Collaborative Management of Medication-Induced Dyslipidemia: The Role of Pharmacists and Laboratory Specialists in Optimizing Patient Outcomes

Alaa M. Alsayyari[1], Alaa S. Aleiid[2], Jehan H. Ben Hyzaam[3], Ranya F. Arab[4], Amal T. Alenazi[5], Hala H. Almutairi[6], Rayyan D. Alotaibi[7], Nujud K. Hajij[8], Waleed A Alrogy[9]

Health Affairs at the Ministry of National Guard

Abstract

Background: Medication-induced dyslipidemia is a significant risk factor for cardiovascular diseases, particularly in patients taking chronic medications such as corticosteroids and antipsychotics. This study aimed to assess the impact of pharmacist and laboratory specialist collaboration in managing medication-induced dyslipidemia in a tertiary hospital setting.

Methods: A retrospective cohort study was conducted with 200 patients on chronic medications known to induce dyslipidemia. The intervention group (n = 100) received collaborative care from pharmacists and laboratory specialists, while the control group (n = 100) received standard care. Primary outcomes included changes in lipid profiles over six months. Secondary outcomes included cardiovascular events, medication adherence, and patient satisfaction.

Results: The intervention group showed significant improvements in lipid profiles, with reductions in total cholesterol (211 mg/dL to 185 mg/dL, $p < 0.001$) and LDL (141 mg/dL to 110 mg/dL, $p < 0.001$), compared to the control group. Cardiovascular events were lower in the intervention group (8% vs. 14%, $p = 0.041$), and medication adherence was higher (86% vs. 73%, $p = 0.022$). Patient satisfaction with pharmacist-led interventions was also significantly higher (92% vs. 68%, $p < 0.001$).

Conclusion: Collaboration between pharmacists and laboratory specialists significantly improves lipid management and reduces cardiovascular risk in patients with medication-induced dyslipidemia. This interdisciplinary approach enhances patient outcomes and should be integrated into routine care for patients on chronic medications.

Keywords: Medication-induced dyslipidemia, pharmacists, laboratory specialists, lipid profiles, cardiovascular risk, interdisciplinary care

Introduction

Dyslipidemia, characterized by abnormal levels of lipids in the blood, is a major risk factor for cardiovascular diseases, including atherosclerosis, myocardial infarction, and stroke. The management of dyslipidemia is particularly important in patients taking chronic medications, as certain drug classes, such as corticosteroids, antipsychotics, and antiretrovirals, are known to induce or exacerbate dyslipidemia (Simha,

2015). Left unchecked, medication-induced dyslipidemia can significantly increase a patient's risk of cardiovascular events, necessitating timely intervention and continuous monitoring.

Pharmacists play a key role in managing the medication regimens of patients at risk of dyslipidemia, particularly by identifying drugs that may contribute to lipid imbalances and adjusting therapy to mitigate these effects. Interventions such as dose adjustments, switching to alternative medications, or initiating lipid-lowering therapies can be instrumental in improving patient outcomes (Herink and Ito, 2015). Additionally, lifestyle modifications, including diet and exercise, often require reinforcement by pharmacists to ensure patients are managing their dyslipidemia effectively alongside pharmacotherapy.

Laboratory specialists, on the other hand, provide crucial support by monitoring lipid profiles and ensuring that test results are accurate and timely. Biomarkers such as total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides guide clinicians in assessing the extent of dyslipidemia and evaluating the effectiveness of interventions (Ference et al., 2017). In collaboration with pharmacists, laboratory specialists can help ensure that lipid levels are monitored regularly, and that appropriate therapeutic adjustments are made when necessary.

This study aims to explore how the collaboration between pharmacists and laboratory specialists can optimize the management of medication-induced dyslipidemia. By leveraging the expertise of both professions, this interdisciplinary approach seeks to improve the detection, monitoring, and therapeutic management of dyslipidemia, ultimately reducing the risk of cardiovascular events in patients taking chronic medications.

Literature Review

1. Medication-Induced Dyslipidemia

Dyslipidemia is a well-known risk factor for cardiovascular diseases, with its hallmark being abnormal lipid profiles such as elevated levels of total cholesterol, low-density lipoprotein (LDL), and triglycerides, alongside reduced levels of high-density lipoprotein (HDL) (Florez et al., 2005). Medication-induced dyslipidemia is a significant concern, particularly in patients taking long-term therapies. Several classes of drugs are associated with adverse lipid changes, notably corticosteroids, antipsychotics, and antiretroviral drugs (Simha, 2015).

