓	✓	✓	✓
43	Group of Eight Australian	To measure the innovation									

	(universities) and Australian Technology Network (2012) ^[52]	dividend of research generated by Australian universities across areas of: *Defence *Economic *Development *Society (including health) *Environment	✓								✓
44	Ovseiko et al (2012) ^[53]	Academic clinical medicine		✓	✓		✓	✓	✓	✓	✓
45	Schapper et al (2012) ^[54]	Murdoch Childrens Research Institute, Australia	✓	✓			✓	✓	✓	✓	
46	Warner & Tam (2012) ^[55]	Tobacco control research								✓	
47	Laws et al (2013) ^[56]	Population health surveys	✓				✓		✓	✓	✓
48	Milat et al (2013) ^[57]	Health Promotion Applied Research	✓				✓		✓	✓	✓
49	Societal Impact Framework ^[22]	Royal Netherland Academy of Arts & Sciences									✓

Appendix - 2: Research Assessment Metrics for communication sciences and disorders - RAM CD Model

Proxy 1 :Knowledge products including Use and Exchange, Dimension : Publication, Presentation, Participation,						Sub-Dimension: Publications in Journals	
#	Performance indicators / Metrics (Existing)	Data Source	#	Performance indicators / Metrics (Modifications suggested to existing metrics/New suggested for inclusion)	Data Source		
	Number of Publications by faculty and students in			Data to be captured in terms the following	Modification suggested to existing metric		
1	Refereed Journals	UGC		Total number of publications / paper presentations each year / for a given time frame.Per faculty , Per student			
2	Non-refereed Journals/Periodicals with ISBN/ISSN nos.	-do-					
3	Full paper (Regular/Short/ Poster) in Conference Proceedings [Abstracts excluded]	-do-		Mean publications / paper presentations each year / for a given time frame ,Per faculty Per student			
Sub-Dimension : Publications (Others)							
4	Text/Reference Books published by International Publisher with peer-review system	UGC					
5	Subject Books by National Publisher/State Level/ Central Government publications with ISSN/ISBN numbers	-do-					
6	Subject Books by other Local Publisher with ISSN/ISBN numbers	-do-					
7	Chapters contributed to edited knowledge based volumes published by International Publishers	-do-					
8	Chapters in knowledge based volumes by Indian/ National Level Publisher with ISBN/ISSN numbers and with numbers of national / international directories	NAAC					
9	Publication of any reports/ compilations/ clinical round-ups as a part of clinical research to enrich knowledge, skills and attitudes	-do-					
10	International Database (For Eg: Web of Science, Scopus, Humanities International Complete, EBSCO host, etc.)	-do-					
11	Monographs						
Sub- Dimension :Scientometrics							
12	Qualitative Indices : Citation Index,SNIP, SJR , Impact factor h-index	NAAC	13	Qualitative Indices based on discipline specific Journal Rankings	Excellence in Research for Australia (ERA) (2012) ^[9]		
			14	Inclusion of altmetrics	US Research Metrics Working Group (2013) ^[10]		
Sub-Dimension : Professional Updation							
15	Papers in Conferences/ Seminars/ workshops etc.	NAAC					
16	Participation/ Presentation of research papers (oral/poster) in a) International conference b) National Conferences c) Regional/State Level	NAAC					

