Beta-Lactam market research: Progress, challenges and prospects

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\textbf{ABSTRACT}
Antibiotics are robust medicines that are widely used from centuries together to treat bacterial infections such as UTI, Typhoid, and Cholera etc. The similarity between viral and bacterial infection has resulted in the misuse of these antibiotics, the result of which is the development of resistant strains. Such indiscriminate drug usage has been increasing in a vulnerable geriatric and pediatric population. The increase in per capita health expenditure has enhanced the global market of these class of drugs, and the scope is likely to shoot up in the coming years, paving the way for young investors to emerging. The Global market for antibiotics is highly competitive and has a large number of significant players dominating the market share. During the forecast period experts in the field have evaluated Beta-lactam and Beta-lactamase segment to dominate in LAMEA (Latin America, Middle East and Africa) holding the majority of the Market share. However, Asia Pacific was found to be the highest region for contributing more revenues. Detailed market analysis for Beta-lactam/ Beta-lactamase was conducted by doing secondary research where the market segments were compared for antibiotics. The paper discusses several issues related to the area of medicines.

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\section*{INTRODUCTION}
Antibiotics are robust medicines that are widely used from centuries together to treat bacterial infections such as UTI, Typhoid, and Cholera etc. The similarity between viral and bacterial infection has resulted in the misuse of antibiotics, the result of which is the development of resistant strains. Such indiscriminate drug usage, increase in the vulnerable geriatric and pediatric population and increase in per capita health expenditure has enhanced the global market of these class of drugs. The scope is likely to shoot up in the coming years, paving the way for young investors to emerge. The Global market for antibiotics is highly competitive and has a large number of significant players dominating the market share. As per Global Antibiotic Market analysis conducted by Mordor Intelligence Group, the market value was estimated to be USD 42,653.89 Million in 2018 and is predicted to cross USD 56,369.92 Million by 2024, witnessing a CAGR of 4.7% \cite{Mordor Intelligence, 2019}.
### Table 1: Data from few studies that were conducted on Beta lactams from 2010 to 2010

<table>
<thead>
<tr>
<th>References</th>
<th>Indication</th>
<th>Design and type of trial</th>
<th>Sample Size</th>
<th>ADR</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fujita et al. (2010)</td>
<td>Neutropenia patients</td>
<td>Multicentric prospective study in lung cancer patients</td>
<td>21</td>
<td>Serum bilirubin elevation, skin eruption, anterior chest pain &amp; neutrophil depletion</td>
<td>All cases finally displayed improvement</td>
</tr>
<tr>
<td>Sonck et al. (2007)</td>
<td>Renal Failure</td>
<td>Retrospective study in renal failure patients</td>
<td>8</td>
<td>Neurotoxicity and death</td>
<td>One should be careful during Cefepime use, especially if the patient is associated with kidney disease</td>
</tr>
<tr>
<td>Mustafa et al. (2001)</td>
<td>Pediatric cancer patients with fever and neutropenia</td>
<td>Single site, open label RCT study</td>
<td>104</td>
<td>No serious ADR's or death was considered</td>
<td>Cefepime is safer and effective than cefazidime for inceptive empiric therapy of febrile episodes in neutropenic pediatric cancer patients</td>
</tr>
<tr>
<td>Arrieta and Bradley (2001)</td>
<td>Serious urinary tract infections</td>
<td>Multicenter, open label RCT study</td>
<td>521</td>
<td>Cefepime: rash, abdominal pain, vomiting, anxiety, rhinitis and fever. Ceftazidime: rash, vomiting, diarrhea, fever, flu syndrome and erythema</td>
<td>Cefepime was found to be safe and efficacious choice for the treatement of urinary tract infection in children</td>
</tr>
<tr>
<td>Nucci et al. (2010)</td>
<td>Fever, Neutropenia, infections, Pneumonia, Meningitis</td>
<td>Meta-analysis</td>
<td>9467/8288</td>
<td>cefepime patients and 8288 comparator patients cefepime 51 patients, cefotaxime 44 patients</td>
<td>Use of cefepime was not significantly associated with increased mortality, compared with other antibacterial agents</td>
</tr>
<tr>
<td>Sáez-Llorens and O’Ryan (2001)</td>
<td>Meningitis</td>
<td>Open label RCT comparator studies</td>
<td>51</td>
<td>Cefepime: rash, abdominal pain, vomiting, anxiety, rhinitis and fever, oral moniliasis Ceftazidime: rash, vomiting, diarrhea, fever, oral moniliasis</td>
<td>Cefepime was clinically effective and comparable with both ceftriaxone and cefotaxime</td>
</tr>
<tr>
<td>Bradley and Arrieta (2001)</td>
<td>Lower respiratory tract infections</td>
<td>RCT</td>
<td>259</td>
<td>Cefepime: rash, abdominal pain, vomiting, anxiety, rhinitis and fever, oral moniliasis Ceftazidime: rash, vomiting, diarrhea, fever</td>
<td>Cefepime is safe, effective and well tolerated for the empiric treatment of children with Lower Respiratory Tract Infection</td>
</tr>
</tbody>
</table>
The global antibiotic market is so vast that studying the market will demand its segregation. The entire antibiotic market was divided by class into quinolones, macrolides, beta-lactam and beta-lactamase inhibitors and others for the ease of studying.

Beta-lactam and beta-lactamase inhibitors were found to have generated the maximum revenue the previous year, and the same was found to maintain dominance in the coming years. The primary fuel for its dominance is predicted to be its broad-spectrum activity. Experts in the field, upon further analysis, have concluded North America to be the dominating market shareholder in the field.

