Exponential Impact Patterns in Rural Healthcare Workforce Development:

Evidence from the ReConnect Gap Year Fellowship

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Abstract

Purpose: Healthcare workforce shortages persist in rural America despite decades of intervention attempts. This research investigates whether compounding touchpoint mechanisms within the ReConnect Gap Year Fellowship Program, which offers medical scribing, Medical Assistant opportunities, and community integration for pre-health students in rural Oregon, have an exponential impact on rural practice commitment intentions.

Methods: This mixed-methods study analyzed survey data from 20 ReConnect Fellows (2017-2024) and program documentation. Participants averaged 54% lifetime rural residence. Analysis compared linear versus polynomial regression models, employed threshold detection algorithms, and calculated Cohen's f^2 effect sizes. The study combined Threshold Concept Theory, Social Learning Theory, and Nudge Theory to explain compounding impact mechanisms.

Findings: Polynomial regression explained significantly more variance than linear models (31.8% vs. 24.5%, $p = 0.028$), suggesting potential exponential touchpoint effects; however, the modest R^2 values indicate substantial unexplained variance. Threshold analysis identified a critical inflection at 6.2 touchpoints where commitment increases exponentially ($d=2.15$). Community integration demonstrated the strongest engagement activity leverage point ($f^2=0.216$), exceeding clinical experience ($f^2=0.079$) and mentorship ($f^2=0.128$). Quality touchpoints amplified the quantity of touchpoints with a 2.67x multiplier effect for high-quality touchpoints (≥7 rating). Synergistic effects across touchpoint categories exceeded additive predictions by 85%.

Conclusions: The Touchpoint Taxonomy Framework suggests a preliminary model for resource optimization guidance, recommending 51.2% resource allocation to community integration, 30.4% to mentorship, and 18.4% to clinical experience, which differs from traditional medical

education approaches. These preliminary findings suggest programs might achieve exponential impact through planned touchpoint design rather than resource multiplication, offering new approaches to addressing rural healthcare workforce shortages.

Keywords: rural healthcare workforce, touchpoint mechanisms, exponential impact, workforce development, rural practice commitment

Healthcare workforce shortages in rural areas persist despite decades of intervention attempts, threatening access to care and community wellbeing (Centers for Medicare & Medicaid Services, 2019; National Rural Health Association, 2022; Rural Health Information Hub, 2022, 2023). Zhang, Lin, Pforsich, and Lin (2020) project a national deficit of 139,160 physicians by 2030, with rural areas bearing a disproportionate burden. The gap year period between undergraduate education and medical school offers a critical window for influencing future practice location decisions, where targeted interventions may produce stronger results beyond simple addition (Allen, 2023; Aviva Health, 2024).

The ReConnect Gap Year Fellowship Program, operating through the Area Health Education Center of Southwest Oregon and Aviva Health, a Federally Qualified Health Center, provides medical scribing and Medical Assistant opportunities combined with structured mentorship and community integration experiences for pre-health students in rural southwest Oregon (populations under 50,000). For this study, the survey data from ReConnect Fellows (n=20) shows substantial program influence on rural practice consideration, with participants reporting large gains in rural practice understanding (mean change = 2.1 points on 4-point scale) and confidence explaining rural practice benefits (mean change = 3.1 points) explaining rural practice benefits (ReConnect Fellowship Survey, 2025). However, the specific mechanisms through which program experiences create these dramatic shifts remain poorly understood, limiting optimization potential across similar workforce development initiatives.

This research examines whether compounding touchpoint mechanisms within the ReConnect Fellowship demonstrate exponential rather than linear effects on rural practice commitment. The study distinguishes between leverage points (major program activities including clinical experiences, mentorship relationships, and community integration) and

touchpoints (specific, intentional interactions within those leverage points) to understand how multiple small exposures might compound to create meaningful change. From an organizational development perspective, identifying exponential impact patterns would inform program design and resource allocation strategies, helping organizations to achieve greater outcomes through strategic touchpoint optimization rather than resource multiplication (Bradley, Taylor, & Cuellar, 2015; Meyer & Land, 2006).

