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ASSESSING FINANCIAL ACCESS BARRIERS AND THEIR ASSOCIATIONS WITH COST RELATED INSULIN UNDERUSE AMONG DIABETES PATIENTS

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Abstract:

This analysis examines how financial access dimensions differentiate insulin underuse within international debates on treatment affordability. A descriptive reanalysis uses published subgroup counts for 199 patients surveyed at the Yale Diabetes Center in 2017, comparing category proportions and percentage point differences. Income comparisons include 176 respondents with reported income. Overall, 25.6% reported insulin underuse because of cost. Income displayed a nonmonotonic pattern, with underuse ranging from 4.2% in the highest category to 38.5% in an intermediate category. Coverage categories ranged from 17.5% to 50.0%, although the highest proportion represented eight respondents in a combined classification. Equipment purchasing difficulty corresponded to underuse of 54.5%, compared with 14.6% among respondents without difficulty, a difference of 40.0 percentage points. These descriptive contrasts distinguish reported resources, institutional protection and experienced affordability without identifying causal mechanisms. The contribution qualifies interpretations that treat these dimensions as interchangeable indicators of access. Across healthcare systems, the findings support complementary affordability enquiries covering insulin and equipment rather than inferring effective access from income or coverage alone.

Key Words: Affordability; Descriptive Analysis; Financial Access; Insulin Rationing; Treatment Adherence.

1. Introduction:

Insulin affordability concerns whether patients can sustain prescribed treatment alongside the other costs of diabetes care. A prescription establishes clinical need but does not establish the financial capacity to obtain and use treatment consistently. Patients may respond to financial pressure by reducing doses, stretching supplies or delaying purchases. These behaviours make cost related insulin underuse an access problem that cannot be described fully by income or insurance membership alone. Understanding how different financial measures correspond to underuse matters for deciding which affordability questions clinicians and health systems should ask. Evidence across settings establishes the relevance of this problem while highlighting differences in measurement and population coverage. Pfiester et al., 2021, examined responses from 1,066 participants in 64 countries collected during 2020 and reported insulin underuse associated with perceived cost among approximately one quarter of respondents. Their voluntary web survey provides comparative evidence but does not estimate representative national prevalence. Gaffney et al., 2022, used the 2021 National Health Interview Survey to examine insulin rationing in the United States. Together, these contributions show why findings must be interpreted against their sampling designs and outcome definitions rather than combined into a single prevalence estimate.

The patient centred access framework provides a basis for distinguishing the financial dimensions involved. Levesque et al., 2013, conceptualise access through the relationship between healthcare provision and people's ability to obtain care. Applied to insulin use, annual income describes reported resources, prescription coverage identifies an institutional arrangement for financing treatment, and difficulty purchasing diabetes equipment records an experienced affordability constraint. These measures address related but distinct aspects of access. Higher income may increase purchasing capacity, coverage may reduce the amount payable by patients, and equipment purchasing difficulty may indicate pressure across the wider treatment package. These mechanisms guide interpretation without establishing that the observed measures isolate their effects. Evidence on household expenditure and patient payment requirements also cautions against treating any single financial measure as sufficient. Berkowitz et al., 2014, documented overlapping food insecurity and medication underuse among adults with chronic illness, indicating that treatment expenditure competes with other essential needs. Chandra et al., 2010, demonstrated that increased patient cost sharing reduced prescription drug use among elderly beneficiaries. The former identifies competing household demands, while the latter shows how financing arrangements can alter use. Neither implies that broad income categories or named insurance arrangements directly measure the financial burden experienced by every patient.

