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Optimizing community pharmacy performance: Key performance indicators and strategic insights

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Abstract
Community pharmacies often face challenges due to limited resources and technical expertise, which can reduce operational effectiveness and patient care. To address these issues, it is essential to identify key performance indicators (KPIs) that accurately measure pharmacy performance. KPIs include metrics such as sales revenue, prescription volume, medication adherence rates, inventory turnover, labor costs, customer satisfaction scores and other factors. These KPIs are collected and normalized for each pharmacy over monthly, quarterly, and annual intervals to ensure a fair performance comparison. Analyzing these performance metrics provides insights into pharmacy operations, allowing pharmacies to assess their performance, identify strengths and weaknesses, and find opportunities for improvement. Benchmarking through ranking is obtained by comparing KPIs across pharmacies, for stakeholders to adopt best practices and strategies for continuous improvement.

Keywords: Community pharmacies, key performance indicators, metrics, insights, benchmarking

Introduction
Community pharmacies face several challenges due to limited resources and technical expertise (John, 2017) [2], including reduced operational efficiency, poor patient care (Yang *et al.*, 2016) [5], and difficulty implementing technology. These limitations also lead to inventory management issues (Tan *et al.*, 2016) [6], inaccurate performance assessment, compliance and regulatory challenges, financial constraints, and staff training and retention difficulties. As a result, pharmacies struggle with streamlining processes, adopting new technologies, managing inventory, and maintaining a skilled workforce, negatively impacting their service quality and operational efficiency. The investigation aims to identify key performance indicators (KPIs) and metrics that accurately assess (Melton *et al.*, 2017) [1] pharmacy performance to address challenges faced by community pharmacies due to limited resources and technical expertise. These KPIs (Teichert *et al.*, 2016) [4] collectively provide insights into various aspects of pharmacy operations, such as financial performance, service quality, efficiency, and patient safety, enabling pharmacies to assess their performance (Miller *et al.*, 2016) [7], identify areas for improvement, and make informed decisions to enhance overall effectiveness and customer satisfaction.

By obtaining and analyzing aggregated KPI metrics over specific periods, such as monthly, quarterly, and yearly, the investigation aims to provide comprehensive and detailed insights (Teichert *et al.*, 2016) [4] into the operations of community pharmacies. This systematic collection and examination of KPI data allow for a thorough understanding of various aspects of pharmacy performance, including sales, prescription volume, medication adherence, inventory management (Dwivedi *et al.*, 2012) [12] , labor costs, and customer satisfaction. Aggregating these metrics over defined timeframes helps identify trends and patterns that may not be apparent in shorter time spans, thus offering a clearer picture of operational efficiency and service quality. Through this analysis, community pharmacies can evaluate their relative performance (Mossialos *et al.*, 2015) [8] compared to industry benchmarks or peer pharmacies. This comparative evaluation helps pinpoint areas where a pharmacy excels, such as high customer satisfaction (Melton *et al.*, 2017) [1] or efficient inventory turnover, and areas needing improvement, like medication error rates (Miller *et al.*, 2016) [7] or patient wait times.

Furthermore, pharmacies can develop targeted strategies to address gaps and capitalize on opportunities by understanding these strengths and weaknesses. For instance, improving medication adherence rates through patient education programs or optimizing labor costs by refining staffing schedules. Ultimately, this thorough analysis of aggregated KPI metrics empowers community pharmacies to enhance their operational efficiency, elevate the quality

of patient care, and improve overall business performance.
The comparative analysis of performance metrics involves systematically evaluating and comparing key performance indicators (KPIs) across different pharmacies. It enables the ranking of pharmacies based on their relative performance in various areas, such as sales revenue, customer satisfaction, and operational efficiency. This ranking helps identify top-performing pharmacies, highlight best practices, and provide a benchmark for others to strive toward, ultimately fostering a competitive and improvement-driven environment within the pharmacy community.