	d) Local –Univ/College level				
17	Details of workshops/ training programs/ sensitization programs conducted by the institution to promote research culture	NAAC			
#	Performance indicators / Metrics (Existing)	Data Source	#	Performance indicators / Metrics (Modifications suggested to existing metrics/New suggested for inclusion)	Data Source
18	Training Courses and Conference /Seminar/ Workshop Refresher courses, Methodology workshops, Training, Teaching- Learning-Evaluation Technology Programmes, Soft Skills development Programmes, Faculty Development Programmes (a) Not less than two weeks duration (b) One week duration	UGC			
Proxy 2 : Attractiveness to procure projects, Consultancies					
Dimension : Procurement of projects, consultancy			Sub-Dimension: Project grants : Procurement		
19 (a)	Major Research Projects amount mobilized with grants > 30.0 lakhs Intramural Inter / Multi / Trans disciplinary Extramural Inter / Multi / Trans disciplinary	UGC		<i>Data to be captured in terms the following:</i> Total grants procured each year / for given time frame. <i>Distinguishes Intramural and Extramural Research projects, besides classifying them as Inter/Multi/Trans Disciplinary Projects</i>	Modifications suggested to the existing metric
(b)	Major Projects amount mobilized with grants above 5.0 lakhs up to 30.00 lakhs Intramural Inter / Multi / Trans disciplinary Extramural Inter / Multi / Trans disciplinary	UGC		<i>Data to be captured in terms the following:</i> Total grants procured each year / for given time frame. <i>Distinguishes Intramural and Extramural Research projects, besides classifying them as Inter/Multi/Trans Disciplinary Projects</i>	Modifications suggested to the existing metric
©	c) Minor Projects (Amount mobilized with grants above Rs. 50,000 up to Rs. 5 lakh)	UGC		-do-	-do-
			20	Peer reviewed publications per project	Kwan et al. (2007) ^[35]
21	Consultancy Projects carried out / ongoing Amount mobilized with minimum of Rs.10.00 lakh	UGC		<i>Data to be captured in terms the following</i> Total value of consultancy carried out each year / for given time frame	Modifications suggested to the existing metric
Sub-Dimension : Project grants - Evaluation					
22	Completed projects Quality Evaluation Completed Project Report (Acceptance from Funding Agency)	UGC			
Proxy 3 :Knowledge Networking, Collaboration					
Dimension : Partnerships			Sub-Dimension: Partnerships with Academia/Industry/NGO		
23	Collaboration / partnership / networking	NAAC		<i>Data to be captured in terms the following</i> Partnerships with Academia, Industry, NGOs International (outside the country) National (within the country) having clearly defined deliverables	Modifications suggested to the existing metric
			24	<i>Internal collaborative efforts in terms of No. of collaborations, No. of depts. Or disciplines represented</i>	Zamarripa (1993), ^[24] Bernard Becker Medical Library Model (2010) ^[23]
			25	<i>External collaborative efforts in terms of No. of collaborations, No. of depts. Or disciplines represented, No. of institutions represented</i>	Zamarripa (1993), ^[24] Bernard Becker Medical Library Model (2010) ^[23]
#	Performance indicators / Metrics (Existing)	Data Source	#	Performance indicators / Metrics (Modifications suggested to existing metrics/New suggested for inclusion)	Data Source
			26	<i>Scientific consultation with other universities</i>	Zamarripa (1993) ^[24]
			27	<i>Staff movement between academia and industry</i>	Ovseiko et al. (2012) ^[53]
			28	<i>Collaborative research with industry measurement through co-authored outputs</i>	Ovseiko et al. (2012) ^[53]
Proxy 4: Esteem Measures					
Dimension : Prestige			Sub-Dimension: Faculty serving as members in editorial / panel, Membership in professional bodies /Awards and honors		
29	Serving in Editorial board of International / National journals	NAAC	36	<i>Requests for assistance in problem solving</i>	Zamarripa (1993) ^[24]
30	Membership in steering committees of national and international conferences of repute in the field		37	<i>Research scholarships (Post doctoral scholarships)</i>	Research Excellence Framework, UK (2014) ^[7]
31	Research awards received by faculty		38	<i>Serving in Peer review process</i>	New indicator
32	Research awards received by students		39	<i>Serving in Research granting bodies as expert / panel member</i>	New indicator
33	National and International recognition received by the faculty from reputed professional bodies and agencies		40	<i>Serving as Reviewer of Research Projects</i>	New indicator
34	Invitations to conference/ workshop as resource person (as tutorial speaker)		41	<i>Membership in professional bodies with official positions</i>	New indicator
35	Invitations to scientific presentations / lecture (as		42	<i>Membership in research committees of other</i>	New indicator