The closest empirical contribution is Herkert et al., 2019, who surveyed patients at the Yale Diabetes Center between June and August 2017. Their outcome captures any reported insulin underuse because of cost during the preceding 12 months. It includes reducing use, stretching insulin, stopping treatment, or not obtaining prescribed insulin. The outcome therefore concerns a group of reported affordability responses rather than a measured duration of treatment interruption. Their published table relates underuse to income, prescription coverage and difficulty buying diabetes medical equipment. Those relationships are already documented, so reusing the table does not constitute a new discovery of financial barriers. The present contribution is narrower: this analysis brings the three published financial classifications into a consistent descriptive comparison using verified counts, category proportions and percentage point differences. The analytical question is whether these classifications display similar patterns of underuse or reveal distinctions that become obscured when financial access is discussed as one condition. The completed calculations show a nonmonotonic income distribution, variation across coverage categories and a pronounced difference by equipment purchasing difficulty. These patterns qualify a simple interpretation in which income, insurance and

experienced affordability provide interchangeable descriptions of access. They do not establish independent predictor effects or explain the causal pathways producing the differences.

The empirical material comprises published marginal counts for 199 respondents, organised into 11 overlapping subgroup records. Income comparisons include 176 respondents with reported income, while coverage and equipment comparisons each retain the full sample. The approach preserves category definitions and calculates rates from the published integer counts. Its strength lies in transparent denominators and comparable descriptive quantities. The clinical setting provides evidence about affordability among patients already attending diabetes care, although its proportions cannot be transferred directly to national populations or other healthcare systems. This study aims to describe how cost related insulin underuse varies across annual income, prescription drug coverage and difficulty buying diabetes medical equipment. The central research question asks what each financial dimension reveals about the distribution of underuse within the observed sample. Specifically, the analysis compares underuse across income categories, examines differences across coverage arrangements and quantifies the contrast between patients reporting equipment purchasing difficulty and those reporting none. The practical contribution is to inform complementary affordability enquiries rather than infer effective access from income or coverage alone. Its international relevance lies in distinguishing reported resources, financing arrangements and experienced difficulty while retaining the limits of the underlying observations.

2. Theory, Conceptual Framework and Research Questions Development:

This analysis draws on the patient centred access framework, which locates access at the interface between healthcare provision and patients' capacity to obtain care. Affordability depends on the relationship between treatment requirements, available resources and financial protection. Levesque et al., 2013, distinguish the affordability of services from the ability to pay, providing the theoretical basis for examining annual income, prescription drug coverage and difficulty buying diabetes medical equipment as distinct dimensions of financial access. These dimensions can constrain insulin use through different mechanisms, even when patients have obtained a prescription and entered clinical care. The focal outcome is cost related insulin underuse, defined as using less insulin than prescribed, stretching supplies, reducing doses, stopping treatment, or not obtaining prescribed insulin because of cost. The available dataset contains published subgroup counts from 199 patients surveyed at the Yale Diabetes Center in 2017. Herkert et al., 2019, provide the underlying observations. This analysis uses the three financial dimensions as observed categorical measures rather than indicators of a latent construct or components of a composite index. The framework supports separate comparisons of underuse proportions across categories.

Annual income represents the resources potentially available to meet recurring treatment expenses. Under a household budget constraint, insulin purchases compete with other necessary expenditure. Lower income may therefore increase the burden of maintaining prescribed treatment. This mechanism concerns purchasing capacity rather than willingness to adhere, although income alone does not establish the amount available after essential expenses. Evidence on competing household needs supports this interpretation. Berkowitz et al., 2014, found that food insecurity and cost related medication underuse overlapped among adults with chronic illness. Their findings support resource competition as a plausible mechanism, but do not establish that insulin underuse must decline uniformly across successive income categories. Financial protection and differences in treatment expenditure can alter that pattern. This analysis therefore examines the five observed income categories without imposing a linear income gradient.

RQ1: How does the proportion reporting cost related insulin underuse vary across annual income categories?

Prescription drug coverage concerns the institutional allocation of treatment costs between patients and insurers. Unlike annual income, coverage can change the amount patients must pay for a given prescription. Financial protection may preserve access by reducing immediate expenditure, while patient payment requirements can retain financial barriers within insured populations. Chandra et al., 2010, demonstrated that increased patient cost sharing reduced prescription drug use among elderly beneficiaries. This evidence supports the proposed price mechanism, but insurance categories do not directly measure the generosity of individual benefits. National evidence from Gaffney et al., 2022, also identifies insurance related variation in insulin rationing. Nevertheless, the available coverage categories combine differences in eligibility, patient characteristics and financial protection. The framework therefore treats coverage as nominal rather than ranking categories from least to most protective.