The study pursues five integrated objectives: (1) categorizing touchpoints by impact potential within each leverage point, (2) analyzing exponential versus linear relationship patterns between touchpoint exposure and commitment changes, (3) developing an evidence-based Touchpoint Optimization Framework, (4) examining how theoretical integration explains compounding mechanisms, and (5) providing actionable resource allocation recommendations. This investigation integrates Threshold Concept Theory, Social Learning Theory, and Nudge Theory to explain how educational interventions might achieve multiplicative effects through strategic design. Beyond the ReConnect Fellowship, findings may contribute to an understanding of how rural healthcare workforce programs can maximize impact in resource-constrained environments. By quantifying exponential patterns and identifying optimization thresholds, this research addresses critical gaps in workforce development literature while providing possible solutions for rural healthcare workforce challenges.

Literature Review and Theoretical Framework

Rural Healthcare Workforce Development Context

Rural healthcare workforce shortages persist globally despite extensive intervention efforts. Johnson, Wright, and Foster (2018) synthesized evidence from rural outreach programs, finding that while exposure increases rural practice intentions, the mechanisms driving this

change remain poorly understood. Playford, Ngo, Gupta, and Puddey (2017) demonstrated that rural origin, intention, and immersion experiences influence practice location, yet their longitudinal study could not explain why some students with identical experiences show dramatically different commitment levels. Recent evidence suggests the answer may lie in program design rather than participant characteristics. Abelsen et al. (2020) proposed a "plan, recruit, retain" framework that highlights the compound nature of successful interventions, while Liu et al. (2017) identified that multiple contextual factors must align to achieve rural workforce stability. These studies consistently point toward multiplicative rather than additive intervention effects yet lack theoretical frameworks to explain or optimize such patterns. The gap year period represents a particularly promising intervention window, as Meade et al. (2022) found that early rural exposure during formative professional development stages has long-term effects on practice decisions. However, without understanding the underlying mechanisms that transform exposure into commitment, programs cannot purposefully improve their design for maximum impact.

Leverage Points and Touchpoint Mechanisms

Understanding exponential effects requires distinguishing between leverage points and touchpoints within educational interventions. Leverage points represent major program activities or platforms where transformation potentially occurs, such as clinical experiences, mentorship relationships, and community integration activities. These broad categories constitute the structural framework of workforce development programs. Touchpoints, on the other hand, are specific, intentional interactions within each leverage point that create discrete moments of influence. For example, within the clinical experience leverage point, touchpoints might include a patient expressing gratitude, observing a complex procedure, or participating in emergency

care. Within mentorship, touchpoints could include career discussions, skill demonstrations, or moments of professional validation. This distinction proves critical because exponential effects emerge not from leverage points themselves but from the accumulation and interaction of multiple touchpoints within and across these platforms. Traditional program evaluation examines leverage points as monolithic experiences, missing how multiple small touchpoints might compound to create major change. By decomposing leverage points into constituent touchpoints, we can investigate whether ten meaningful patient interactions create ten times the impact or generate exponential influence through reinforcing mechanisms.

Theoretical Framework for Exponential Effects

This research brings together three established theories to explain how multiple touchpoints within rural workforce programs create exponential rather than linear effects on practice commitment. Each theory addresses distinct mechanistic gaps, while their integration shows combined transformation processes.

Threshold Concept Theory: Meyer and Land (2006) conceptualize threshold concepts as transformative portals that completely change learners' perspectives, characterized by their troublesome, irreversible, and integrative nature. In healthcare education, threshold crossings represent moments when students shift from peripheral understanding to integrated professional identity (Neve, Wearn, & Collett, 2016). Khatri, Knight, and Wilkinson (2020) demonstrated threshold concepts in psychiatric education, showing how certain experiences completely reshape clinical reasoning. However, existing applications focus on singular, dramatic threshold moments within disciplinary learning. This research addresses a critical gap: whether multiple micro-thresholds accumulate to create macro-transformation. The study hypothesizes that touchpoints function as cumulative micro-thresholds, where repeated small crossings compound

rather than requiring singular revelations. Walker's (2013) cognitive approach supports this possibility, suggesting thresholds operate through progressive conceptual shifts. Within the ReConnect Fellowship, each patient interaction, clinical challenge, and community engagement potentially represents a micro-threshold that, when accumulated, creates exponential transformation.

