The last time I spoke with the Board I had a simple message: namely that we hire faculty to provide an education to our students in the classroom and to the world via their research. In this latter capacity they are sole proprietors of their research programs – if you wish, they run a small business (called for example a lab) within a holding company called the University. They have a vision and a mission. They write business plans (called proposals), they generate revenue (via grants) and they have a product (new knowledge and educated students and post-docs).

This time I also have a simple message: Northwestern’s research has grown at a rate greater than any of our peers, we have achieved this growth by executing on a strategic plan, which includes developing an ecosystem that attracts, retains, and advances the careers of great faculty and students, and that our path forward includes iterative evaluation and up-dating of the plan, the implementation of the plan, and the strengthening and growth of the research ecosystem. Buried in this is a question, one we can explore now and will need to explore iteratively, regarding the institutional will to drive forward on a bold research agenda. In part, I mention this because at some institutions, the agenda is to not lose ground – our bolder agenda (to grow the research program here at Northwestern) comes with implications regarding institutional resources.
How do we learn?

- We gather evidence and we form stories.
- We have a thought about how the world works – a hypothesis.
- We take data, distill it into information, coalesce that into knowledge from which we develop wisdom.
- But, in the end, we develop stories with ever deeper meaning and understanding. Stories that allow us to develop paradigms about how the world works. And we repeat the process, we ask new questions that allow us to gather more data and form better stories.
- It’s the same whether one studies physics, chemistry, biology, or anthropology, sociology, or economics.
So what can go wrong?

- Inadequate methods and poor data yield wrong stories (and knowledge/wisdom)
  - Intentionally falsified or fabricated or plagiarized (FFP)
  - Not fully sharing data, poorly managing data, ...
- Poor practices
  - Repeatability blinded, not repeated, all results, random – controls, valid materials, the right statistics
  - Churniness and hyperactivity / 200 firms... in claimed research
  - Non-reproducible results (often not due to negligence or malfeasance, but subtle differences in methods)
- These results lead to dead-ends
- The pernicious effects:
  - Changes peoples health practices
  - Impacts patients who have false hopes
  - Impacts researchers who try to replicate data – wastes their time
  - Impacts companies who try to replicate and put company resources into development
    - And it’s not just drug companies that waste replicable materials


Northwestern | RESEARCH
Pipeline: Therapeutics
So what can go wrong?

- Inadequate methods and poor data yield wrong stories (and knowledge/wisdom)
  - Intentionally falsified or fabricated or plagiarized (f3p)
  - Not fully sharing data, poorly managing data, ...
- Poor practices
  - Baggy: not blinded, not repeated, all results, a and - controls, valid materials, the right statistics
  - Cheevers and demotic: bias, 203 terms, in internal research
  - Non-reproducible results (other not due to negligence or malfeasance, but subtle differences in methods)
- These results lead to dead-ends
- The pernicious effects:
  - Changes peoples health practices
  - Impacts patients who have false hopes
  - Impacts researchers who try to replicate data – wastes their time
  - Impacts companies who try to replicate and put company resources into development
    - And it’s not just drug companies that waste replicable materials
      - The University wants to know if these assets have value
      - Impacts funders (the taxpayers) who are not so interested in wasteful use of fund
The Path Forward?

Outline:

• Education for Trainees
• What could Funding Agencies do
• What could be done at the level of the
  – University
  – School
  – Department
  – Investigator
  – Journals
• Approach to the root causes
The Path Forward?

- Training of researchers (not the whole answer)
- RCR is an obvious answer (but not the only one)
  - Should we (can we) make this mandatory for all?
    - RCR is not compliance
    - RCR is how you conduct great science
      - Poor safety leads to poor science
      - Irresponsible conduct leads to poor science
    - Undergrads: an short (online) course at the start of an engagement
    - Grad students: not just for those required by federal regulations but all PhD students and all Masters students doing research
    - Post-docs (all of them): perhaps they should help teach the course
    - This requires developing courses for each level in each department
      - Rich in content, engaging, and specific

- But who controls the curriculum?
The Path Forward?

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    - Post-docs (all of them): perhaps they should help teach the course
    - This requires developing courses for each level in each department
      - Rich in content, engaging, and specific
    - Should be a requirement by all funders
      - In the US: not just NSF and NIH
The Path Forward?

• For Funding Agencies
  – A robust system for helping institutions with ORI cases – ie for institutions who come forward with allegations, support would be helpful (carrots not sticks)
  – A single system for handling ffp cases
• Research Integrity Advisory Board
  – Goal: help to improve the research enterprise
  – Recommended by National Academies
The Path Forward?

• At the school level
  – A positive approach to RCR training
    • Make teaching of RCR real – a prof gets credit for teaching this class
    • Provide support for online activities
    • Help departments develop RCR
    • Give students someone with whom to talk about problems
    • Give faculty help with research misconduct cases (often they've not seen a grad student with such problems in the past)
    • Give faculty service credit for serving on an ORI committee
      – This is a lot of work!!
      – ORI committee work does not particularly advance one's career
The Path Forward?

• At the Department and Investigator level
  – A culture of nurturing and training of grad students and post-docs.
    • The pressure of modern research careers pushes trainees to the limits and they cut corners
  – Robust RCR courses
  – A system that allows students and post-docs to come forward with problems (their own and obversed in others) – without retribution and that deals with other problems
The Path Forward?

- What should researchers do
  - They serve vital institutional roles
    - Journal editors
    - Conference organizers
    - Dissertation committee members
    - Reviewers for grants and papers
    - Leaders in professional societies
    - Members of national academies

- They should be sure that research integrity a real part of the culture of all these institutions
The Path Forward?

• What should journals do
  • Correct the literature promptly
  • Offer various types of retractions: not all retractions are equal
  • Journals are where we present our
    – Hypothesis (or design)
    – Materials and methods
    – Results
    – Discussion – our story
  • Journals should archive the data and methods
    – The details of the materials and methods (perhaps videos?)
    – The path from the raw data to the data presented in the article
    – The computer code
    – The details of the statistical analysis ...
The Path Forward?

- Get at the root causes of Research Integrity Issues
  - Wrong incentives?
    - Highly cited articles; High impact journals
    - Quantity of articles matters
    - First to publish matters
    - Promotion and tenure: funding, publications, awards
    - It’s not just the bad actors, it’s the entire industry

- We need a serious, continuing discussion of how to help this situation
  - Let’s start with data – how big is this problem?
  - Research Integrity Advisory Board
    - Call for this in the US – not enforcement, advisory!
    - But research is global – we need global solutions
      - The Singapore Statement is a great start
The Goal of Research

Discover new knowledge to advance and positively impact the world
  We need to be able to trust the new knowledge

Produce graduates who, over a career that can extend 40+ years, impact the world
  We need to produce graduates who can do work with integrity
Thank you!