RQ2: How does the proportion reporting cost related insulin underuse vary across prescription drug coverage categories?

Difficulty buying diabetes medical equipment captures an experienced affordability constraint. Whereas income measures resources and coverage identifies an institutional arrangement, equipment purchasing difficulty reflects a reported inability to meet a specific diabetes care expense. Insulin and equipment draw on the same household resources, making difficulty purchasing one component a plausible marker of financial pressure affecting the other. Pfiester et al., 2021, documented underuse of insulin and diabetes supplies across different healthcare coverage settings. This evidence supports examining affordability across the treatment package rather than considering insulin expenditure in isolation. However, equipment purchasing difficulty may also reflect greater treatment requirements. Its association with insulin underuse therefore represents the coexistence of financial constraints, rather than evidence that equipment difficulty causes underuse.

RQ3: How does the proportion reporting cost related insulin underuse differ between patients who report difficulty buying diabetes medical equipment and those who do not?

The conceptual framework links each observed financial dimension separately to the observed proportion reporting insulin underuse. These links represent associations informed by affordability theory. Income comparisons use 176 participants with reported income, while coverage and equipment comparisons each use 199 participants. The same patients contribute to several dimensions, so subgroup counts are not pooled across dimensions. Because the source distributions were available during framework development, the research questions are exploratory. Their resolution rests on category specific counts, proportions and percentage point differences, without imposing a predetermined direction or requiring every comparison to show a difference.

3. Data:

This analysis establishes the provenance of the published observations, documents sample retention and defines the measures used to examine financial access barriers.It combines verified subgroup counts with reproducible descriptive calculations to resolve the three research questions.

3.1 Data Sources, Population, and Sample Construction:

The empirical source is the table titled Characteristics of Survey Participants in Herkert et al., 2019, identified by DOI 10.1001/jamainternmed.2018.5008. The attached workbook reproduces the published subgroup counts rather than individual survey responses. Access and extraction metadata are retained in the workbook. The source is a published research table, with no separate dataset release, series identifier or underlying patient data licence supplied. The empirical setting is outpatient diabetes care at the Yale Diabetes Center in the United States. Observations concern patients surveyed between June and August 2017, within the eligibility window of 2010 to 2023. The data form a cross section without repeated measurements. Annual income describes a reported yearly resource category, while insulin underuse concerns behaviour during the preceding 12 months. The substantive population comprises patients prescribed insulin who face recurring diabetes treatment expenses. The accessible frame comprises clinic attendees meeting the source eligibility criteria. Recruitment was confined to one clinical setting, so the sample does not represent all patients with diabetes. The secondary analysis retains every published category corresponding to the three financial dimensions. Selection therefore follows the available source structure rather than a prospective sampling protocol.

Table 1: Sample construction

Stage	Patients	Published Subgroup Records	Reason or Rule
Eligible clinic frame	354	Not applicable	Source eligibility criteria
Eligible patients without a completed survey	155	Not applicable	Difference between eligible patients and respondents
Completed survey sample	199	Not applicable	Retained source respondents
Income analysis	176	5	Excludes 23 respondents without reported income
Prescription coverage analysis	199	4	Retains all published coverage categories
Equipment affordability analysis	199	2	Retains both reported difficulty categories
Consolidated analytical table	199 unique patients	11	Overlapping marginal classifications

The 11 records represent categories rather than independent patients. Their denominators cannot be added across dimensions. No additional sample losses arise from controls, temporal transformations or model estimation because the implemented analysis uses descriptive comparisons.

3.2 Data Integration, Cleaning, and Quality Assurance:

Integration consists of placing the three published classifications in one structured table. A unique record identifier distinguishes each category, while a common source identifier links records to their provenance. No patient identifiers, external records or temporal series are merged. Repetition of patients across classifications reflects the marginal table structure and is not treated as duplication. Quality checks confirm that every outcome count lies between zero and its category denominator. For each record, the number without underuse equals the denominator minus the number reporting underuse. Coverage and equipment classifications each reconcile to the full sample. Income categories reconcile to the smaller sample with reported income. No category is removed because its observed proportion is high or low.