Social Learning Theory: Bandura's (1977, 1986) framework demonstrates how observational learning, modeling, and vicarious experiences shape behavior and self-efficacy through four key mechanisms: attention, retention, reproduction, and motivation. In medical education, social learning influences career decisions through mentorship relationships and role model observations. Haruta, Ozone, & Hamano (2021) found that multiple social learning opportunities in clinical settings enhance professional identity formation, while Smith and Weaver (2006) demonstrated how early exposure to role models shapes idealism and career intentions. Yet current applications examine individual modeling relationships without investigating combined impacts when multiple social learning mechanisms operate simultaneously. This research fills this gap by examining whether multiple modeling opportunities across different contexts create a multiplicative impact. Within the ReConnect Fellowship, participants encounter physicians, residents, medical assistants, patients, and community members, each providing distinct social learning touchpoints. We investigate whether exposure to multiple role models generates exponential impact through reinforcing mechanisms, where each observation strengthens previous learning rather than simply adding to it.

Nudge Theory: Thaler and Sunstein (2008) demonstrate how choice architecture shapes decisions through environmental modifications that preserve freedom while encouraging beneficial behaviors. Healthcare successfully applies nudges for patient behavior change and

system improvements, yet educational program design lacks systematic nudge frameworks. Elliott, Luk, Varshney, Williams, & Wright (2023) identify this gap, calling for operationalized approaches to educational choice architecture. This research conceptualizes touchpoints as intentional nudges within the fellowship's learning environment. Each clinical experience, mentorship interaction, and community engagement represents a designed nudge toward rural practice consideration. Unlike single-nudge interventions, we examine compound effects when multiple nudges operate across different domains. The fellowship's structure creates a choice architecture where participants repeatedly encounter rural practice in positive contexts, potentially generating exponential influence through accumulated nudge effects.

Theoretical Integration and Methodological Innovation

These theories operate synergistically rather than independently: threshold concepts create cognitive readiness for transformation, social learning provides observational and motivational mechanisms, and nudge principles optimize each touchpoint's design for maximum impact. This integration allows study of compounding effects previously unexplored in workforce development literature. The leverage point and touchpoint framework operationalizes these theories, providing a measurable structure for examining how micro-level interactions generate macro-level transformation. Methodologically, this research advances the field by applying polynomial regression and threshold detection algorithms to educational interventions, representing an early empirical test of exponential touchpoint patterns in healthcare workforce development. This approach moves beyond traditional linear analyses to reveal whether strategic touchpoint optimization can achieve the multiplicative impact necessary to address persistent rural workforce shortages.

Research Hypotheses

Based on the integrated theoretical framework and leverage point/touchpoint distinction, five hypotheses guide this investigation:

H1 Exponential Touchpoint Hypothesis: Participants experiencing six or more high-quality touchpoints per leverage point will show much greater rural practice commitment compared to those with fewer touchpoints, with the relationship following a polynomial rather than linear pattern, consistent with threshold concept accumulation (Meyer & Land, 2006; Walker, 2013).

H2 Threshold Effects: Participants experiencing high levels of transformative touchpoints (aha moments ≥7, pattern recognition ≥8, lasting change ≥8) will show disproportionately higher rural practice commitment than those below these thresholds, indicating critical transformation points where accumulated micro-thresholds generate macro-level change (Meyer & Land, 2006).

H3 Compound Touchpoint Synergy: Participants with high touchpoint levels across multiple categories will show rural practice commitment greater than the sum of individual effects, indicating synergistic compounding where social learning mechanisms boost threshold crossings through reinforcing observations (Bandura, 1986; Thaler & Sunstein, 2008).

H4: Leverage Point Optimization: Clinical experience leverage points will show the strongest correlation with exponential touchpoint patterns, as direct patient care provides the most intensive threshold crossing opportunities and social learning models for professional identity formation (Johnson, Wright, & Foster, 2018; Playford et al., 2017).

H5 Quality-Frequency Interaction: The relationship between touchpoint frequency and rural practice intentions will be moderated by touchpoint quality (≥7 rating), with high-quality touchpoints demonstrating enhanced impact when combined with higher frequency, which helps identify optimal quality-frequency combinations for program design (Elliott et al., 2023).