2. Materials and Methods

Community pharmacy data containing sensitive information is difficult to obtain due to privacy concerns; one approach is to generate synthetic data that resembles real prescription claims, billing patterns, and patient behavior (Rutter *et al.*, 2015) [9]. Tools and techniques exist to create synthetic pharmacy operational datasets that preserve statistical properties and relationships in real data while ensuring patient privacy.
The key performance indicators (KPIs) and metrics essential for assessing pharmacies' performance are identified and defined. These metrics cover various metrics, such as: - Sales Revenue, which is determined by prescription volume, transaction value, and seasonal trends, while Prescription Volume (Borle *et al.,* 2014) [11] is influenced by demographics, disease prevalence, and healthcare utilization. (Brown *et al.,* 2016) [3] Medication Adherence Rates are impacted by patient demographics, medication type, and treatment duration, and Inventory Turnover is determined by sales volume, prescription refills, and inventory practices. Labor Costs are based on staffing levels, salaries, and productivity (Rabbanee *et al.,* 2015) [10], and Customer Satisfaction Scores are derived from service quality, wait times, and perceived value. Geographic Location is assigned using regions or geospatial data, and Demographics are generated from population statistics or census data for patients and employees. Average Transaction Value (ATV) measures customer spending per transaction, and Profit Margin assesses profitability after costs and expenses. The prescription Fill Rate measures the efficiency of filling prescriptions, while the Generic Dispensing Rate (GDR) indicates the percentage of prescriptions filled with generics. Patient Wait Times represent the average wait time for pharmacy services, and the Medication Error Rate measures the frequency of errors in dispensing or labelling. Return on Investment (ROI) reflects the financial return on various investments, and the Customer Retention Rate measures customer loyalty over time. Finally, Medication Therapy Management (MTM) Utilization tracks the provision of medication therapy management services, and the Adverse Drug Event (ADE) Reporting Rate indicates the frequency of reported adverse drug events.
Simulated datasets emulating the intricacies and nuances of community pharmacy operations are crafted through Python programming specifically for the identified key performance indicators (KPIs) (Teichert *et al.,* 2016) [4] and metrics. This process involves leveraging Python's programming capabilities to generate synthetic data for 3 three-year everyday operations for 10 pharmacies that mirror real-world scenarios and reflect the dynamics of pharmacy activities.
KPIs have significantly different scales, ranging from small to large values; the data are normalized to bring them to a comparable scale. Normalization uses the Min-Max Scaler Eq. (1) function to adjust each KPI's values to a standardized range or distribution, ensuring they are directly comparable.

$$X'_{i,j} = \frac{X_{i,j} - \min(X_j)}{\max(X_j) - \min(X_j)} \qquad (1)$$

Where $X_{i,j}$ is the value of metric j for pharmacy i, $\min(X_j)$ and $\max(X_j)$ are the minimum and maximum values of metric j across all pharmacies.
The data for each key performance indicator (KPI) across that timeframe are summarized to generate aggregated metrics for each pharmacy over a specific period, such as monthly, quarterly, or yearly. This process typically includes calculating various statistics, such as averages, sums, or other relevant measures, to provide a comprehensive view of the pharmacy's performance over the period.
The performance indices (Teichert *et al.*, 2016) [4] are created by combining multiple KPIs into a single composite score or index. This allows for a holistic assessment of pharmacy performance, considering various aspects such as sales revenue, patient satisfaction, and medication adherence. The aggregated data are used to benchmark the pharmacies and assess their relative performance. In this work, the approach used is ranking, where pharmacies are ordered based on their performance scores for specific KPIs. The equally weighted sum of the normalized metrics for each pharmacy is computed to get a composite score Eq. (2). Min-Max normalization Eq. (3) is applied to sets of composite scores to rank the pharmacies. By employing these benchmarking techniques, stakeholders can gain valuable insights into each pharmacy's relative strengths and weaknesses, identify best practices, and implement strategies to drive continuous improvement and enhance the overall performance of the pharmacies.

$$S_i = \sum_{j=1}^{n} X'_{i,j} \qquad (2)$$

$$R'_i = \frac{S_i - S_{min}}{S_{max} - S_{min}} \qquad (3)$$

Where S_i is the composite score for pharmacy i, R'_i is the normalized composite Rank for pharmacy i, which lies in the range $[0,1]$, S_{min} is the minimum composite score in the dataset, and S_{max} is the maximum composite score in the dataset.
Visualizations can be tailored to the preferences and needs of different audiences, ensuring that the findings are effectively communicated and actionable insights are derived. It enables better interpretation and communication of the findings, making it easier to understand pharmacies' performance. Charts and graphs are generated to visually represent the data, allowing stakeholders to quickly identify trends, patterns, and outliers. The benchmarking results are visualized as the comparative performance of pharmacies across different key performance indicators (KPIs).

3. Results and Discussion

The data collected for performance analysis of community pharmacies can be tailored to meet the specific needs of organizations, allowing for a focus on individual key performance indicators (KPIs) or a combination of metrics to address specific challenges. This work highlights and discusses on some of the selected key performance analysis results.
The customer satisfaction scores in Fig 1, for ten community

pharmacies (CP 01 to CP 10) for 2015 ranged from approximately 54% to 57%. Overall, the scores indicate relatively stable customer satisfaction with minor fluctuations. CP 01 and CP 07 achieved the highest satisfaction scores, around 57%, while CP 08 had the lowest, slightly below 55%. Pharmacies CP 02 through CP 06 had stable scores around 55-56%, and CP 09 and CP 10 showed slight increases towards the end of the year. Notably, CP 07 peaked before a sharp decline at CP 08, indicating potential issues at CP 08 that warrant further investigation.