	keynote speaker panel / session chair			<i>institutions</i>	
			43	<i>Translations into foreign language of publications (of an institute / individual)</i>	Zamarripa (1993) ^[24]
Proxy 5: Research targeting and Capacity building					
Dimension : Ph.D./PG, UG students mentoring and guidance			Sub-Dimension: Ph.D. / Post-Doc Guidance ,PG dissertation / Projects for UG students		
44	No. of Ph.D. students guided / supervised Ph.D Degree awarded / Thesis Submitted	NAAC UGC		Data to be captured in terms the following No. of post doctoral students guided No. of PG students guided for dissertation No. of UG students guided for research projects / summer internship	Modifications suggested to the existing metric
45	No. of M.Phil. students guided for dissertation	UGC			
Proxy 6 :Products / Applications					
Dimension : Products			Sub-Dimension: Patents, Research Data		
46	Patent / Technology Transfer /Product process	NAAC	47	Audio visuals / Documentaries, films	Bernard Becker Medical Library Model (2010) ^[23]
			48	Research data generated	Bernard Becker Medical Library Model (2010) ^[23]
			49	Databases resulting from research study / Meta data from research data	Bernard Becker Medical Library Model (2010) ^[23]
			50	Research data deposited with shared depository	Bernard Becker Medical Library Model (2010) ^[23]
#	Performance indicators / Metrics (Existing)	Data Source	#	Performance indicators / Metrics (Modifications suggested to existing metrics/New suggested for inclusion)	Data Source
			51	Theoretical Constructs / Models based on research study	Bernard Becker Medical Library Model (2010) ^[23]
			52	Conceptual Frameworks / Systematic Reviews	Bernard Becker Medical Library Model (2010) ^[23]
			53	Research study findings lead to new direction and / or field of research	Bernard Becker Medical Library Model (2010) ^[23]
			54	Income from intellectual property/ technology know-how / license agreement patents copyrights etc.	Ovseiko et al. (2012), ^[53] Bernard Becker Medical Library Model (2010) ^[23]
Proxy 7 : Innovation in diagnostic, management, service delivery					
Dimension : Professional practice enhancement			Sub-Dimension: Manuals, Guidelines, Training materials		
			55	<i>Evidence based practice</i>	Kuruville et al. (2006) ^[32]
			56	<i>Number of new guidelines, standards and protocols developed</i>	Graham K.E.R. (2012) ^[51]
			57	<i>Number of new manuals / training materials developed</i>	Graham K.E.R (2012) ^[51]
			58	<i>Diagnostic application for identification of a disease, disorder or condition developed as a result of the research study</i>	Bernard Becker Medical Library Model (2010) ^[23]
			59	Screening tool for identification of a disease, disorder or condition developed as a result of the research study	Bernard Becker Medical Library Model (2010) ^[23]
			60	Intervention strategies	Liebow et al. (2009) ^[39]
			61	Tele-rehabilitation initiatives / measures	Bernard Becker Medical Library Model (2010) ^[23]
			62	Mobile Rehabilitation Applications	Bernard Becker Medical Library Model (2010) ^[23]
			63	Websites on rehabilitation	Bernard Becker Medical Library Model (2010) ^[23]
			64	Cost savings in aids and devices: low cost hearing aids, low cost-alternate substituted implants	Bernard Becker Medical Library Model (2010) ^[23]
			65	Adoption of research and / or results used to inform a change in health policy, program , or service delivery, recommendation for the health system, etc.	Graham K.E.R. (2012) ^[51]
			66	Reported health service benefit	Wooding et al. (2004) ^[29]
Proxy 8: Policy Impact					
Dimension : Policy Formulation, Legislation			Sub-Dimension: Laws, Regulations		
			67	Guidelines and documents addressing policies	Bernard Becker Medical Library Model (2010) ^[23]
			68	Awareness of research results in policy making	Bernard Becker Medical Library Model (2010) ^[23]
			69	Invitation to serve on Policy Advisory	Bernard Becker Medical

				Boards/Committees for policy development	Library Model (2010) [23]
			70	Research study cited in Legislation/Acts/National/State Policies/Guidelines/Quality Standards	Bernard Becker Medical Library Model (2010) [23]
#	Performance indicators / Metrics (Existing)	Data Source	#	Performance indicators / Metrics (Modifications suggested to existing metrics/New suggested for inclusion)	Data Source
Proxy 9: Innovation in public health initiatives having Societal impact					
Dimension : Public Education / Public Health Initiatives			Sub-Dimension: Public Education /Social Benefits		
71	Extension and dissemination activities (public lectures, talks, popular writing etc. not covered elsewhere) impacting Prevention, incidence, prevalence, improving quality of life of persons with communication disorders	UGC	72	Social media initiatives: Twitter, blogs, Facebook, etc	Bernard Becker Medical Library Model (2010) [23]
			73	Presentations to community groups and organization	Zamarripa (1993) [24]
			74	Number and description of social benefits and well-being outcomes reported as achieved by grantees by type, and target groups.	Graham K.E.R. (2012) [51]
			75	Total Value of the Quality Added Life Years (QALYs)	Buxton et al. (2008) [37]
			76	Mean lag between research and impact	Kuruvilla et al. (2006) [32]
			77	Health literacy	Kuruvilla et al. (2006) [31,32]
			78	Health status	Kuruvilla et al. (2006) [31,32]
			79	Social capital and empowerment	Kuruvilla et al. (2006) [32]
			80	Increased level of public engagement with science and research	Ovseiko et al (2012) [53]
			81	Pre-and during - research process liaison with potential users	Ovseiko et al (2012) [53]
			82	Reported economic benefits	Wooding et al., (2004) [29]
			83	Press release for creating awareness among Society	Buykx et al., (2012) [6]
				Innovations in Public Health / Public Education Initiatives	
			84	No. of street plays in rural / remote areas for creating awareness	New indicator
			85	No. of walkathons for creating awareness	New indicator
			86	No. of public education pamphlets prepared/ translated in local languages	New indicator
			87	No. of public lectures in local languages	New indicator
			88	No. of Radio Shows in local channels on awareness, prevention	New indicator
			89	No. of TV Shows in local channels on awareness, prevention	New indicator
			90	No. of articles in popular vernacular newspapers/ magazines	New indicator

http://www.rand.org/content/dam/rand/pubs/monographs/MG1200/MG1217/RAND_MG1217.sum.pdf

How to cite this article: Ramkumar S, Savithri SR, Narayanasamy N. Conceptual framework for measurement of research productivity in communication sciences and its disorders in Indian context. Int J Health Sci Res. 2016; 6(4):386-404.