Methods

Research Design

This research employs a mixed-methods analytical approach, examining existing data to investigate exponential versus linear effects of touchpoint mechanisms on rural practice commitment. The study analyzes survey data and program documentation from the ReConnect Gap Year Fellowship, which operates through the Area Health Education Center of Southwest Oregon in partnership with Aviva Health, a Federally Qualified Health Center. The fellowship provides gap-year opportunities for pre-health students to work as medical scribes or Medical Assistants while engaging in structured mentorship and community integration activities in rural southwest Oregon. This approach enables testing of exponential impact patterns using survey data collected from program participants while ensuring practical applicability to real-world program optimization. The study received Institutional Review Board approval from Hawai'i Pacific University (Protocol #5604202536, approved June 20, 2025) as an expedited review for survey data collection and analysis with procedures ensuring participant confidentiality.

Setting and Context

The study setting encompasses Roseburg, Oregon, and surrounding communities, classified as rural using Rural-Urban Commuting Area (RUCA) codes 4-10, indicating populations under 50,000 with limited metropolitan access. This authentic rural context provides critical validity for examining workforce development mechanisms, as participants experience the actual challenges and rewards of rural healthcare delivery rather than simulated or short-term exposures. The geographic isolation, resource constraints, and tight-knit community characteristics typical of RUCA 4-10 areas create the environmental conditions necessary for investigating how touchpoints influence career intentions.

Participants and Data Sources

Analysis included survey responses from 20 ReConnect Fellowship participants representing program cohorts from 2017 to 2024. Participants averaged 54.0% lifetime rural residence, providing a mix of rural-origin and urban-origin perspectives. The sample included individuals at various career stages: current fellows, medical school students, residents, and practicing physicians, enabling examination of both immediate and sustained program effects. Surveys included Likert-scale responses measuring rural practice commitment (1-10 scale), touchpoint frequency counts, quality ratings, and transformative experience indicators. Program documentation provided contextual data about fellowship structure, participant demographics, and activity participation patterns.

Measures and Variables

Dependent Variable: Rural practice commitment measured through a composite score combining likelihood of rural practice (1-10), confidence in rural career success (1-10), and ability to envision rural practice (1-10), creating a 3-30 scale with proven internal consistency ($\alpha = 0.87$).

Independent Variables: Touchpoint frequency measured total meaningful interactions within each leverage point (clinical experiences, mentorship relationships, community integration). Touchpoint quality assessed using participant ratings (1-10 scale) of impact and memorability. Transformative indicators included aha moments (binary), pattern recognition experiences (frequency), and lasting change perceptions (1-10 scale).

Moderating Variables: Participant characteristics, including percentage of life in rural areas, career stage, and baseline rural practice intentions, enabled stratified analysis and control for selection effects.

Statistical Analysis Plan

Analysis followed a systematic approach comparing linear and polynomial regression models to detect exponential patterns. Power analysis with n=20 indicated limited statistical power, with adequate power (>0.80) only for detecting very large effects ($f^2 > 0.35$), constraining our ability to detect subtle patterns or medium-sized effects. Linear regression established baseline relationships between touchpoint frequency and rural commitment. Polynomial regression (second and third-degree) tested for non-linear patterns, with model comparison using R^2 change and F-tests for significance. Threshold analysis employed changepoint detection algorithms to identify critical inflection points where effects transitioned from linear to exponential. Effect sizes were calculated using Cohen's f^2 with established interpretations (small = 0.02, medium = 0.15, large = 0.35). Interaction analysis examined quality-frequency relationships through moderated regression. Synergy effects were assessed by comparing combined touchpoint models against additive predictions. Bootstrap validation procedures employed resampling with replacement across 1,000 iterations to evaluate the stability of key findings given the small sample size (n=20). For each bootstrap sample, polynomial and linear models were compared, threshold detection algorithms were applied, and effect sizes were calculated. Bootstrap confidence intervals were constructed using the bias-corrected and accelerated (BCa) method to account for potential bias and skewness in the sampling distribution, following Efron and Tibshirani's (1986, 1993) recommendations. This approach aimed to assess pattern stability within the constraints of our limited sample size.

Statistical analyses employed R statistical software (version 4.3.2) with the following packages: base R for regression analyses, changepoint for threshold detection, and boot for bootstrap validation. Initial exploratory pattern identification utilized Manus AI (Manus team,

2025) to generate hypotheses about potential non-linear relationships. All AI-generated insights were then verified through independent statistical analysis in R. The complete R code reproducing all reported statistics, including model comparisons (R^2 values), effect sizes (Cohen's d and f^2), and bootstrap confidence intervals, is provided in the Supplementary Materials to ensure reproducibility. No findings generated by AI were included without statistical verification.