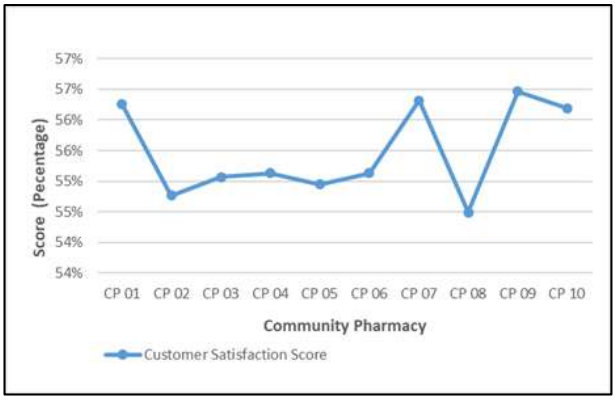

Fig 1: Analysis of customer satisfaction score for the year 2015

The stability among CP 02 to CP 06 suggests consistent service quality, with minor fluctuations likely due to specific incidents or seasonal variations. High scores at CP 01 and CP 07 may reflect effective practices that could be modelled by others, while CP 08's drop highlights the need for targeted improvements. The analysis highlight that there is a need for qualitative studies at CP 08 to identify dissatisfaction causes, implementation of successful practices from higher-scoring pharmacies, and continuous monitoring to enhance overall customer satisfaction and service quality.

The comparative analysis of performance metrics in Fig 2, for ten community pharmacies in 2015 reveals significant variability in profit margins, with CP 01, CP 05, and CP 08 nearing 80%, while CP 03 and CP 09 drop to around 40%.

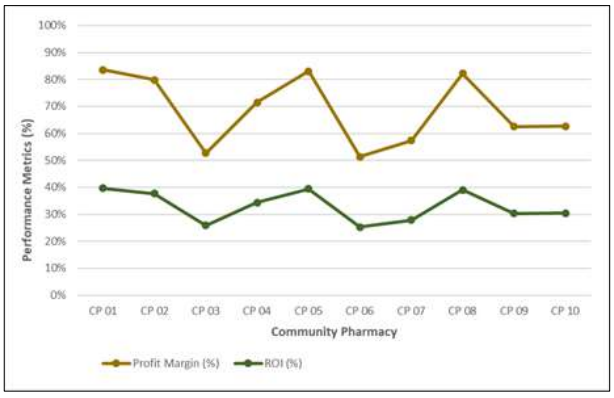

Fig 2: Comparative Analysis of Performance Metrics – Profit Margin (%) and ROI (%) for the Year 2015

Notable fluctuations are observed between CP 03 to CP 05 and CP 07 to CP 08. ROI remains relatively stable but lower than profit margins, with CP 01 and CP 08 slightly exceeding 40% and CP 03 dipping below 20%. Pharmacies like CP 02, CP 04, and CP 07 maintain ROI within the 30-40% range. The data shows higher profit margins do not always correlate with higher ROI. Performance gaps suggest management efficiency, cost control, and revenue generation disparities. Stable ROI in some pharmacies indicates consistent practices, while variable profit margins suggest market conditions or operational cost changes. The analysis highlights the need for targeted strategies to improve performance in lower-performing pharmacies and suggests adopting best practices from higher-performing ones to bridge performance gaps.

The comparative analysis of rate percentages for performance metrics in Fig 3, across ten community pharmacies in 2015 shows that medication adherence and customer retention rates are consistently high, around 50%, indicating effective customer engagement and treatment adherence. Prescription fill rates and generic dispensing rates vary moderately between 30% and 40%, reflecting differences in operational efficiency. Medication error rates and adverse drug event reporting rates remain below 20%, highlighting strong safety and quality control.

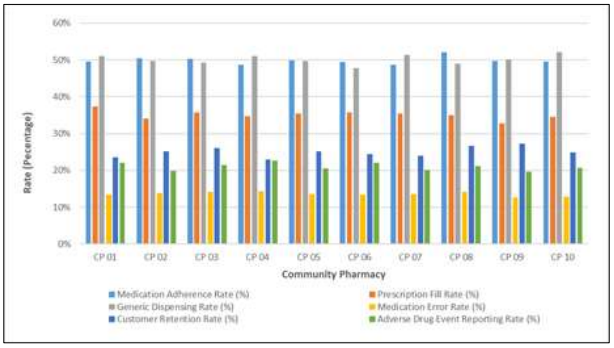

Fig 3: Comparative Analysis of Rate Percentage of Performance Metrics for Year 2015

Overall, the pharmacies maintain high adherence and retention rates while minimizing errors, though there is room for improvement in standardizing prescription and dispensing practices to enhance efficiency.

