From a single meeting to a scientific community: Quantification of the “Advances in Neuroblastoma Research Association” network

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1 BACKGROUND

From 1975 through 2016, 18 “Advances of Neuroblastoma Research” (ANR) congresses were held solely devoted to neuroblastoma research, addressing basic, translational, and clinical science. None of meetings has been "diluted" by other topics, which makes them a good model to describe the development and interaction among a circumscribed scientific community.

The contributions of authors, their institutions, and countries to the abstracts of the congresses were analyzed for frequencies of entered names (harmonized spellings) and for the interactions between authors as evident from their co-authors.

The publication success was estimated by the Hirsch index (h-index) and retrieved from the Web of Science for the time span 1975-2017. Only research papers with the word "neuroblastoma" in the headline, the abstract, or the keywords were used. The h-index is an accepted measure of recognition of an individual, combining the number of their publications with their citations. The impact factor of journals or articles was not considered.

The interactions were measured by "weight" and "centralities." The term "weight" stands for fractionalized counting. Each abstract had a weight of 1, for example, in an article with 10 authors, each had a weight of 0.1. Centralities were evaluated using undirected, unweighted graphs, where nodes represent authors, institutions, or countries and edges a joint contribution to one or more abstracts. The degree centrality is considered a measure of local connections, closeness centrality for global connections, betweenness centrality for brokerage, and eigenvector centrality for leadership. The lobby-index captures the efficiency of interactions within a network (degree centrality of an author and his/her neighbors). Communities of institutions were defined as a tightly knit group characterized by a high density of ties compared to all other connections and calculated using the Louvain algorithm. Each research institution can belong only to one community.

1.1 Development of the congresses

The Advances in Neuroblastoma Research (ANR) congresses were founded by Dr Audrey Evans from the Children’s Hospital of Philadelphia, which is still a leading institution. They were held in 1975, 1979, 1984, 1987, 1990, 1993 (all in Philadelphia, USA), 1994 (Heidelberg, Germany), 1996 (Philadelphia, USA), 1998 (Bath, UK), 2000 (Philadelphia, USA), 2002 (Paris, France), 2004 (Genoa, Italy), 2006 (Los Angeles, USA), 2008 (Chiba, Japan), 2010 (Stockholm, Sweden), 2012 (Toronto, Canada), 2014 (Cologne, Germany), and 2016 (Cairns, Australia). The selection of presentations at the congresses was done by the local organizing committee after independent evaluation of the submitted abstracts. Altogether 8,459 authors contributed to 3,993 abstracts. The number of abstracts per congress increased from 16 in 1975 to a maximum of 458 in 2014. The number of authors (not necessarily physically present) per congress increased from 16 to 1,899, the number of institutions increased from 13 to 236 (total 553), and countries from 4 to 36 (total 53). Hosting a congress was associated with a peak of abstracts from the hosting country, but this effect was reversible with the exception of the United States (numbers roughly sustained).

The mean number of authors per abstract increased from 2.3 in 1975 to 7.4 in 2016. Surprisingly, high proportions of authors, institutions, and even countries participated only once in an ANRA congress: 57 (74%) (authors), 26 (39%) (institutions), and 13 (15%) (countries).

Note that 42% of abstracts belonged mainly to basic research science and 29% each to translational and clinical sciences. Abstracts of
a clinical nature were minimal until 1993. From 2004 on, basic science
abstracts have indisputably been in the lead.

1.2 | Geography of collaborations

The major institutions for neuroblastoma research are centered in
North America, Europe, Japan, and Australia, whereas South America,
Africa, and large parts of Asia were underrepresented (not shown).
Figures 1A and 1B highlight the different structures of the established
scientific communities in the United States (Figure 1A) and Europe
(Figure 1B). Thirteen neuroblastoma communities were identified
worldwide. For the United States, one large community with 139
cooperating institutions (pink circles, headed by Philadelphia) and one
smaller community (green circles) were visible. The smaller belonged
to the European SIOPEN group. In contrast, in Europe, five major
communities were found with 123 (SIOPEN), 77 (“Cologne”), 45
(“Genoa”), 17 (“Barcelona”), and 11 (“Warsaw”) institutions. Except of
the multilateral SIOPEN group, the other appeared largely language-
oriented (German, Italian, Spanish, Polish) and may reflect aspects of
their historical formation. The Japanese community (Chiba) attracted 68 and the Australian community (Sydney) 24 institutions. All figures comprised the entire time span from 1975 to 2016. Dynamic changes were not considered.

1.3 Satellites

The central scientific network of neuroblastoma research consisted of 8,235 authors from 520 institutions in 42 countries (fewer than the totals). Institutions without a single link to the central network at any time were designated as satellites; 33 institutions were identified as satellites comprising 224 authors from 22 countries. Their authors attended 1-4 congresses over a period of 1-16 years. Twelve countries had satellite and network-integrated institutions. Most satellites were located in countries with less financial resources.

1.4 Networking and publication success

Per author, 0-202 neuroblastoma articles had been published as of July 23, 2017. The citations per author ranged from 0 to 12 930 and the h-indices from 0 to 61. An h-index of up to 30 could be achieved as a single author, while authors with an h-index over 40 typically had 200 and more co-authors over the time span.

The best correlation between networking of authors at congresses (co-authorship) and later publication success was found by "weight" ($R^2 = 0.508$). The $R^2$ values were 0.474 for degree centrality, 0.364 for the lobby-index, 0.330 for betweenness, and 0.127 for closeness centrality. All five parameters retained their independent significance in a multivariable model.

The h-index of institutions was best predicted by degree centrality ($R^2 = 0.417$) and weight ($R^2 = 0.308$) and less by betweenness ($R^2 = 0.268$) or closeness centrality ($R^2 = 0.019$).

The publication success of countries was best correlated with weight ($R^2 = 0.748$) and betweenness (brokerage; $R^2 = 0.704$) was very high, whereas degree and closeness centralities were less predictive.

2 CONCLUSION

The analysis of 18 ANRA congresses over a period of 42 years demonstrated that active contributions to congresses were correlated with later publication success. The quantification of interactions between co-authors was in good agreement with subjective impressions.

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How to cite this article: Berthold F. From a single meeting to a scientific community: Quantification of the “Advances in Neuroblastoma Research Association” network. *Pediat Blood Cancer*. 2019;66:e27696. https://doi.org/10.1002/pbc.27696