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Patents and Growth

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A key aspect of reducing new knowledge to practice in the field of medicine is successfully navigating the process of patenting inventions and licensing them to facilitate their use. University faculty and their departments have much to gain from a detailed understanding of how this is done because even small deviations in laboratory practice, documentation, or execution of the process may completely negate possible benefits. Here we describe good laboratory practice for documentation of medical research, the process of patenting intellectual property, and its potential impact on faculty and their departments. As the field of medicine rapidly changes, faculty and their departments who are knowledgeable about these issues will be best positioned to see their ideas converted into treatments for disease.

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The purpose of medical research is to increase our understanding of the observable world so that discovery can be put into practice to reduce human suffering. Our understanding of skin biology and related medical science has advanced greatly since the Society for Investigative Dermatology was founded in 1937, and it promises to continue growing rapidly. An aspect of this enterprise that receives less attention than the discovery process is the reduction to practice of new knowledge. Once new insights and approaches to manage disease are uncovered, this knowledge must be integrated into the practice of medicine. Successfully moving discovery into practice provides the deep satisfaction of knowing that one's research efforts have been worthwhile. Since the passage of the Bayh–Dole Act of 1980, which permitted universities to obtain patents and license inventions derived from government-funded research (Sampat, 2010), moving discovery into practice has also provided significant monetary benefits to investigators and their universities. If discoveries are transformative, the amounts of revenue generated can be very large. Because of this change in the law, patent grants to universities have increased from less than 300 a year in 1980 to more than 3,000, with US universities collectively earning almost $2 billion each year (Sampat, 2010). For departments lucky enough to have faculty that make such discoveries, these monies can create endowments that allow a department to be more supportive of cutting-edge science, take advantage of opportunities, or provide resources to support outstanding faculty. An excellent example of this is provided by the University of Pennsylvania—Albert Kligman did his seminal research on retinoic acid effects in skin while serving as a faculty member there, providing millions of dollars in royalties to the department to support its educational, research, and patient-care missions (Stanley, 2006).

Licensing of patent rights has also stimulated an increase in new university-associated small businesses; as many as three are created per university each year. More than two-thirds of these small companies were supported by universities taking equity positions in the company (AUTM Licensing Survey, http://www.autm.net/Surveys.htm). Royalty revenue can be big business for universities (although only about 10% actually realize large returns), so ensuring that their technology-transfer office is effective in supporting faculty inventors is important (Bulut and Moschini, 2009). Proper stewardship of faculty patents and licensing can provide a significant percentage of university revenue. In addition, the efficacy of university administrators, such as department chairs and the technology-transfer office, varies greatly from one institution to another. Table 1 lists the total research funding and license revenue for fiscal year 2009 at several universities, illustrating the diverse level of revenue that licensing provides to these institutions (AUTM Licensing Survey, http://www.autm.net/Surveys.htm).

For university researchers to realize the benefits of invention, the first step in the process is keeping an accurate and thorough record of the research being done. In its most stringent form, this process is called good laboratory practice (GLP). GLP is an approach to experimentation and documentation that entails systematic controls on research quality as well as managing the research process to ensure uniformity, consistency, reliability, and reproducibility of the data. The process is required for data that are to be presented to the US Food and Drug Administration for assessment of new drugs (Knight and Cree, 2011). In a pharmaceutical manufacturing environment, rigorous attention is paid to standards and maintenance of the laboratory equipment, test facility operation, and documentation of personnel training. The origin of materials; their quality, labeling, and storage; conduct of experiments to include all proper controls; and logs documenting these items are required. Key aspects of proper GLP documentation are summarized in Table 2.