Corticosteroids, for example, are commonly used to treat inflammatory and autoimmune conditions but can lead to elevated LDL and triglycerides by increasing hepatic lipid synthesis and promoting insulin resistance (Florez et al., 2005).). Antipsychotics, especially second-generation agents like olanzapine and clozapine, have also been implicated in dyslipidemia, with studies showing significant elevations in triglycerides and LDL cholesterol in patients on long-term therapy (Herink and Ito, 2015). Antiretrovirals, particularly protease inhibitors used in HIV treatment, are similarly associated with lipid abnormalities, exacerbating cardiovascular risk in this already vulnerable population (Gillcrist, 2020).

2. The Role of Pharmacists in Managing Dyslipidemia

Pharmacists are uniquely positioned to manage medication-induced dyslipidemia through regular medication reviews, identifying at-risk patients, and recommending therapeutic adjustments. Pharmacists can provide critical interventions, such as switching to alternative medications with fewer dyslipidemic effects or initiating lipid-lowering therapies, such as statins or fibrates, to mitigate the adverse lipid effects of necessary chronic medications (Lee et al., 2019).

In addition to pharmacotherapy, pharmacists are instrumental in patient education, counseling patients on the importance of lifestyle modifications such as dietary changes and physical activity to complement pharmacological management (Patti et al., 2019). Studies have demonstrated that pharmacist-led interventions can significantly reduce cholesterol levels in patients with medication-induced dyslipidemia. For example, Herink and Ito (2015) found that pharmacist-driven lipid management programs resulted in improved LDL and triglyceride levels in patients on antipsychotic therapy.

3. The Role of Laboratory Specialists in Monitoring Dyslipidemia

Laboratory specialists play a critical role in managing dyslipidemia by providing accurate and timely lipid profile assessments. The primary biomarkers monitored include total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides (Ference et al., 2017). Regular lipid testing is essential for both the diagnosis of dyslipidemia and the monitoring of therapeutic interventions, especially in patients who are taking medications that may negatively impact lipid metabolism.

Accurate laboratory data allows for timely intervention, enabling pharmacists and clinicians to adjust therapy before dyslipidemia progresses to more severe cardiovascular complications. Moreover, laboratory specialists ensure that results are interpreted in the context of clinical guidelines, facilitating collaborative decision-making between pharmacists and other healthcare providers (Florez et al., 2005). Collaborative models involving both pharmacists and laboratory specialists have shown to be effective in optimizing chronic disease management, especially in monitoring and adjusting therapy based on biochemical markers (Blonde et al., 2018).

4. Collaborative Care Models for Dyslipidemia Management

The integration of pharmacists and laboratory specialists into collaborative care models has been shown to improve outcomes in managing dyslipidemia, particularly when induced by chronic medications. In such models, laboratory specialists provide the biochemical data required to detect dyslipidemia early, while pharmacists use this data to adjust medication regimens and provide personalized patient care (Lee et al., 2019).

One example of successful collaboration is in the management of dyslipidemia in patients on antiretroviral therapy, where routine lipid monitoring by laboratory specialists prompts early therapeutic adjustments by pharmacists to mitigate cardiovascular risks (Gillcrist, 2020). Similarly, in psychiatric populations receiving antipsychotic medications, collaborative interventions have reduced the incidence of metabolic syndrome, including dyslipidemia, through coordinated efforts between laboratory monitoring and pharmacist-led medication adjustments (Herink and Ito, 2015).

5. Impact of Early Detection and Intervention on Cardiovascular Outcomes

Early detection of dyslipidemia and prompt therapeutic interventions are critical in preventing long-term cardiovascular complications. Dyslipidemia is a modifiable risk factor, and its management can significantly reduce the risk of atherosclerotic cardiovascular disease, myocardial infarction, and stroke (Ference et al., 2017). Collaborative care models that involve both pharmacists and laboratory specialists are uniquely positioned to detect lipid abnormalities early and intervene before they lead to more severe outcomes.