The workbook preserves published percentages separately from rates calculated using integer counts. Two inconsistencies require explicit handling. The source reports 51 of 199 patients as 25.5%, whereas the count based calculation gives 25.6%. It reports 30 of 55 patients with equipment purchasing difficulty as 56%, whereas the corresponding calculation gives 54.5%. Analytical rates use the published counts and retain the original percentages for traceability. Missing income affects 23 respondents, representing 11.6% of the survey sample. These respondents are excluded only from income comparisons. No income values are imputed, interpolated or replaced with zero. The combined coverage category containing none, other or unknown remains intact because the published table does not separate its components. Income categories remain in reported US dollars. No currency conversion, inflation adjustment or midpoint substitution is applied. The analysis therefore preserves categorical purchasing capacity rather than constructing continuous income estimates.

3.3 Variable Measurement, Construction, and Validation:

Financial access is represented by three observed dimensions. The distinction between resources, institutional protection and experienced affordability follows the access framework of Levesque et al., 2013. These dimensions remain separate because their marginal distributions do not provide the joint information needed to construct or validate a patient level index.

Table 2: Variable dictionary

Variable or Indicator	Analytical Role	Definition and Construction	Source and Identifier	Unit and Frequency	Transformation and Direction	Missing Value Rule	Coverage and Limitation
Annual income	Financial resource dimension	Five published income categories	Source table, income rows	US dollar categories, observed once	Original categories retained; higher categories indicate greater reported income	Exclude unreported income	176 patients; no exact income amounts
Prescription drug coverage	Institutional protection dimension	Four published coverage categories	Source table, coverage rows	Nominal category, observed once	No numerical ranking imposed	Retain combined none, other or unknown category	199 patients; benefit generosity is unobserved

Variable or Indicator	Analytical Role	Definition and Construction	Source and Identifier	Unit and Frequency	Transformation and Direction	Missing Value Rule	Coverage and Limitation
Difficulty buying diabetes medical equipment	Experienced affordability dimension	Reported difficulty classified as yes or no	Source table, equipment rows	Binary category, observed once	Yes indicates reported difficulty	Retain both categories	199 patients; expenditure amounts are unobserved
Cost related insulin underuse	Outcome	Any reported insulin underuse attributed to cost	Source table, outcome counts	Binary response concerning preceding 12 months	Higher category proportion indicates more reported underuse	Use published outcome counts	Self reportedbehaviour
Category denominator	Calculation input	Published number of patients in each category	Source table, participant column	Integer count	No transformation	Retain published counts	Categories overlap across dimensions
Underuse proportion	Descriptive outcome measure	Underuse count divided by category denominator	Calculated from published counts	Proportion within category	Multiply by 100 for percentage presentation	Calculate only with a positive denominator	Describes the observed category
Percentage point difference	Descriptive comparison	Difference between two category percentages	Calculated from category proportions	Percentage points	Positive values indicate a higher proportion in the first named category	Compare available categories	Unadjusted comparison

Equation 1 defines the category specific underuse proportion.

$$p_g = \frac{u_g}{n_g}$$

Here, p_g denotes the underuse proportion in category g, u_g denotes patients reporting underuse, and n_g denotes the category denominator. Equation 2 defines the descriptive difference between two categories.

$$D_{ab} = 100[p_a - p_b]$$

Here, D_{ab} denotes the percentage point difference between categories a and b, while $p_a$and $p_b$denote their respective underuse proportions. The overall proportion calculated from the counts is 25.6%. Across income categories, proportions range from 4.2% to 38.5%; across coverage categories, they range from 17.5% to 50.0%. Equipment difficulty categories yield 14.6% and 54.5%. Means, standard deviations and medians of numerical category codes would not describe these categorical measures meaningfully. Validation consists of denominator reconciliation, arithmetic checks and preservation of source definitions. External evidence from Pfiester et al., 2021, supports distinguishing insulin affordability from affordability of diabetes supplies, but does not independently validate the observations in this sample.