In the cutting-edge research conducted at universities, not all aspects of GLP are required, but thorough documentation of laboratory work is requisite. Determination of inventorship

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can depend on defining the path of idea creation, so relevant discussions with others should also be documented, and corroborated in writing by those involved. It is especially important to document dates when discussions or experiments took place. The overall emphasis for documentation is that the researcher demonstrate diligence in the pursuit of discovery. Although data generated in the course of conducting scientific research do not necessarily become the subject of a patent's claims, data that are not directly part of the claims can be very important for the purpose of enabling the invention, and the documentation should be complete. Ultimately, the notebook is used to establish patentability, the date of invention, and inventorship. In academia, it should be made clear to all participants in the scientific process what their role is in the discovery. Students rotating through laboratories, graduate students, and postdoctoral fellows should clearly understand whether their research activities constitute participation in the inventive process. Providing technical assistance for research does not constitute a role in the inventive process. It is the responsibility of the principal investigator to ensure that everyone involved in the project understands this relationship. Additionally, because disclosure of inventions to the public prior to patent filing can invalidate protection in some markets, students contributing to patentable research may face a conflict between being able to present their work and allowing the work to be patented. Principal investigators must be clear with students about such issues at all times.

Once a discovery is made, the next step in the process is securing patent protection (Pressman, 2011). This step can be problematic because public disclosure can lead to loss of patent rights. The investigator must recognize the need for patent protection and file the patent application before any "enabling" disclosures are made to the general public. How does the patenting process work? At a university, the invention must first be disclosed to the appropriate institutional department, usually the technology transfer office. Once a decision is made to seek patent protection, an application is drafted by a patent attorney. A patent application consists of several required sections: a description of the field covered by the patent, a description of related art that the new patent seeks to improve on, and a description of how the new invention is an improvement over background art or overcomes problems with existing art. If there are drawings, the drawings are described in detail.

The application next provides a detailed description of the invention. For example, if a gene was discovered, the sequence is listed in the detailed description. If it is a new computed tomography imaging device, it will show how the X-ray source is applied to the patient and how the signals are collected and present the mathematics of reconstructing the image for interpretation. The preferred embodiment of the invention is then discussed. Inventions may be carried out in a variety of ways, but the inventor must describe the best way to make and/or use the invention, although other embodiments may also be described. The patent must describe the invention completely and in sufficient detail that the reader with ordinary skill in the field can understand how to make and/or use it. The heart of the patent application is a claim or list of claims that define the scope of protection that will be legally conferred if the patent is granted.

As an example, a very abbreviated set of claims from US Patent 7,888,392 is presented in Table 3 (http://patft.uspto.gov). A classic dermatologic invention, this patent describes an ointment containing a pharmaceutical agent that has an antipruritic effect in a vehicle with low skin irritancy and excellent storage stability. As this patent illustrates, claims are broken down into independent and dependent claims. Of the four listed, claims 1 and 2 are independent and claims 3 and 4 are dependent. Claim 1 teaches the formula for the ointment (together with reference to the diagram; not shown here), and claim 2 teaches the method of making the ointment. Claims 3 and 4 further describe aspects of claim 1; hence, they are dependent claims.

After the claims, the final portion of a patent application is a short (fewer than 150 words) abstract describing the invention. When the patent is issued, the abstract is placed on the front page, together with the patent number, date, and title. The inventors are then listed, and in cases in which the inventors have the duty to assign their rights to the invention to their institution, there is a listing for the assignee. There is also a list of patents and other publications that the Patent Office used as "prior art" during examination of the patent application. Prior art becomes important in patent litigation if validity of the patent comes into question.

US patent law was written into the US Constitution in paragraph 8, section 8, of Article 1 and went into effect upon its signing. George Washington signed the first patent issued in the United States,

Table 1. Royalty revenue at several major universities

Institution	Total research funding ($)	Royalty revenue ($)	Royalty revenue as a percentage of the total
California Institute of Technology	521,436,800	47,665,535	9.1
Case Western Reserve	332,661,000	16,281,957	4.9
Columbia	604,660,000	154,257,579	25
Ohio State University	716,461,278	1,711,719	2.4
University of North Carolina	666,871,589	3,063,947	4.5
University of Rochester	337,246,000	46,025,270	13.6
Stanford	733,266,108	65,054,187	8.9