The evidence supports that pharmacist-driven lipid management, particularly when combined with routine laboratory monitoring, can lead to meaningful reductions in LDL cholesterol and triglyceride levels,

ultimately improving patient outcomes (Lee et al., 2019). Moreover, addressing medication-induced dyslipidemia early, especially in patients on long-term therapies like corticosteroids and antipsychotics, can prevent the progression to more severe cardiovascular diseases (Patti et al., 2019).The literature underscores the importance of managing medication-induced dyslipidemia through interdisciplinary collaboration between pharmacists and laboratory specialists. By working together, these healthcare professionals can detect dyslipidemia early, adjust therapy, and provide patients with personalized care that mitigates the cardiovascular risks associated with chronic medications. Given the growing use of medications that adversely affect lipid profiles, it is essential to implement collaborative care models to optimize dyslipidemia management and improve patient outcomes.

Methodology

Study Design

This was a retrospective, observational cohort study conducted at a tertiary care hospital. The study aimed to evaluate the role of pharmacists and laboratory specialists in managing medication-induced dyslipidemia in patients on chronic medications. The focus was on determining how collaboration between pharmacists and laboratory specialists impacted lipid profile outcomes and cardiovascular risk in patients receiving long-term therapies such as corticosteroids, antipsychotics, and antiretroviral medications.

Study Population

The study included adult patients (≥18 years old) who were taking chronic medications known to induce dyslipidemia, such as corticosteroids, second-generation antipsychotics, and antiretroviral therapies. Patients were eligible for inclusion if they had been on these medications for at least six months and had at least two recorded lipid panel results (baseline and follow-up).

Inclusion Criteria:

- Patients aged 18 years or older.
- Patients taking corticosteroids, antipsychotics, or antiretroviral medications for at least six months.
- Patients with baseline and follow-up lipid profiles, including total cholesterol, LDL, HDL, and triglycerides.
- Patients who received pharmacist-led medication reviews and laboratory-monitored lipid profiles during the study period.

Exclusion Criteria:

- Patients with pre-existing dyslipidemia prior to the initiation of the chronic medications under investigation.
- Patients with other metabolic disorders that could confound lipid levels (e.g., diabetes, hypothyroidism).
- Patients with incomplete medical records or missing lipid profile data.

A total of 200 patients met the inclusion criteria and were included in the final analysis. Patients were divided into two groups: an intervention group (n = 100) where pharmacists and laboratory specialists collaborated in dyslipidemia management, and a control group (n = 100) that received standard care without interdisciplinary collaboration.

Intervention: Collaborative Care Model

Patients in the intervention group received collaborative care, where pharmacists and laboratory specialists worked together to manage medication-induced dyslipidemia. The collaborative approach involved:

- Pharmacists 'Role:
  - Conducted medication reviews to identify medications contributing to dyslipidemia.
  - Recommended therapeutic adjustments, such as switching medications or adjusting doses, and initiated lipid-lowering agents (e.g., statins) as needed.
  - Provided patient education on lifestyle modifications (diet, exercise) to complement pharmacotherapy.

- Laboratory Specialists 'Role:
  - Performed and monitored lipid panel tests, including total cholesterol, LDL, HDL, and triglycerides.
  - Provided timely test results to pharmacists for clinical decision-making.
  - Monitored the effectiveness of lipid-lowering therapies by conducting follow-up lipid profiles at 3-month intervals.

In the control group, patients received standard care where pharmacists were not directly involved in the management of dyslipidemia, and laboratory results were reviewed by the attending physicians only.

Data Collection

Data were retrospectively collected from the electronic medical records (EMR) of patients. The following data were extracted:

- Demographic Information: Age, gender, body mass index (BMI), smoking status, and comorbidities (e.g., hypertension, cardiovascular disease).
- Medication History: Chronic medications associated with dyslipidemia (e.g., corticosteroids, antipsychotics, antiretrovirals) and any lipid-lowering agents prescribed during the study period.
- Lipid Profiles: Baseline and follow-up lipid levels, including total cholesterol, LDL, HDL, and triglycerides, at 3 and 6 months post-intervention.
- Pharmacist Interventions: Type and frequency of pharmacist-led medication adjustments, patient education sessions, and lifestyle counseling.
- Laboratory Monitoring: Frequency of lipid panel monitoring, and any changes in lipid levels over time.
- Clinical Outcomes: Incidence of cardiovascular events (e.g., myocardial infarction, stroke), hospitalizations related to cardiovascular complications, and patient adherence to prescribed lipid-lowering medications.

Outcome Measures

The primary outcome of the study was the improvement in lipid profiles, measured by changes in total cholesterol, LDL, HDL, and triglycerides from baseline to follow-up (at 3 and 6 months).

Secondary outcomes included:
- Reduction in cardiovascular events (e.g., myocardial infarction, stroke) during the study period.
- Medication adherence, as assessed by patient follow-up visits and refill data for lipid-lowering medications.
- Patient satisfaction with pharmacist-led interventions, measured through patient-reported outcomes surveys.

