How do you develop a research question?

Congratulations by now you have identified your research idea and hopefully found a mentor to facilitate your research. What follows is one of the most important aspects of all good research: developing the precise research question. The reason why this process is so important is that it determines exactly what you are going to research, which population, what methodology you will use, which variables you will examine and which outcome you will measure. By asking a precise research question you are then able to ensure that all the participants that need to be examined are included in your study. The process of defining the precise research question takes time and often needs to be refined many times.

Defining your research question is not an activity in isolation – the research question is the first step of linking your research idea to how you will do your research, which data you will collect and what you will measure/compare. A precise research question eliminates uncertainties, decreases the number of weaknesses of the study and forms the basis of a clear publishable article.

The basis of research is to compare. Purely describing something is not research.

Example: If you drink a glass of red wine and you say: "I am drinking a glass of red wine", it is purely describing what you are doing and is not research. However, if you say: "I am drinking a glass of excellent red wine", you are doing research, because how do you know the glass of red wine you taste is excellent? You compare it to other glasses of wine you have tasted and therefore you can make a statement that it is excellent.

Your research question will clearly identify the two essential elements of your hypothesis:
1. the key determinant and
2. the primary outcome.

These are the elements you will use when you decide on what type of study to do and to develop your two-by-two table (Step 5).

As an example: in a study comparing oscillation to conventional ventilation of HIV infected children suffering from PJP, the key determinant would be type of ventilation and the primary outcome would be death.

There are numerous aids to help you develop and define your research question and many are known by their acronyms: PICOT[1], PESICO[2], SPICE[3] etc. The acronym we have chosen to use in this manual is the PICOT criteria as this is widely known and used. The acronym PICOT stands for:

P = population (The exact population you are going to study, who are you including and excluding, is your population representative of the population you would like to apply your findings to.)

I = intervention (The intervention might be a drug, new technique, new test or treatment regimen etc. In clinical research you will often not implement a new intervention, but will measure the effect of various variables, which can be viewed as biological "interventions", on the outcome.)

C= comparator (Which group of patients are you comparing to which other group? Premature babies born in hospital to those born outside the hospital, TBM treated medically to those treated surgically, HIV positive to HIV negative children etc.)

O = outcome (What is the outcome you want to measure? Mortality, duration of hospitalization, time to diagnosis, symptom free etc.)

T = time (Over what time period are you going to include research subjects in your study?)

PICOT analysis is also valuable when you are critically evaluating an article to ensure that all the aspects are addressed in the article.

Examples of how to use PICOT:
P: The population refers to the study population (also known as a sample). If your study population are all premature babies admitted to a hospital and you go to the ward where such babies are usually admitted to find them, you might miss some premature babies admitted to the paediatric surgical ward, the overnight wards or those babies discharged over the weekend. By being more precise you can limit bias by ensuring the population you are investigating all have an equal chance of being included in your study. By being more rigorous you would then

1 Thabane L,Thomas T, Chenglin Ye,Paul J. Posing the research question: not so simple Can Anesth (2009) 56:71–79
2 Schlosser RW, Koul R, Costello J. Asking well built questions for evidence base practice in argumentative and alternate communication. J Commun Disird 2007; 40: 225-228.
3 Booth A. Clear and present questions: Formulating questions for evidence based practice. Library Hi Tech. 2006;24:355-368

for example define the population to the premature babies born in the hospital between Monday morning at 08h00 and Friday afternoon at 16h00 admitted to a specific ward. You will have to carefully think about the above inclusion criteria to prevent bias.

I: If you do an intervention study, the intervention must be clearly defined. If you are studying oscillation as an intervention the indications for oscillation must be clearly defined. You might need to discuss the indications with the PICU team to make sure they are widely accepted and going to be uniformly applied. If the indications for oscillation are not clearly defined and applied this will lead to bias.

C: The group of patients you are going to use to compare to the group receiving the intervention needs careful thought. They need to be representative of the whole group from which those with the problem you are studying are coming from. Careful thought needs to be given to this group.

O: The outcome should be a hard outcome and clearly defined. In your oscillation study death would be a hard outcome. Time to extubation would depend on many variables e.g.: preference of the clinician, how busy the ICU is, day or night shift etc. This would be an interesting outcome but highly dependent on many other factors (known as confounding variables).

T: The time for including subjects needs to be carefully thought through. At night the admission ward where you are recruiting babies might be run by less experienced medical officers compared to experienced specialists during the day. Your outcomes could vary according to time of admission and not to your intervention.

You must be prepared to critically think about your research question, discuss it with colleagues and be prepared to revise your question. After a discussion with a senior colleague/mentor you might be surprised how much the exact research question (not necessarily your research idea) has changed and needs to be revised.

Clinical researchers will not only be interested in the primary outcome. You might not only be interested in the deaths among those receiving an intervention, say ventilation (oscillation vs. conventional ventilation) of HIV positive children treated for PJP, but would also be interested in many important secondary outcomes. Examples of secondary outcomes could include duration of assisted ventilation, duration of supplementary oxygen required, duration of hospitalization, survival one year after discharge, those diagnosed outside your hospital vs those diagnosed within the hospital, etc. All these aspects must be thought of when designing your research question to ensure that the data to answer these secondary outcomes are also included in the case report form (CRF). Remember

you might not be able to answer all the secondary outcomes that are interesting as the data might not be available or your study might not be powered to answer the question. If however you have not collected the data you will never be able to answer the questions.

Although it might be interesting to answer numerous secondary outcomes, collecting the extra data might not be feasible or practical. Moreover, it is not justifiable to consider that, if your primary question does not 'pan out', you can probably find another result that will be significant. This is not research, it is a 'fishing expedition'. Therefore think carefully and limit the number of secondary outcomes.

Your research idea might lead to numerous excellent and exciting research questions. Choose to do one that excites you and is feasible. You might be able to interest another researcher or registrar to do a separate aspect of the study. You will both gain from this collaboration. You might even be able to answer the rest of you research questions as a senior registrar or consultant.

Be prepared to revise the precise research question many times. It is worth the effort and will reward you later.

Gie, R., & Beyers, N. (2014). Getting started in clinical research: Guidance for junior researchers. Cape Town: Department of Paediatrics and Child Health, Faculty of Medicine and Health Sciences, Stellenbosch University.