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The Reasons for and Solutions to Chronic Drug Shortages in the United States

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George A. Chressanthis, Ph.D., Principal Scientist, Axtria Inc.

> There's no such thing as a free lunch.
>
> *Milton Friedman (1912-2006) American economist and 1976 Nobel Prize laureate in economic sciences*

1. Existence of Chronic Drug Shortages

One of the more vexing and troubling public health policy issue that has plagued the US pharma industry, yet receiving less deserving public news coverage than other industry stories, has been the existence of chronic drug shortages since the turn of the 21st century. A drug shortage is defined in which the "total supply of all clinically interchangeable versions of an FDA-regulated drug is inadequate to meet the current or projected demand at the patient level."[1] The peak year was 2011, with 251 drug shortages, 73% being generic sterile injectable drugs, used to treat cancer, sepsis, and many other life-threatening conditions.[1] While the annual number has dropped, the issue of chronic drug shortages still persists, despite attempts by the FDA and federal legislation to remedy the problem.[2-3] The 2011-2014 period saw 456 situations of drug shortages severe enough to potentially cause adverse effects on patients and changes in treatment.[4] Health practitioners in office-based and hospital settings as well as policymakers have been alarmed at the adverse consequences to patients and higher costs to the healthcare system caused by persistent and prolonged drug shortages. The issue of chronic drug shortages in the US recently came again to the forefront of health policymakers with discussions announced between the FDA and Pfizer regarding the shortage of numerous injectable medicines, including emergency syringes of epinephrine.[5] Manufacturing, distribution, and third party delays were cited by Pfizer for the shortages according to the FDA.[5]

This white paper will briefly address the following two questions related to chronic drug shortages in the US:

- What are the key reasons for and solutions to the existence of chronic drug shortages in the US?
- Is there a role for the application of pharmaceutical decision science analytics to help mitigate the problem of chronic drug shortages?

2. Reasons for and Solutions to Chronic Drug Shortages

Five factors have been identified as driving the number of drug shortages in the United States in an excellent report referenced here.[4] This report provides conclusions that closely align with insights also reported in the academic journal literature.

1. *Market withdrawals*. A high percentage of drug shortages come from single-sourced injectable generic manufacturers. Maintaining quality controls is a problem given the low margins received for producing more complex and costly injectable drugs. The marginal cost of production is far greater for manufacturing injectable drugs than traditional small molecule pills. Moreover,

given the specialized nature of producing injectable drugs, manufacturing lines are not easily transferable to the production of other drugs. Thus, when a single-sourced manufacturer is shut down due to failing to meet FDA drug quality regulations, there is insufficient supply to meet demand, thus resulting in a shortage. Financial incentives, such as instituting an investment tax credit specifically targeted to generic manufacturers for maintaining the quality of production facilities could assist companies. Given the social costs of higher healthcare spending caused by drug shortages on the care of patients, such an investment tax credit would make sense on economic grounds when comparing net marginal social benefits to costs.

2. *Supply chain design*. Improvements in supply chain management are needed by companies, especially through improved demand estimation for a product through better coordination of processes of sales, demand planning, inventory management, and production. Such process improvements would allow for more accurately estimating capacity requirements and establishing manufacturing redundancies to mitigate the effect of production breakdowns that occur in the supply chain system. The application of decision science analytics can provide greater clarity in these processes that will improve business planning.

3. *Purchaser-manufacturer incentives*. As alluded in factor (1), insufficient financial incentives are a major factor in contributing to drug shortages. The formation of guaranteed-volume contracts or the ability to retain contracts would allow for lessening the risks of investments in manufacturing equipment needed to produce these specialized medicines.

4. *Limited market insights into future demands*. The study reference here, and interviews conducted with pharma executives, found that improvements are needed in obtaining better information on expected demand. Internal operations improvements are needed in the areas of sales and operations planning, demand forecasting, and market environmental information that affects external systems and programs. Again, this key factor points to a role in expanding the use of decision science analytics to help reduce drug shortages.

5. *Managing regulatory expectations*. Executive interview comments noted that regulations affected drug shortages

given production delays and higher costs to receive approvals for expanding manufacturing capacity or improving existing equipment. Further, many of the drug shortages involve older medicines developed 10-20 years ago, where government regulations prevent product and process improvements given the risks and costs. The moral of the story here is that all government regulations must balance the marginal cost versus the marginal benefit of imposing such rules.

3. Conclusions and the Role of Decision Science Analytics

The chronic problem of drug shortages in the US does not appear to be going away any time soon, despite numerous government policy efforts to address the problem. The social costs to our society caused by drug shortages, though not directly measured, are likely significant, in reductions in health outcomes and higher costs of care. Aside from the typical factors seen as causing drug shortages as elaborated in the previous section, what caught this author's eye was the growing realization how the application of improved decision science analytics could provide much needed information for manufacturers to reduce the problem through more effective planning. We typically see the application of pharma decision science analytics to address sales and marketing type questions. But here, we see how the expanded use of decision science analytics applied in a different setting can significantly help manufacturers institute more effective and efficient processes to mitigate the drug shortage problem that plagues the system.

This white paper ends with two parting thoughts about trying to address this significant social health problem which should not be occurring in a developed healthcare system as seen in the US. First, alleviating the problem of chronic drug shortages in the US will take resources. As the opening quote signifies, "there's no such thing as a free lunch." Investments are needed to upgrade manufacturing and planning processes, supply chain management systems, and the information needed to support these improvements to reduce the level and severity of drug shortage. Added incentives are required for companies to continue bringing these life-saving medicines to the market. Second, Axtria is well-positioned to assist companies given their pharma expertise in decision science analytics, commercial operations, and cloud information management to develop technologies that leverage all three previous areas into tools that allow for more effective and efficient dynamic decision-making.

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George A. Chressanthis, Ph.D.
Principal Scientist
Axtria Inc.
300 Connell Drive, Suite 5000
Berkeley Heights, NJ 07922
Email: george.chressanthis@axtria.com

Contact Us

+1-877-9AXTRIA
info@axtria.com

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