3.4 Analytical Framework, Identification, and Reproducibility:

The implemented framework is descriptive. It resolves each research question through category counts, underuse proportions and percentage point differences. Comparisons use observed variation within each financial dimension. They do not estimate independent predictor contributions because the workbook contains marginal classifications rather than joint patient records. For equipment affordability, the calculated difference is 40.0 percentage points between patients reporting difficulty and those reporting no difficulty. This quantity describes sample separation without attributing that separation to an intervention or isolating an affordability effect. The distinction between the analytical question and a causal objective follows the clarification advocated by Hernán, 2018.

Interpretation considers denominator size alongside magnitude. The combined none, other or unknown coverage category contains eight patients, so each patient represents 12.5 percentage points within that category. Its observed proportion therefore requires particular caution. Reported differences are not labelled statistically significant, and descriptive contrasts are not converted into declarations of hypothesis confirmation. This approach respects the distinction between substantive magnitude and statistical evidence discussed by Greenland et al., 2016. Reproducibility rests on the workbook's retained counts, category labels, source identifier, published percentages and calculation formulas. The contribution is a transparent descriptive reanalysis of financial access dimensions. Its international relevance lies in separating resource availability, coverage arrangements and experienced affordability while retaining the geographical limits of the observed sample.

4. Methods:

4.1 Research Design and Analytical Target:

This analysis uses a descriptive cross-sectional design to examine how reported insulin underuse varies across three financial access dimensions. The analytical targets are category specific proportions and differences between those proportions. The underlying responses concern patients surveyed at the Yale Diabetes Center between June and August 2017. Cost related underuse refers to reported behaviour during the preceding 12 months. The published observations originate from Herkert et al., 2019. The analytical record is a published subgroup category, while the underlying observational unit is a patient. Categories within each financial dimension partition the relevant sample. Categories across dimensions contain overlapping patients and are analysed separately. Consequently, the consolidated records are not treated as independent observations in a pooled model. The design uses observed differences between categories without attributing those differences to treatment assignment or an external intervention. Its purpose is descriptive comparison, not conditional effect estimation. Patient characteristics, treatment requirements and financial circumstances may contribute jointly to the observed patterns. The interpretation therefore remains aligned with the descriptive question rather than implying causal identification, consistent with the distinction between analytical objectives and causal claims discussed by Hernán, 2018.

4.2 Measurement and Descriptive Specification:

Table 1 documents sample construction, and Table 2 defines the measures and their coverage. Annual income retains its five published categories. Prescription coverage retains four nominal categories without imposing a ranking of protection. Equipment purchasing difficulty retains the reported yes or no classification. No category codes are interpreted as continuous measurements. The calculations follow Equation 1, which defines each underuse proportion as the published number reporting

underuse divided by the corresponding category denominator. Percentages equal these proportions multiplied by 100. Equation 2 defines differences between category percentages in percentage points. Both calculations use integer counts rather than rounded source percentages.

Income comparisons use the highest reported income category as the descriptive reference. Coverage comparisons use Medicare Part D, and equipment comparisons use respondents reporting no purchasing difficulty. These reference choices organize presentation and do not establish normative benchmarks. Category specific proportions remain available so readers can interpret each contrast against its denominator. The analysis also calculates the proportion of all reported underuse cases occurring among respondents with equipment purchasing difficulty. Its denominator is the total number reporting underuse, rather than the total survey sample. This case share describes concentration within the observed sample and is distinguished from the underuse proportion within that category. Means and standard deviations of category codes are not calculated because they would depend on arbitrary numerical assignments.

4.3 Sample Alignment, Processing, and Consistency Checks:

Coverage and equipment comparisons each use 199 respondents. Income comparisons use 176 respondents with reported income. The remaining 23 respondents are excluded only from income calculations. No values are imputed, and missing income is not recoded as zero. The combined none, other or unknown coverage category remains unchanged because its components cannot be separated from the published information. Processing begins with the published category labels; participant counts and underuse counts. Each category receives a unique record identifier and retains a common source identifier. The number without underuse is calculated by subtracting the underuse count from the category denominator. No external dataset is merged, and no patient records are reconstructed.

