Paediatric Respiratory Reviews 13 (2012) 63–66

Contents lists available at ScienceDirect

Paediatric Respiratory Reviews

Research: from concept to presentation

Successful grant writing

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ARTICLE INFO

Keywords:
Grants
writing
funding
respiratory research
review

SUMMARY

Obtaining research funding is central to the research process. However many (clinician-) scientists receive little, or no, training in the process of writing a successful grant application. In an era of reductions in research budgets and application success rates, the ability to construct a well presented, clear, articulate proposal is becoming more important than ever.

Obtaining grants is a method to achieve your long term research goals. If you are able to formulate these long term goals, it is relevant to explore the market and investigate all potential grant opportunities. Finally, we will provide an outline of key elements of successful research grants.

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INTRODUCTION

Writing research grants is a central part of the work for a (clinician-) scientist. Being successful in obtaining research grants is perhaps one of the most important factors in becoming an independent researcher and pursuing an academic career. Whereas researchers spend a lot of time to improve their knowledge and skills in their research field, it is remarkable that there is limited training on how to write research grants. This is important at a time when research funding is becoming more and more restricted, and thus obtaining grants is getting more and more competitive. For example, the United States National Institute of Health budget for funding research almost doubled between 1998 and 2004, but flattened between 2004 and 2008. Success rates of independent research project grants (R01) for renewal of previously funded grants dropped between 2000 and 2008 from 53% to below 24%.[1] In the United Kingdom, researchers are currently facing an expected cut of at least 10% of the total research budget.[2] In respiratory research, the challenge may even be bigger compared to other fields. The field of respiratory research is underfunded when compared to the burden of respiratory disease to the society, in terms of morbidity and mortality.[3,4] Thus, it is important to consider the funding process in more detail as well as the art and science of writing research grants ("grantsmanship"). This review is based on a literature review of others' experiences,[5–14] as well as a reflection of our own experience in grant writing. We will consider the preparation of grant proposals as a way to accomplish long term research goals, and the quality of the grant proposal as key components of successful grantsmanship.

HOW IS GRANT MONEY DISTRIBUTED?

Empirical data in the biomedical literature on how grant money is distributed is scanty. There is debate whether scientific merit (the best science gets funded) is the key predictor for obtaining grants. Other mechanisms may be important as well, such as accumulative advantage (to those who have grant money, more will be given) or a political, hegemonial system (elite scientists distribute grant money between themselves). In 2004, Viner *et al.* investigated these three models (merit, accumulative advantage, political) by analyzing the United Kingdom Engineering and Physical Science Research Council (EPSRC) peer reviewed funding process between 1995 and 2001, and provided evidence for all three models. The EPSRC considers about 5000 research proposal per year. Viner and co-workers defined a most active group of grant submitters, either submitting 5 or more grants, and/or receiving 3 or more grants between 1995 and 2001. This group represented 26% of the submitting population, and was responsible for submission of 61% of all research proposals. 44% of this most active group was appointed in the ESPRC peer review college. There was a significant association between securing grants and being member of the peer review college in the group of applicants that had a relatively low acceptance rate. In the group with higher acceptance rates, longevity of membership of the peer review college was an important predictor for obtaining grants, suggesting that those more experienced have an advantage.[15] These findings suggest that funding resources are preferentially distributed to those

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doi:10.1016/j.prrv.2011.02.001

with power in the distribution process, but it is important to realize that the causality for this association is unknown. Are those who formulate excellent research grants, and get them funded, invited to become part of the peer review process? Or does involvement in decision making bring success? Or is there an unmeasured confounder, such as talent of the individual?[15] Moreover, if proven track record in the field is one of the criteria used to assess the quality of the grant, this will introduce an advantage to those that who have been previously successful in obtaining grants. In this study, also several other predictors for grant success were found, such as home institution and ethnicity, but not gender.[15]

From the perspective of the researcher, it is important to consider researcher's behaviour that is associated with success in obtaining grant money. This was investigated among 286 US academic researchers (mean age 55 years, 49% full professors) from the fields of biological sciences, mathematics, physical and computer science. A detailed assessment of each researcher was made, including individual aspects (type of research, networking, proven record of accomplishment), individual efforts (number of agencies applied to, number of grants applied for), support (either by university of by own research team), and system characteristics (grant type, teaching, research facilities). Significant predictors of funding success were personal factors (having had education in grant writing, and a reduced teaching workload), networking (attending association meetings, meeting association officers and participating in consortia), increased research team size and submitting a higher number of research proposals.[16] Interestingly, factors such as the number of publications and academic rank were not significantly related to funding success.

In this review, we will propose that obtaining research grants is a method to achieve your long term goal. If you are able to formulate these long term goals, it is relevant to explore the market and investigate all potential grant opportunities, being a project grant or a personal career grant. Finally, we will provide an outline of key elements of successful research grants. The process of preparing your research grant is depicted in the figure.