Data Analysis

Data were analyzed using SPSS version [XX]. Descriptive statistics were used to summarize the demographic characteristics and baseline lipid levels of the study population. Comparative analysis between the intervention and control groups was conducted as follows:

- Paired t-tests were used to assess changes in lipid profiles within each group from baseline to follow-up at 3 and 6 months.
- Independent t-tests were used to compare the mean differences in lipid profiles between the intervention and control groups at 3 and 6 months.
- Chi-square tests were used to analyze categorical outcomes, such as the incidence of cardiovascular events and hospitalizations.
- Multivariate regression analysis was performed to identify predictors of lipid profile improvement, adjusting for confounding variables such as age, BMI, smoking status, and medication use.

Ethical Considerations

The study was approved by the ethics committee. As this was a retrospective study, the requirement for patient consent was waived. All data were anonymized to maintain patient confidentiality, and access to electronic medical records was restricted to authorized research personnel only. The study adhered to the principles outlined in the Declaration of Helsinki.

Limitations

This study had several limitations. First, its retrospective design may introduce biases related to incomplete data or missing records. Additionally, the study was conducted at a single tertiary hospital, limiting the generalizability of the findings to other healthcare settings. Finally, while the study focused on medication-induced dyslipidemia, other factors such as dietary habits or physical activity levels were not consistently recorded, which may have influenced lipid profiles.

Findings

1. Patient Demographics and Baseline Characteristics

A total of 200 patients were included in the study, with 100 in the intervention group (pharmacist and laboratory specialist collaboration) and 100 in the control group (standard care). The mean age of patients was 55.6 years (SD = 10.8), and 52% were male. There were no significant differences between the intervention and control groups in terms of demographic characteristics, underlying conditions, or baseline lipid levels.

Table 1: Patient Demographics and Baseline Characteristics

Characteristic	Total (n = 200)	Intervention (n = 100)	Control (n = 100)	p-value
Mean Age (years)	55.6 ±10.8	56.1 ±10.6	55.2 ±11.0	0.561
Male (%)	52%	50%	54%	0.678
BMI (kg/m²)	27.8 ±4.6	28.0 ±4.7	27.7 ±4.5	0.741
Smoking Status (%)	38%	39%	37%	0.801
Hypertension (%)	42%	43%	41%	0.674
Baseline Total	210 ±32	211 ±30	208 ±34	0.614

Cholesterol (mg/dL)				
Baseline LDL (mg/dL)	140 ±28	141 ±29	139 ±27	0.731
Baseline HDL (mg/dL)	44 ±10	43 ±11	45 ±9	0.659
Baseline Triglycerides (mg/dL)	168 ±45	169 ±46	167 ±43	0.702

2. Primary Outcome: Improvement in Lipid Profiles

Patients in the intervention group demonstrated significantly greater improvements in lipid profiles compared to the control group. At 6 months, the intervention group showed a reduction in total cholesterol from 211 mg/dL to 185 mg/dL ($p < 0.001$) and LDL from 141 mg/dL to 110 mg/dL ($p < 0.001$). The control group showed only modest improvements, with total cholesterol decreasing from 208 mg/dL to 198 mg/dL ($p = 0.049$) and LDL from 139 mg/dL to 128 mg/dL ($p = 0.051$). Improvements in HDL and triglyceride levels were also more significant in the intervention group.

Table 2: Changes in Lipid Profiles from Baseline to 6 Months

Lipid Parameter	Baseline (Mean ±SD)	6 Months (Mean ±SD)	p-value (within-group)	p-value (between-groups at 6 months)
Total Cholesterol (mg/dL)				
Intervention	211 ±30	185 ±28	< 0.001	< 0.001
Control	208 ±34	198 ±32	0.049	
LDL (mg/dL)				
Intervention	141 ±29	110 ±27	< 0.001	< 0.001
Control	139 ±27	128 ±29	0.051	
HDL (mg/dL)				
Intervention	43 ±11	48 ±10	0.002	0.003
Control	45 ±9	46 ±8	0.075	
Triglycerides (mg/dL)				
Intervention	169 ±46	150 ±40	0.006	0.012
Control	167 ±43	161 ±42	0.091	

3. Secondary Outcomes: Cardiovascular Events and Medication Adherence

The incidence of cardiovascular events was lower in the intervention group, with only 8% of patients experiencing a cardiovascular event (e.g., myocardial infarction, stroke) compared to 14% in the control group ($p = 0.041$). Additionally, patients in the intervention group showed higher medication adherence, with 86% adhering to their prescribed lipid-lowering therapies, compared to 73% in the control group ($p = 0.022$).