Furthermore, supportive government legislation, such as the (GAIN) Act, is expected to expedite the approval process. Many prevailing well-planned strategies such as collaborative development, regional expansion, product development too, are becoming the leading cause for the development of new pipeline molecules. One such instance for the same is the agreement between Department of Health and Human Services and AstraZeneca in the year 2015, which led to the exploration of Aztreonam and Avibactam (Mordor Intelligence, 2019).

The development of antibiotic resistance is on the rise and is rendering the entire class ineffective. This might harm market growth.

Some major players in the antibiotic market field include Astellas Pharma, GlaxoSmithKline, Novartis AG, Abbott Laboratories, Sanofi S.A, Pfizer, Bayer AG Bristol Myers, Eli Lilly Squibb etc. Generic manufacturers dominate the market (Mordor Intelligence, 2019).

**Challenges**

According to experts reinvigorating antibiotic R&D is going to be immensely challenging few years down the line due to a multitude of regulatory, scientific and economic barriers.

The first and foremost challenge to the antibiotic market would likely be the shortage of experts in the field to come out with lead molecules or novel approach to discover antibiotics. But discovering narrow-spectrum antibiotics, fruitful against emerging antibiotic resistance too might not solve the problem as it might easily replace most of the broad-spectrum antibiotics from the market. This might be a real challenge for dominant players presently ruling over the antibiotic market (CIDRAP, 2017).

The second critical challenge is the preclinical phase, which is appropriately termed by experts as the ‘valley of death’. Till today there exists no appro-
appropriate model to study the effect of antibiotics and its resistance. The existing methods are not reliable enough, i.e. it’s not possible to assure the safety of antibiotics based on extrapolated data. Funding the trials, too, is a very challenging hurdle to be overcome (CIDRAP, 2017).

The journey of antibiotics doesn’t stop over there. The very next hurdle is navigating through distinct licensing policies of various approving agencies, which will surely increase the expense of products. In the end, justifying the cost will be a significant challenge to both emerging and existing companies (CIDRAP, 2017). Even generic antibiotic manufacturers are not free from hurdles. The generic market is facing downward pressure due to significant challenges associated with its clinical indication.

METHODOLOGY

This study is a secondary research study wherein different market research websites, clinical trial websites and PubMed articles were screened for the collection of information. Through the literature review, studies were identified based on the inclusion and exclusion criteria for evaluating the data. Market data was collected from market research websites such as Allied Market Research and Mordor Intelligence etc. Figure 1 depicts the detailed methodology used for data collection and analysis.

Studies were screened to check the safety and efficacy of a few Beta Lactams with the keywords which were conducted from 2000 to 2010. The study results are discussed under results and discussion.

RESULTS AND DISCUSSION

Clinical safety for a few beta-lactams was reviewed. Various clinical studies showed that third-generation antibiotics were beneficial to treat a variety of conditions. But they did exhibit few ADR. The results were tabulated (Table 1).

Market analysis of beta-lactam antibiotic: Beta-lactam antibiotics market analysis was done by screening various market research websites.

Global antibiotic market: Present and Future is depicted in Figure 2 and provides insight from 2017 and 2025.

The global market forecast shows that the antibiotic market will increase at a CAGR of 2.1% from the present $ 42,335 Million to $ 50,374 Million in 2025 (Allied Market Research, 2018b). As classified according to the class, beta-lactams are on top and continue to be on top till 2025 in comparison to all other antibiotics (Farooqui et al., 2018). When Comparing region-wise, Asia-Pacific region is said to dominate over other regions due to the ease availability of antibiotics in this region and also increase in sales of OTC medicines. However, LAMEA will experience high growth rate because of easy access, no regulatory obligations and as well as identification as OTC drug (World Health Organization, 2018).

Global antibiotic market based on the class (Allied Market Research, 2018a): Beta-lactam market is further classified as penicillin, cephalosporins, carbapenems, monobactam and the combination of these. The highest revenue contributor in beta-lactam category was cephalosporin, and the same trend is anticipated in future too. The advantage of having broad-spectrum activity and development of a new generation of cephalosporin can tend to decrease antimicrobial resistance. One more advantage is that it can act against multiple groups of bacteria, This has led to the increased demand of cephalosporin among other class which in turn will fuel the growth in the antibiotic market across the globe. The global antibiotic market of Beta-Lactam and other antibiotics are depicted in Figure 3.

CONCLUSION

Beta-lactam/ Beta-Lactamase inhibitors were the highest revenue generators and expected to dominate in future too. Compared with resistance rates of other antibiotics, Beta Lactams are much safely used over a wide range of infections worldwide. Clinical data analysis also proved the efficacy and safety of third-generation beta-lactams. As an addition to this, the development of new approaches for treating numerous infections and an increased clinical trial will further drive the growth of this market. Though the emergence of resistant strains is not a severe problem associated with this class of drugs irrational use of these medicines and delay in the safety approval will impede the growth of this sector. On the other hand, the development of advanced molecules and novel combination therapies to treat the resistance may further offer a significant chance for the competitors to increase their market share. This report is a quantitative study carried out to find the market trends and opportunities that are available beta-lactam sector. Based on the results obtained from this secondary research, beta-lactam and Beta-lactamase inhibitors might be better than other antibiotics in terms of both safety and market. It would probably be a safe sector for emerging investors to enter. A comprehensive analysis of specific factors that are inhibiting the growth of this segment is explained.
Limitations of the study

1. The study was done for a short period. Hence it was possible to screen only a few surveys.

2. The class was beta-lactam antibiotics; other antibiotics were not considered in the study.

3. In-depth analysis of all the specific regions on beta-lactam market would have given more clarity to stakeholders to formulate region-specific plans.

4. This study can be further extrapolated to draw sharper conclusions in clinical as well as market analysis.

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Conflict of Interest

The authors declared no conflicts of interest.

REFERENCES