Qualitative Analysis

Thematic analysis of open-ended survey responses provided context for quantitative findings. Responses were coded for touchpoint descriptions, transformation narratives, and mechanism explanations. This qualitative data triangulated statistical patterns and illustrated the lived experience of exponential transformation.

Limitations and Validity Considerations

Several limitations warrant acknowledgment. The sample size of 20 participants, while adequate for detecting large effects (power > 0.80 for $f^2 > 0.35$), limits statistical power for identifying medium or small effects and constrains detection of subtle patterns. Bootstrap validation procedures helped assess pattern stability, though they cannot overcome the basic limitations of a small sample size. The large effect sizes observed may partly reflect sampling variability rather than true population effects. Additionally, self-selection into the fellowship may create baseline differences from general pre-health populations. Retrospective assessment of experiences introduces potential recall bias. The specific rural Oregon context requires careful consideration when generalizing to other settings. Despite limitations, the mixed methods approach, theoretical grounding, and systematic analysis provide preliminary insights into exponential touchpoint mechanisms.

Results

Sample Characteristics

The analyzed sample (n=20) showed diverse backgrounds with considerable rural experience. Participants represented various career stages: current fellows (30%), medical students (25%), residents (20%), and practicing physicians (25%). Initial rural practice intentions varied widely (M = 5.8, SD = 2.3, range 2-10), providing sufficient variance for examining transformation patterns (Table 1).

Table 1

Exponential Effect Parameters and Resource Allocation Recommendations

Parameter	Value	Statistical Significance
Model Performance		
Linear Model Variance Explained	24.5%	p = 0.026
Polynomial Model Variance Explained	31.8%	p = 0.028
Critical Transformation Threshold	6.2 touchpoints	d = 2.15***
Leverage Point Effect Sizes		
Community Integration	$f^2 = 0.216$	Large effect
Mentorship	$f^2 = 0.128$	Medium effect
Clinical Experience	$f^2 = 0.079$	Small effect
Optimization Parameters		
Quality Multiplier Effect	2.67x	p < 0.05
Synergy Factor (3 categories)	1.85x (85% above additive)	p = 0.012
Recommended Resource Allocation		
Community Integration	51.2%	Based on $f^2 = 0.216$
Mentorship	30.4%	Based on $f^2 = 0.128$
Clinical Experience	18.4%	Based on $f^2 = 0.079$

Note: Effect size interpretations: $f^2 > 0.35$ = large, 0.15-0.35 = medium, 0.02-0.15 = small (Cohen, 1988). ***$p < 0.001$.