Table 3: Cardiovascular Events and Medication Adherence

Outcome	Intervention (%)	Control (%)	p-value
Cardiovascular Events	8%	14%	0.041
MedicationAdherence	86%	73%	0.022

4. Patient Satisfaction with Pharmacist-Led Interventions

Patient satisfaction was significantly higher in the intervention group, with 92% of patients reporting being "very satisfied" or "satisfied" with the pharmacist-led interventions in managing their dyslipidemia, compared to 68% in the control group ($p < 0.001$).

Table 4: Patient Satisfaction with Care

Satisfaction Level	Intervention (%)	Control (%)	p-value
Very Satisfied/Satisfied	92%	68%	< 0.001
Neutral	6%	22%	
Dissatisfied/Very Dissatisfied	2%	10%	

Summary of Findings

The results of this study indicate that the collaboration between pharmacists and laboratory specialists significantly improves the management of medication-induced dyslipidemia. Patients in the intervention group demonstrated greater reductions in total cholesterol and LDL levels, improved adherence to lipid-lowering therapies, and experienced fewer cardiovascular events compared to the control group. Additionally, patient satisfaction with pharmacist-led interventions was significantly higher, highlighting the importance of interdisciplinary collaboration in chronic disease management.

Discussion

This study aimed to evaluate the impact of collaboration between pharmacists and laboratory specialists in managing medication-induced dyslipidemia in patients on chronic medications. The findings demonstrated that the interdisciplinary approach led to significantly improved lipid profiles, reduced cardiovascular events, higher medication adherence, and increased patient satisfaction compared to standard care.

Improvement in Lipid Profiles

One of the most significant outcomes of this study was the improvement in lipid profiles in the intervention group, where pharmacists and laboratory specialists collaborated to monitor and manage dyslipidemia. Patients in the intervention group showed a significant reduction in total cholesterol and LDL levels after six months of intervention. These findings are consistent with previous studies that have highlighted the effectiveness of pharmacist-led interventions in improving lipid levels through medication adjustments and patient education (Herink and Ito, 2015). The results also underscore the importance of regular lipid monitoring by laboratory specialists, which ensures timely detection of dyslipidemia and enables pharmacists to make appropriate therapeutic adjustments.

The modest improvement in the control group suggests that standard care, which lacked pharmacist and laboratory specialist collaboration, may not be as effective in managing dyslipidemia, particularly in patients taking chronic medications with known dyslipidemic effects, such as corticosteroids and antipsychotics

(Simha, 2015). The significant improvements in HDL levels and triglyceride reductions further emphasize the value of a collaborative approach in managing all aspects of dyslipidemia.

Reduction in Cardiovascular Events

The reduction in cardiovascular events in the intervention group highlights the clinical relevance of improved lipid management. Patients in the intervention group experienced fewer cardiovascular events, including myocardial infarctions and strokes, compared to the control group. This is consistent with the established link between dyslipidemia and an increased risk of cardiovascular disease (Ference et al., 2017). By addressing dyslipidemia early and effectively through pharmacist-led interventions, the risk of long-term cardiovascular complications can be reduced. This finding further supports the role of interdisciplinary collaboration in improving patient outcomes, particularly in populations at higher risk for cardiovascular disease due to medication-induced dyslipidemia.

Medication Adherence

Another key finding of this study was the higher medication adherence in the intervention group. Pharmacists played a crucial role in counseling patients on the importance of adherence to lipid-lowering therapies, adjusting medication regimens as needed, and educating patients about the risks associated with dyslipidemia. As a result, 86% of patients in the intervention group adhered to their prescribed medications, compared to 73% in the control group. This finding aligns with existing literature, which has shown that pharmacist involvement in chronic disease management can improve adherence to prescribed therapies (Lee et al., 2019). The higher adherence in the intervention group likely contributed to the more significant improvements in lipid profiles and the reduction in cardiovascular events.

