Conducting Research - It's your everyday work

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When I was a young microbiologist I regularly researched and resolved everyday problems in my hospital, but rarely published them because I doubted their worth to anyone outside my institution. Inevitably, a few years later, someone else with less doubt published it! I came to the realization that had I made the research available, a colleague's quandary could be resolved more quickly or they would be saved repeating the research. Now I firmly believe in the axiom, *"If the answer isn't obvious and the problem's worth solving, it's worth publishing.*

I want to encourage you to consider the value of giving colleagues access to your "work". I say "work" because you are constantly gathering data, conducting enquiries, drawing conclusions and putting your own results into practice for the safety of colleagues. This is *research*. With a slight refinement, it can be formalised, peer-reviewed, and put into print. Your files are a goldmine of topics.

One of the greatest barriers to conducting research is not ability, it is self-doubt, it is our inner voices saying "*My work is not worthy of publication*". Wrong. It *is* valuable. Every time you find a solution to a problem, a colleague could benefit. But don't forget the benefit to you including self-worth, credibility, promotional and career opportunities, and knowing you have contributed to a body of knowledge.

Another barrier is time, but hey, OH clinicians are specialists at fitting 26hrs in the day! It will require a commitment – so it's best to allocate a specific time/day that you devote to the issue. It's amazing how much literature you can scan in a lunchtime.

Research is *any creative work undertaken on a systematic basis in order to increase the stock of knowledge... to devise new applications*,[1] i.e. any original investigation producing results that increase knowledge.

Broadly, it is divided into:

- Applied (resolving a problem) or Pure (no foreseeable application)
- Quantitative (using numbers) or Qualitative (using words/views);
- Analytical (explorative evaluation of gathered information) or Argumentative (opinionated/comparing viewpoints).

Research by OH clinicians will be applied, often quantitative sometimes qualitative, and usually analytical (at least in early career).

In your institution, what current problem needs your investigation to resolve? To start, forward a half-page overview of a problem and your ideas to a research colleague and ask their opinion – you will be surprised at their supportive response.

Throughout my career I have conducted quantitative, analytical, applied research so as an example let me outline how I went about one of my current research topics in a multi-authored study.

Applied research commonly has a logical sequence of seven steps.

1. Identify problem

One of my interests is preventing sharps injuries (SI) and my "problem" was that the rapid rate of decline of sharps injuries following the Needlestick Prevention Act of 2001 had halted in last 5 years. The question arose, *"How can US healthcare facilities that extensively use safety devices, reduce SI further".*

Hint: Research a specific, manageable question – don't tackle large issue first-up.

2. Research literature

You no doubt will already have a good command of the literature surrounding your field, but researching requires you to delve more deeply and widely. Remember, your work needs be original to be accepted.

- Use your medical librarian – they are amazingly skilled at finding articles.
- Use Internet search engines!
- Annotate and record all references that impact on your research topic.
- You cycle through Q-search-reflect- Q-search-reflect, etc

My earlier research had shown that a sharps container with enhanced engineering significantly reduced SI[2] but the research did not involve US hospitals. A literature search showed:

In terms of SI technology, the US is more advanced than the countries in the previous research
(**Q.** *So would container SI be issue in US?)*
⬇
US literature showed sharps containers were associated with a significant number of SI
(**Q.** *How? What causes container SI in US?)*
⬇
US Literature showed >90% container SI were: during deposit of own sharp; and protrusion of a previous sharp.
(**Q.** *Could container design be an issue?)*
⬇
Literature indicated the two causes were most likely due to aperture size and counterbalanced-door sensitivity.
(**Q.** W*ould enhanced engineering resolve)*
⬇
Literature said "probably".

Hint: Consider software for managing your references, e.g. RefWorks.

3. Formulate hypothesis

A hypothesis is a tentative explanation for a phenomenon, used as a basis for further investigation.

Given the above literature review we formulated the following hypothesis: *"That container associated SI could be reduced with enhanced engineering of apertures and counterbalanced doors".*

Hint: Make your hypothesis specific.

4. Construct research design

There are several research "models" to test hypotheses. The analytical research design should: adequately test the hypothesis; identify and control extraneous factors; enable results to be generalizable; enable hypothesis to be rejected or retained by statistical means; and be efficient for your available resources. Don't forget sampling and sample size selection to ensure validity and reliability of data.

We chose an *intervention* model, i.e. hospital SI data ("dependent variable") was compared before and after introducing the engineered container ("independent variable"). This design was sufficient to test the hypothesis however an opportunity arose to test the hypothesis further by examining SI data from a cohort of hospitals not using the container. The double study lessened the likelihood of extraneous factors having an affect ("confounding variables").
Hint: Keep design simple and brainstorm exclusion of confounding variables.

5. Collect data

Ensure:

- there is no selection bias in your sampling.
- you organize/categorize/collate your data and remain objective in the process.
- data is (or was) readily and continuously available over the study period
- no changes were made to data collection methods during the study period.
- you report sufficient information about your subjects to identify the population group from which they were drawn.

In our study, because container-associated SI are between 5-10% of all SI, it was unlikely that data from *one* hospital would have the "power" to test the hypothesis – I was fortunate that 10 co-authors pooled their data from 14 hospitals that adopted the engineered container.
Hint. If you recently resolved a problem, the "data" may already be in your files.
Hint2: Regularly backup electronic data and store in two disparate sites.

6. Analyse

Statistics enable us to determine the degree of certainty that the result is true. Most clinicians (including myself) need help choosing the appropriate statistical method for analysing experiential/observational ("empirical") data.

Your research colleagues can advise who to contact.

We categorized and analyzed >2,000 SI during the study and used CHI[2] test to analyze results; a p (probability) value of ≤0.05 as significant; and coupled it with Risk Ratio and Confidence Limits for additional confidence in conclusions. Our data showed a p value of <0.001 so we were able to say the, "*intervention significantly reduced Container-associated SI"*

Hint. Talk with statistician or "stats colleague" early i.e. research design stage.

7. Interpret and write

By this time you will have selected the "outlet" for your research (conference, journal, etc) so you need set out the manuscript and format the references in their style and use their language throughout.

In this stage you examine the data for trends. Did it show what you predicted? Could any factor other than the intervention have caused the effect? Could my data collection methods have affected results? How do results compare with literature?

How best can I clearly present my data, i.e. graphs, tables, pictures, etc?

Most journals have several levels of articles from brief to major.

We decided to present the data first at a conference[3] and then work on the formal manuscript for a journal (that too can be one or more revisions both before and after submission. We are proud of the research in that it affirmed the intervention was successful, it was regarded as "solid" research (it won an award for best paper at a second conference!), it added to the SI body of knowledge and may assist other colleagues with a similar quandary. And, the data came from records on file! Also of importance - it enabled several clinicians to publish for the first time.

Hint: Every journal has "Advice to authors" on their website – follow it assiduously.

1. OECD (2002), *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*, OECD: Paris. http://www.naci.org.za/OECD/FrascatiManual2002.pdf
2. Grimmond T, Creech R, Taylor C, Pandur R, Kampen R, Kable W, et al. Sharps Injury Reduction Using the Sharpsmart Reusable Sharps Management System. *J Hosp Infect*; 2003; 54:232-38.
3. Grimmond T, Bylund S, Fink R, Anglea C, Beeke L, Callahan A, Christiansen E, Flewelling K, McIntosh K, Richter K, Vitale M. Sharps Injury & Sharps Waste Reduction: a Multi-centre Study of a Reusable Device. [abstract] Am J Infect Control 2009;37:E141-142.

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