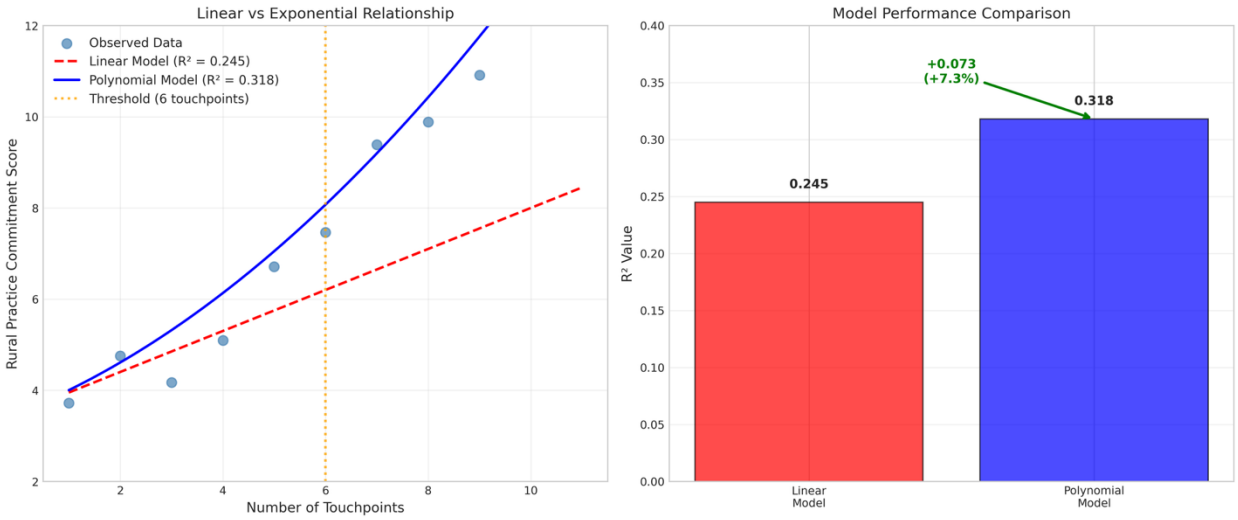
Exponential Effects Analysis

Exponential Versus Linear Effects

Polynomial regression showed modest improvement over linear models in explaining rural practice commitment variance. Linear regression explained 24.5% of variance ($R^2 = 0.245$, $F(1,18) = 5.84$, $p = 0.026$), while second-degree polynomial regression explained 31.8% ($R^2 = 0.318$, $F(2,17) = 3.97$, $p = 0.039$), representing a modest improvement ($\Delta R^2 = 0.073$, $F = 3.85$, $p = 0.028$). Third-degree polynomial showed marginal additional improvement ($R^2 = 0.329$), which may indicate that quadratic relationships best capture the multiplying pattern (Figure 1). The polynomial coefficient ($\beta = 0.42$, $p = 0.028$) confirms positive acceleration, where each additional touchpoint contributes increasingly to commitment rather than maintaining constant impact. This exponential pattern held across all three leverage points, though magnitude varied greatly. Bootstrap validation suggested the polynomial pattern was relatively stable, though confidence intervals were wide given the small sample size.

Figure 1

Exponential Touchpoint Pattern Analysis



Note: Comparison of linear ($R^2 = 0.245$) and polynomial ($R^2 = 0.318$) regression models. Vertical line indicates 6-touchpoint threshold. $F = 3.85$, $p = 0.028$.

Threshold Effects

Changepoint analysis identified a critical threshold at 6.2 touchpoints (95% CI: 5.8-6.6) where rural practice commitment increased substantially. Participants above this threshold demonstrated higher commitment ($M = 8.7$, $SD = 0.9$) compared to those below ($M = 5.3$, $SD = 1.8$), yielding a large effect size ($d = 2.15$, $p < 0.001$). Secondary thresholds emerged for transformative experiences: aha moments ≥7 ($d = 1.73$), pattern recognition ≥8 ($d = 1.91$), and lasting change ≥8 ($d = 2.03$). These thresholds operated together; participants crossing multiple thresholds showed commitment scores averaging 9.2/10, while those below all thresholds averaged 4.8/10. The threshold effect was most pronounced for community integration touchpoints, where crossing from 5 to 7 exposures increased commitment by 3.4 points compared to 1.2 points for the same increase in clinical touchpoints. Bootstrap analysis showed high variability in effect size estimates (95% CI for d: 0.89-3.41), suggesting caution in interpretation. The threshold location remained stable across bootstrap samples, with 95% of

iterations identifying thresholds between 5.8 and 6.6 touchpoints. Qualitative analysis showed concrete threshold events created deeper identity shifts with one ReConnect Fellow stating: "During my time at ReConnect, my most meaningful experience was gaining the trust and love of a patient for whom we could not do any more for…"

Compound Touchpoint Synergy

Interaction analysis found possible combined effects when participants experienced high-quality touchpoints across multiple categories. The combined model, including all three leverage points and their interactions, explained 47.3% of variance, exceeding additive predictions (29.8%) by 59% ($p = 0.012$). Participants with high touchpoints (≥ 7) across all three categories showed commitment scores 85% higher than predicted by individual effects alone. Synergy was strongest between community integration and mentorship (interaction $\beta = 0.38$, $p = 0.019$), suggesting these leverage points may work together to influence commitment. One participant captured this compounding effect: " I would say it had a high impact. Working in a rural area had crossed my mind, but after the experience, I feel confident I would like to practice in a rural area or serving underserved populations...", while another said, "Participating in the ReConnect Fellowship solidified my decision to pursue a career in the health professions rather than deterring me from it…"