Patient Satisfaction

Patient satisfaction was significantly higher in the intervention group, with 92% of patients reporting satisfaction with the pharmacist-led care. This indicates that patients value the personalized attention provided by pharmacists, particularly in managing chronic conditions like dyslipidemia. The education provided by pharmacists, coupled with laboratory specialists' accurate and timely lipid monitoring, likely contributed to patients feeling more engaged in their care. Previous studies have also found that pharmacist-patient interactions improve patient satisfaction and contribute to better health outcomes (Patti et al., 2019). In contrast, the control group, which lacked interdisciplinary involvement, reported lower satisfaction levels, further underscoring the benefits of collaborative care.

Clinical Implications

The findings of this study have important clinical implications. First, they highlight the critical role of pharmacists and laboratory specialists in managing medication-induced dyslipidemia, particularly in patients on chronic therapies that negatively impact lipid profiles. This collaborative approach not only improves lipid levels but also reduces the risk of cardiovascular events, which are a major concern for these patients. Second, the study demonstrates the value of involving pharmacists in chronic disease management, particularly for medication adherence, which is crucial for the success of long-term therapies.

Healthcare providers should consider implementing similar interdisciplinary care models, where pharmacists and laboratory specialists collaborate to monitor and manage chronic conditions. The positive outcomes observed in this study support the integration of pharmacists into lipid management programs, especially in high-risk patient populations.

Limitations

While the results of this study are promising, several limitations should be noted. First, the study was conducted in a single tertiary hospital, which may limit the generalizability of the findings to other healthcare settings. Additionally, the study relied on retrospective data collection, which may introduce bias related to missing or incomplete records. Furthermore, while the study focused on medication-induced dyslipidemia, other factors such as dietary habits and physical activity were not consistently recorded and may have influenced the lipid outcomes.

Future Research

Future studies should consider a multi-center approach to validate these findings in different healthcare settings. Additionally, further research is needed to explore the long-term effects of pharmacist and laboratory specialist collaboration in managing other chronic conditions associated with dyslipidemia, such as diabetes and metabolic syndrome. Studies that incorporate patient lifestyle factors, including diet and exercise, could provide a more comprehensive understanding of the interventions needed to manage dyslipidemia effectively.

Conclusion

In conclusion, this study demonstrates that collaboration between pharmacists and laboratory specialists significantly improves the management of medication-induced dyslipidemia in patients on chronic medications. The interdisciplinary approach led to greater improvements in lipid profiles, reduced cardiovascular events, higher medication adherence, and increased patient satisfaction. These findings highlight the importance of integrating pharmacists and laboratory specialists into chronic disease management programs to optimize patient outcomes and reduce long-term cardiovascular risks.

References

1. Blonde, L., Khunti, K., Harris, S. B., Meizinger, C., &Skolnik, N. S. (2018). Interpretation and impact of real-world clinical data for the practicing clinician. *Advances in therapy*, *35*, 1763-1774.

2. Ference, B. A., Ginsberg, H. N., Graham, I., Ray, K. K., Packard, C. J., Bruckert, E., ... &Catapano, A. L. (2017). Low-density lipoproteins cause atherosclerotic cardiovascular disease. 1. Evidence from genetic, epidemiologic, and clinical studies. A consensus statement from the European Atherosclerosis Society Consensus Panel. *European heart journal*, *38*(32), 2459-2472.

3. Florez, H., Silva, E., Fernández, V., Ryder, E., Sulbarán, T., Campos, G., ... & Goldberg, R. (2005). Prevalence and risk factors associated with the metabolic syndrome and dyslipidemia in White, Black, Amerindian and Mixed Hispanics in Zulia State, Venezuela. *Diabetes research and clinical practice*, *69*(1), 63-77.

4. Gillcrist, M. (2020). *HIV, cardiovascular disease, anti-retroviral resistance: the issue with protease inhibitors and a need for alternatives* (Master's thesis, Boston University).

5. Herink, M., & Ito, M. K. (2015). Medication induced changes in lipid and lipoproteins.

6. Lee, H., Ryu, K., Sohn, Y., Kim, J., Suh, G. Y., & Kim, E. (2019). Impact on patient outcomes of pharmacist participation in multidisciplinary critical care teams: a systematic review and meta-analysis. *Critical care medicine*, *47*(9), 1243-1250.

7. Patti, A. M., Giglio, R. V., Papanas, N., Rizzo, M., & Rizvi, A. A. (2019). Future perspectives of the pharmacological management of diabetic dyslipidemia. *Expert Review of Clinical Pharmacology*, *12*(2), 129-143.

8. Simha, V. (2015). Drug-induced dyslipidemia. *Dyslipidemias: Pathophysiology, Evaluation and Management*, 267-286.