FORMULATING YOUR LONG TERM RESEARCH GOALS

What is the goal of your line of research in five or ten year's time? And how will your research in the long term serve patients, science and society? Formulating an answer to this question may not be as straightforward as you might think. Taking a few days off, to reflect upon your long term future goals may seem impossible in your busy daily life, but is usually rewarding in the end. Once these long-term research goals have been formulated, obtaining research grants no longer is a goal in itself, but serves the long term vision you created. This will also help you to refrain from ad-hoc grant opportunities. Attractive as they may seem, they tend to be time consuming and they distract you from your long-term research focus. Moreover, being able to articulate the benefit of your long term goals to patients and the society aids in completing the "benefits of your research" and "relevance to society" paragraphs of your grant application.

Having decided on direction of your research for the next years, it is helpful to consider the questions in Box 1. Some authors point toward the importance of seeking a mentor in this phase of your career,[9,12,14] who can supervise you with your first grants.

THE MARKETING OF RESEARCH

Let us consider the grant as a product, and potential funders as the market. Before bringing a novel product to the market, an in depth knowledge of the market; i.e. potential funders, their interests and priorities, is of utmost importance. Most universities have officers who will assist you in identifying potential grant opportunities, who have knowledge and experience in the types of grants that get funded, and who may liaise you with people who wrote successful grants.

Box 1. Questions to be answered to before starting to write a grant

- Do I or does my team have all relevant skills, techniques, and knowledge?
- Should I consider additional training or recruiting new personnel?
- Do I have local, national and international collaborations to achieve my goals?
- How good are my grant writing skills, should I attend a workshop?
- Am I ready to be a full investigator or should I be a co-investigator first?
- Should I seek a mentor?

Funding sources of grants can be distinguished into (1) government; either national, or international; (2) patients advocacy groups; (3) charity, and (4) pharmaceutical industry. It is also important to consider the type of grants, either directed at the person of the researcher (i.e. career grants), or at achieving specific research aims (i.e. project grants). These research aims have to fit the priorities formulated by the funding agency. Finally, it is important to obtain insight into the decision process of grants, either by scientific committees, internal and external reviewers, or by interviews. If you are not familiar with grants decision making, it may be very wise to interview colleagues who have been successful, or members of the scientific board that make decisions or recommendations. Many institutions will keep a record of academic staff that serve on grant review bodies and it is wise to contact these people to ask for advice on the decision making process. For those considering submitting a grant to the NIH, there are several papers describing the process of the NIH review for preclinical[13] and clinical[11] studies, career development[9] and conference grants.[10]

For career grants, it is important to familiarise yourself with criteria for funding agencies, with respect to quality or quantity of your publications, scientific esteem (i.e. awards) and international experience. Do you meet these criteria and is it visible that you belong to the top 10% of your age group? Take some time to look at the profiles of those who get funded, and compare your CV with theirs. For a project grant, it is important to ask yourself: Is the market ready for my grant idea? If the answer is no, you may consider strategies to interest the research community and grantors in your ideas, for example by publishing a 'novel ideas' paper or pilot data first, by proposing to organise a session on a scientific conference delineating your ideas, or by presenting your ideas to opinion leaders in the field (who also may serving as scientific advisors for grantors), governmental and patient organisations.

THE QUALITY OF THE GRANT

You, as the principal investigator of this grant, are primarily committed to the quality of your research and your grant. We will not discuss the quality of the research *per se*, but focus on how to describe your research idea in a grant proposal. Key elements of writing project grants are presented in Box 2.[3,6]

Innovation

How novel is your idea? Are 10 groups all over the world able to perform the research you propose, and perhaps already doing it, or are you in the unique position to innovate the field? Some grantors

Box 2. Key elements of projects grants

- the innovativeness of the idea
- a clear focus on a well written hypothesis
- testable specific aims
- appropriate preliminary data
- quality of the environment where the proposed research will be performed
- scientific stature of the applicants
- correct budget justification
- fulfilment of all regulatory paperwork, including institutional review board approval

specifically ask for cutting edge, potential risky, science and the application of novel techniques. Can you clearly explain why this research is novel, why you are the right person to undertake this and what the potential impact of the research you propose to conduct is likely to be?

A clear focus on a well written hypothesis

Is it possible to state the core idea of your grant in one or two sentences? This core hypothesis should be based on a state of the art review of the literature, and preferably pilot data. It should be concise, and lead to testable specific aims. Some authors suggest supporting your core idea with a clear figure[14] that illustrates the proposed mechanisms of your core hypothesis. A poorly focused or overly ambitious hypothesis reduces the likelihood of the grant being funded.