Consistency checks verify positive denominators, nonnegative counts and underuse counts that do not exceed category totals. Category counts are reconciled separately within each financial dimension. Income records sum to the sample with reported income, while coverage and equipment records each sum to the full respondent sample. Reconciliation occurs within dimensions to avoid counting the same patients repeatedly. The workbook preserves published percentages alongside calculated proportions. Where those values differ, the calculations retain the published integer counts and recompute the percentage. This rule addresses arithmetic inconsistencies without altering reported responses. No observations are removed because of extreme proportions, and no income midpoint substitution, currency conversion or inflation adjustment is applied. The measures therefore retain their original categorical meaning.

4.4 Analytical Implementation, Interpretation, and Replicability:

The calculations are implemented through spreadsheet formulas and independently checked using Python arithmetic. They require division, subtraction, multiplication and aggregation of published counts. Calculations retain full numerical precision; percentages and percentage point differences are rounded to one decimal place for presentation. Differences are calculated before rounding, so they may differ slightly from subtraction of displayed percentages. Tables 3 to 5 report denominators, outcome counts and calculated percentages for the three financial dimensions. The income and coverage tables additionally present reference category differences. These outputs resolve the research questions through observed distributions and contrasts. No sampling weights are applied because the source table does not supply weights for these respondents.

Interpretation emphasizes magnitude, denominator size and category composition. A large observed percentage in a small category is not treated as evidence of a precisely estimated population relationship. The calculations do not produce confidence intervals, significance tests or adjusted coefficients. Accordingly, differences are described as sample contrasts rather than statistically established effects. This distinction follows Greenland et al., 2016, who caution against conflating numerical estimates, statistical evidence and substantive interpretation. Replication materials comprise the consolidated workbook, source attribution, variable definitions, retained published percentages and calculation formulas. These materials support reconstruction of the descriptive outputs directly from the published counts. The analytical choices were made with the source distributions available and are therefore exploratory. The methodological contribution is transparent implementation of established descriptive procedures, with consistent denominators and explicit separation of overlapping classifications.

5. Findings:

This analysis examines variation in cost related insulin underuse across income, prescription coverage and equipment affordability categories. The findings resolve three research questions using published counts, calculated proportions and percentage point differences. Interpretation concerns observed sample patterns rather than causal effects or independent predictor contributions.

5.1 Analytical Sample and Outcome Distribution:

The dataset represents 199 patients surveyed at the Yale Diabetes Center between June and August 2017. Of these, 51 reported insulin underuse because of cost and 148 did not. The proportion calculated from the published counts is 25.6%. The source observations come from Herkert et al., 2019; the findings presented here constitute a descriptive reanalysis of that published sample. Coverage and equipment comparisons each include all 199 respondents. Income comparisons include 176 respondents because 23 did not report income, equivalent to 11.6% of the sample. The 11 subgroup records describe overlapping classifications of these patients and do not constitute 11 independent samples. Underuse percentages are calculated from integer counts. This approach gives 54.5% for respondents reporting equipment purchasing difficulty, rather than the published 56.0%, and 25.6% overall, rather than the published 25.5%. These arithmetic differences affect presentation but leave the underlying counts unchanged.

5.2 Annual Income and Insulin Underuse:

Underuse differs across income categories without following a uniform income gradient. The highest income category records the lowest proportion, at 4.2%. However, the largest proportions occur in the two intermediate categories, at 38.5% and 37.8%, rather than among respondents reporting the lowest income.

Table 3: Insulin underuse across annual income categories

Annual Income	Respondents	Reporting Underuse	Underuse Percent	Difference From Highest Income Category, Percentage Points
USD 100000 or more	24	1	4.2	0.0
USD 50000 to 99999	26	10	38.5	34.3
USD 25000 to 49999	37	14	37.8	33.7
USD 10000 to 24999	53	13	24.5	20.4
Below USD 10000	36	7	19.4	15.3

The USD 25000 to 49999 category exceeds the lowest income category by 18.4 percentage points. Consequently, the observed distribution does not support describing progressively lower income as corresponding to progressively greater underuse. It instead identifies separation between the highest income category and the remaining categories, alongside variation within those remaining groups. RQ1 is resolved descriptively: underuse varies across income categories, but the pattern is not monotonic. This distinction is consistent with the conceptual separation between reported resources and effective ability to obtain care in Levesque et al., 2013. Income categories alone do not reveal the financial protection or treatment expenses associated with those resources.