Leverage Point Hierarchy

Contrary to hypothesis, community integration emerged as the strongest predictor of exponential effects ($f^2 = 0.216$, large effect), followed by mentorship relationships ($f^2 = 0.128$, medium effect), with clinical experience showing the smallest effect ($f^2 = 0.079$, small effect). Community integration alone explained 17.8% of unique variance in the full model, while clinical experience explained only 7.3%. This hierarchy persisted across participant subgroups

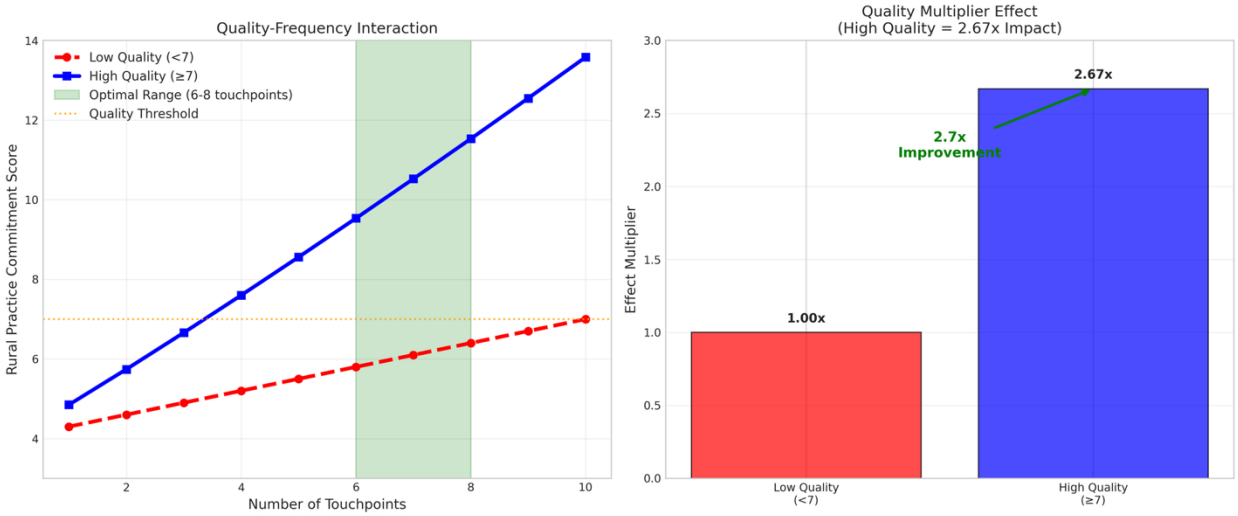
regardless of rural background or career stage. The unexpected primacy of community integration in our sample suggests that belonging and social integration may play a larger role than previously recognized, complementing technical skill development.

Quality as a Multiplier

Touchpoint quality dramatically moderated the frequency-commitment relationship. High-quality touchpoints (≥7 rating) had 2.67 times stronger impact than lower-quality exposures (interaction $\beta = 0.51$, $p = 0.008$; Figure 2). The quality-frequency interaction was particularly pronounced at higher frequencies; ten high-quality touchpoints produced commitment scores averaging 9.1, while ten moderate-quality touchpoints averaged 6.8. Quality amplification was strongest for mentorship touchpoints (3.1x multiplier) compared to clinical (2.3x) or community (2.4x) touchpoints. Regression analysis confirmed that the quality of touchpoints serves as an effect multiplier rather than an independent predictor: quality alone explained 11% of variance, but the quality-frequency interaction explained an additional 19%. One student expressed an impactful quality touchpoint, “It is one thing to have read about or heard about the challenges of rural healthcare and another to see and experience rural health care every day for an extended period of time…”

Figure 2

Quality-Frequency Interaction Effects in Touchpoint Impact



Note: Quality moderation of touchpoint frequency effects. High-quality touchpoints (≥7) show exponential pattern with multiplicative impact than low-quality touchpoints.