The comparative analysis of quarterly inventory turnover ratios in Fig 4, for ten community pharmacies in 2015 reveals a moderate turnover rate between 1.5 and 2.5. Turnover ratios are consistent across quarters, with CP 05 and CP 10 showing the highest efficiency (approaching 2.5), while CP 01 and CP 03 have lower ratios (around 1.5), indicating slower inventory movement. Minor seasonal variations are observed, but no significant deviations. High turnover ratios suggest effective inventory management, reducing holding costs and ensuring fresher stock, whereas lower ratios may indicate overstocking or slower sales, tying up capital and risking obsolescence. Consistent turnover ratios reflect stable demand and efficient restocking. Pharmacies with higher ratios might employ better forecasting, purchasing, and sales strategies, serving as models for improvement. Enhancing inventory management could boost efficiency and profitability in underperforming pharmacies.

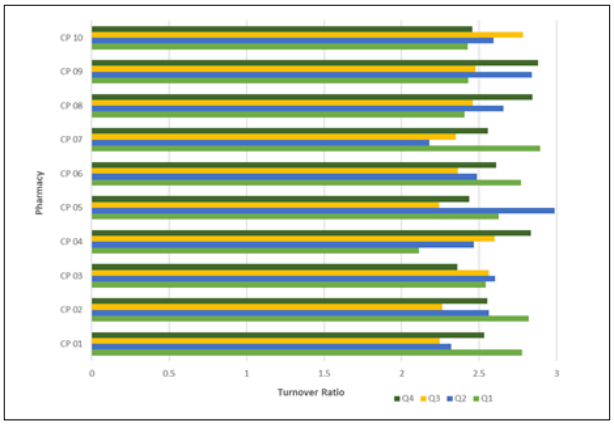

Fig 4: Comparative Analysis of Quarterly Inventory Turnover for the Year 2015

The performance rankings for ten community pharmacies (CP 01 to CP 10) over three consecutive years, 2015, 2016, and 2017, reveal significant trends, as shown in Fig 5.

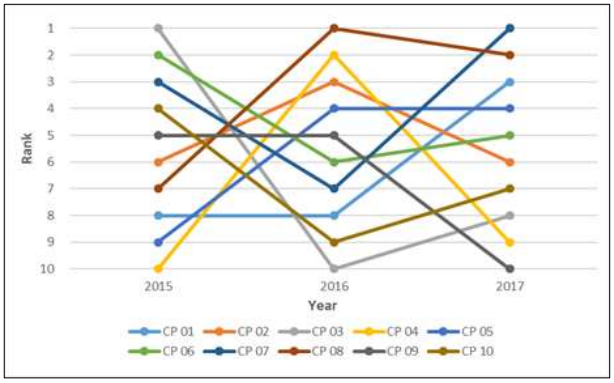

Fig 5: Performance Ranking of Pharmacies Over Three Consecutive Years

Each value represents the rank of the pharmacy for that particular year, with 1 being the highest (best performance) and 10 being the lowest (worst performance). In 2015, CP 04 and CP 05 were the lowest performers, while CP 03 and CP 06 achieved the highest ranks. In 2016, CP 03 and CP 10 showed marked improvement, attaining the lowest ranks, whereas CP 08 and CP 04 fell to the top. By 2017, CP 04 and CP 09 were the lowest performers, with CP 07 and CP 08 consistently at the top. Notably, CP 04 maintained a low performance across the years, CP 05 declined after an initial strong performance, CP 03 improved dramatically from 2015 to 2016, and CP 08 consistently performed poorly. Comparative analysis indicates that CP 03 and CP 10 have significantly improved, while CP 05 and CP 07 have declined. CP 01 remained stable, maintaining mid-range ranks. The data underscores the dynamic nature of pharmacy performance, suggesting that successful strategies should be sustained and analyzed for further improvements while underperforming pharmacies must reevaluate their operational approaches. Regular monitoring and comparative analysis are crucial for identifying effective practices and areas needing improvement, promoting continuous enhancement across all pharmacies.

4. Conclusions

Community pharmacies encounter substantial obstacles from scarce resources and technical know-how, which can impact operational effectiveness and patient care quality. Creating synthetic datasets replicating actual pharmacy activities offers a solution by facilitating the examination of critical success factors without infringing on patient confidentiality. Key performance indicators (KPIs) such as sales revenue, prescription volume, medication adherence rates, inventory turnover, labor costs, customer satisfaction scores and other factors, are essential for this analysis. These KPIs are standardized to ensure they are comparable and are consolidated over defined timeframes to deliver a thorough understanding of pharmacy performance. By analyzing these KPIs and metrics, pharmacies can identify strengths and areas for improvement. Strategic initiatives based on these insights can enhance operational efficiency, higher customer satisfaction, and improve financial performance. Regular benchmarking and continuous monitoring are crucial for sustaining improvements and adopting best practices and strategies for ongoing enhancement and excellence in pharmacy operations.

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