Testable specific aims

This is the experimental part of the grant. The specific aims should be tested in an experimental design that has a clear rationale, and that answers the questions raised. Convince yourself and the reviewers that you are able to perform and deliver this experimental part and able to interpret the data. Make sure your specific aims clearly relate to the overall hypothesis, how will undertaking the experiment test the hypothesis you have proposed? It is advisable to make this clear to the reader, rather than burying it in a dense paragraph of text, or omitting it altogether in an attempt to squeeze a few more words into the grant's page or word limit. Furthermore, show that you are aware of the strengths and limitations of your experiments or clinical studies. If necessary, provide back up strategies. A timeline may be helpful showing the long range planning of the grant.[14] (See the paper by Inouye and Fiellin for an example[11]). It is important that your grant is well organized and correct (use a readable font, no spelling errors, correct page, table and figure numbers, references checked, budget adds up to the total requested grant). More and more grantors use online submission systems which can do strange things to layout, references and special symbols that you use. It is wise to test this system ahead.

One of the most important tasks for you to complete before you even consider submission is to ask colleagues, collaborators or a mentor, to read your grant and provide feedback. Listen to their comments and rewrite the grant accordingly. An excellent check list for grants for clinical studies is provided by Inouye and Fiellin.[11] For personal grants, it is important to show your personal track record emphasizing your contribution to scientific output (i.e. previous grants, presentations, papers), and your international experience and collaborations. To emphasize your contribution, speak about 'I' instead of 'we'.

Finally, try to adopt a clear, short, simple and concrete style making your grant easy to read. You are probably reading this article while being tired, sitting at home, lying in bed or travelling, and so are reviewers reading your grants. If you experience difficulties in writing scientific papers or grants, there are excellent courses or books that could be helpful.[17] Last but not least, take enough time to draft both the scientific abstract, as well as the abstract for the lay public. These should be carefully written, stating clearly the long term goal of your research, the hypothesis and specific testable aims as well as the potential impact of your work.

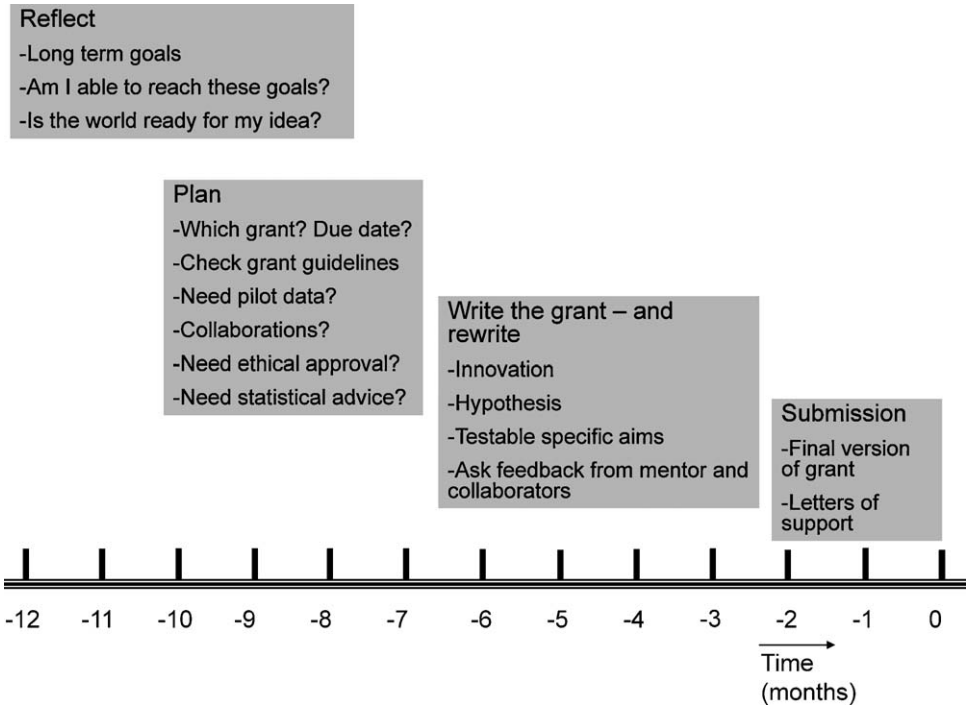

Figure 1. Timeline for preparing a grant application (after Inouye and Fiellin[11]).

PLANNING AND ORGANISATION

The last, but by no means the least, key factor in successful grant writing is your ability to plan and organise your time (Figure 1). Research your potential funders well in advance and take note of usual application deadlines. Take the time to draft your proposal well in advance so you have time to seek advice from colleagues and mentors. If they suggest more pilot data is needed or the application would benefit from initiating a collaboration, there needs to be time available to do so. While most of us (the authors not excepted) lead busy professional lives and see deadlines as a challenge to be met, you will not be able to present your research proposal to best effect without the time to personally reflect and seek the opinions of others before revising the application.

CONCLUSION

In summary, writing research grants is an art that can be learned.Once you are able to formulate your long term research goals, and have investigated grant opportunities and preferences of grantors, you can start preparing your grant proposal. Involve mentors, colleagues and collaborators to improve your grant proposal. Plan your grant preparation carefully. And even if you do so, remember; everyone has had grants rejected. Showing persistence in pursuing your research aims will ultimately be rewarding.

CONFLICT OF INTEREST

GHK and JHW report no perceived conflict of interest relating to the subject of this review.

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