5.3 Prescription Coverage and Insulin Underuse:

Coverage categories also display variation. Medicare Part D records an underuse proportion of 17.5%, compared with 22.4% for Medicaid with or without Medicare and 31.8% for employer sponsored coverage. The combined none, other or unknown category records 50.0%.

Table 4: Insulin underuse across prescription coverage categories

Prescription Coverage	Respondents	Reporting Underuse	Underuse Percent	Difference From Medicare Part D, Percentage Points
Medicare Part D	40	7	17.5	0.0
Employer sponsored	66	21	31.8	14.3
Medicaid with or without Medicare	85	19	22.4	4.9
None, other or unknown	8	4	50.0	32.5

Employer sponsored coverage exceeds Medicare Part D by 14.3 percentage points. This contrast shows that the presence of a named insurance arrangement does not correspond to a common observed level of underuse. It does not establish differences in benefit generosity because those benefits are not measured. The combined none, other or unknown category contains eight respondents. Each respondent therefore contributes 12.5 percentage points to its proportion. Its classification also prevents interpreting the result as an estimate exclusively for uninsured patients. RQ2 is resolved as variation across coverage categories, without an inferred ranking of insurance effectiveness. Gaffney et al., 2022, provide national evidence on coverage related differences in insulin rationing, but their estimates are not pooled with this clinical sample.

5.4 Equipment Affordability and Integrated Findings:

Equipment purchasing difficulty displays the largest category contrast reported in this analysis. Underuse reaches 54.5% among respondents reporting difficulty, compared with 14.6% among those reporting no difficulty. The difference is 40.0 percentage points.

Table 5: Insulin underuse by equipment purchasing difficulty

Difficulty Buying Diabetes Medical Equipment	Respondents	Reporting Underuse	Underuse Percent
No	144	21	14.6
Yes	55	30	54.5

Respondents reporting equipment purchasing difficulty comprise 27.6% of the sample but account for 58.8% of all reported underuse cases. This concentration resolves RQ3: reported equipment affordability difficulty coincides with a higher observed proportion of insulin underuse. The result identifies overlapping affordability problems without establishing which difficulty preceded the other. Pfiester et al., 2021, similarly examine affordability across insulin and diabetes supplies, supporting the relevance of considering the treatment package rather than insulin alone. Across the three dimensions, income shows a nonmonotonic distribution, coverage shows categorical variation, and equipment difficulty shows a pronounced binary separation. These findings distinguish patterns within the observed sample rather than establish comparative predictive performance. The contrasts are descriptive magnitudes and are not labelled statistically significant, consistent with the distinction between numerical differences and inferential evidence emphasized by Greenland et al., 2016.

6. Discussion:

Financial access barriers are not interchangeable descriptions of insulin affordability. Tables 3 to 5 show distinct patterns across reported income, prescription coverage and equipment purchasing difficulty. The proportions calculated through Equation 1 reveal a nonmonotonic income distribution, variation across coverage arrangements and a pronounced contrast by experienced affordability difficulty. Equation 2 places these differences on a common percentage point scale without treating them as independent effects. The contribution is an integrated descriptive interpretation of published observations, rather than discovery of previously undocumented relationships. Herkert et al., 2019, already identified affordability problems in the underlying sample. This reanalysis clarifies why income, insurance status and experienced financial difficulty should retain separate meanings when interpreting insulin underuse. The income pattern challenges a simple interpretation in which progressively fewer resources correspond to progressively greater underuse. Table 3 places the largest observed proportions in intermediate income categories, while the highest income category records the smallest proportion. This distribution makes a uniform income gradient an inadequate description of the sample. Resource competition offers a plausible interpretation, but the observations do not establish

how household expenditure decisions produced these differences. Berkowitz et al., 2014, documented overlapping food insecurity and medication underuse among adults with chronic illness, illustrating why income may incompletely represent available treatment resources. The theoretical implication is that purchasing capacity depends on expenditure commitments as well as reported income, while the present evidence measures only the latter.

Equipment purchasing difficulty identifies a concentration of underuse that broad resource categories alone do not describe. In Table 5, respondents reporting difficulty comprise 27.6% of the sample but account for 58.8% of reported underuse cases. These shares describe the distribution of observed cases, not the contribution of a causal pathway. The 40.0 percentage point contrast calculated through Equation 2 makes experienced affordability difficulty a relevant clinical enquiry, without establishing its predictive superiority. Levesque et al., 2013, distinguish financial accessibility from patients' ability to obtain care. The findings give that distinction a concrete descriptive expression: a reported difficulty meeting diabetes care expenses captures an experience that income categories and coverage labels do not directly measure. Coverage variation exposes the limits of interpreting insurance membership as effective financial protection. Table 4 shows underuse within every named coverage arrangement, while the combined none, other or unknown category cannot isolate uninsured patients. Consequently, the observed differences cannot rank insurance systems or identify specific benefit design failures. Chandra et al., 2010, demonstrated that patient cost sharing can reduce prescription use, establishing why actual payment requirements matter beyond coverage membership. The practical implication is to assess affordability directly among insured patients rather than infer it from their coverage category. Separately, the discrepancies between published percentages and integer counts demonstrate the value of preserving source values while calculating analytical rates consistently through Equation 1.

International relevance rests on the distinction between formal coverage and experienced access, rather than transfer of the sample percentages across countries. Pfiester et al., 2021, examined insulin and supply affordability across different healthcare coverage settings, whereas Gaffney et al., 2022, assessed insulin rationing through a national United States survey. Those designs address broader populations than this single clinical sample and therefore do not provide directly interchangeable prevalence estimates. Read together, the evidence supports asking about insulin and equipment affordability alongside income and insurance during clinical assessment. Tables 3 to 5 justify those complementary enquiries, but do not establish that any screening or financing intervention reduces underuse. The transferable contribution is a measurement distinction: resources, institutional arrangements and experienced difficulty describe different aspects of access and should not substitute for one another.

7. Conclusion and Implications:

Access to prescribed insulin remains incomplete when patients cannot sustain the wider costs of diabetes care. This analysis shows that financial access cannot be represented adequately by a single socioeconomic classification. The observed patterns distinguish available resources, institutional protection and experienced purchasing difficulty without establishing their combined or causal effects. The contribution is a transparent reinterpretation of published evidence that clarifies why these dimensions should remain conceptually distinct. It qualifies simplified affordability explanations by showing that greater reported resources do not correspond uniformly to less treatment underuse, while formal protection does not describe a common experience of access. For healthcare managers, the findings support incorporating direct affordability enquiries into routine consultations alongside administrative eligibility information. Such enquiries can identify reported difficulties that broad classifications leave unspecified and inform referrals for financial assistance. Policy assessment should likewise consider patients' ability to obtain the complete treatment package rather than treating enrolment as sufficient evidence of effective protection. Operationally, consistent documentation of purchasing difficulties could improve communication between clinical teams and support services. Across healthcare systems, the transferable insight concerns measurement and assessment, rather than universal prevalence estimates. Its social relevance lies in making patients reported financial constraints visible within decisions about continuing care.

The published marginal counts create opportunities for research using individual records that connect financial circumstances, treatment requirements and reported behaviour. Repeated observations could establish temporal ordering and distinguish persistent difficulties from temporary disruptions. Comparisons across healthcare systems could assess whether the descriptive patterns vary with benefit design and patient payment requirements. More detailed measures could separate the components of combined coverage categories and characterize respondents with unreported financial information. Prospective evaluations could then test whether affordability assessment linked to assistance improves treatment continuity. These extensions would assess transferability and investigate mechanisms that the present descriptive evidence cannot identify.

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