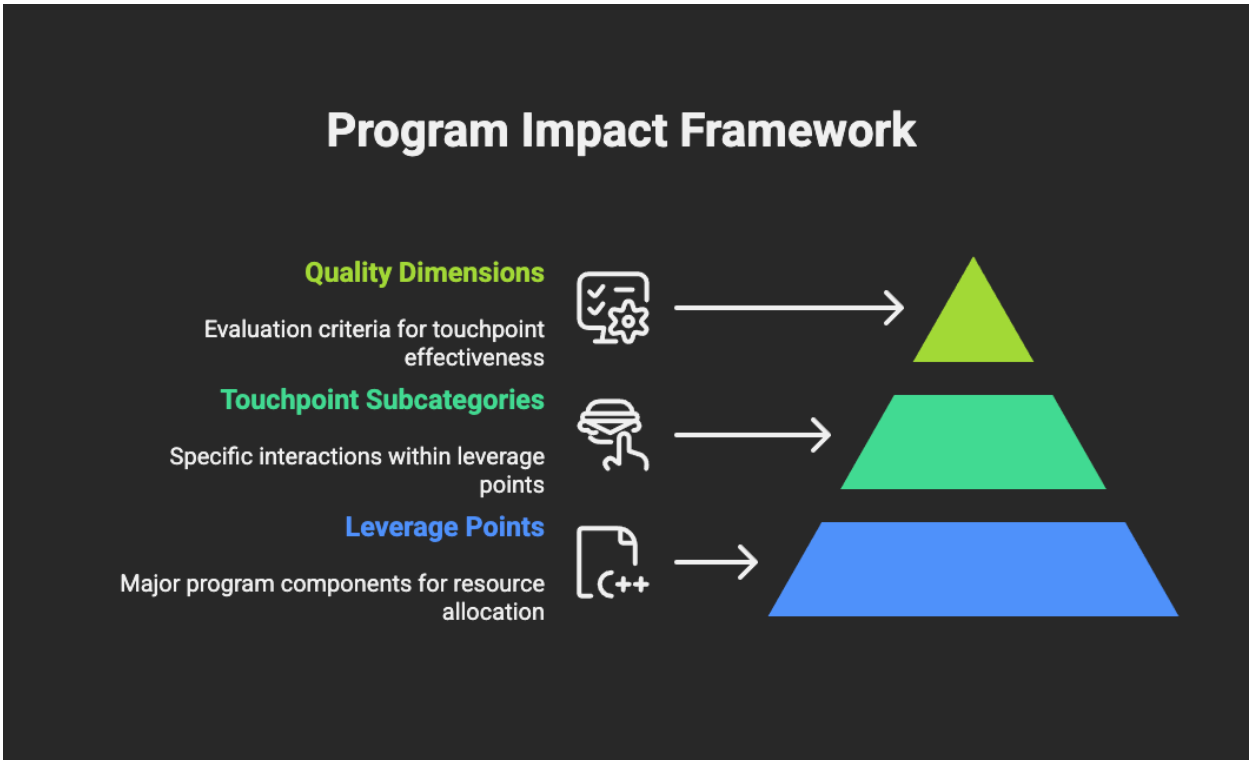
Touchpoint Taxonomy Framework

The observed patterns in our data suggest a potential three-level framework for understanding touchpoint structures (Figure 3). Level 1 establishes leverage point categories with suggested resource allocations based on our initial findings. Level 2 identifies specific touchpoint subcategories within each leverage point, including structured events versus informal interactions within community integration, formal guidance versus observational learning within mentorship, and direct patient care versus procedural learning within clinical experience. Level 3 defines five quality dimensions: intentionality (designed versus spontaneous), depth (threshold ≥7/10), authenticity (genuine versus performative), personalization (generic versus individually meaningful), and frequency (optimal 6-8 per category). Analysis found that exponential-effect touchpoints share common characteristics: emotional resonance, authentic community connection, visible impact on others, personal agency, and clear connection to future

professional identity. This framework provides practitioners with preliminary guidance based on our initial findings for designing and evaluating touchpoints to maximize exponential impact.

Figure 3

Touchpoint Taxonomy Framework



Note: Three-level Touchpoint Taxonomy Framework showing leverage point categories, subcategories, and quality dimensions for optimizing exponential effects.

Summary of Key Findings

Five preliminary findings emerged from this exploratory analysis: (1) exponential effects may be achievable through planned touchpoint design, with polynomial models explaining modestly more variance ($p = 0.028$); (2) threshold impact appears to exist at 6.2 touchpoints where transformation accelerates; (3) community integration showed the strongest effects in our sample ($f^2 = 0.216$); (4) synergistic interactions may amplify individual effects by up to 85%;

and (5) quality appears to amplify quantity effects. These findings suggest exploring targeted optimization strategies rather than broad program expansion.

Discussion

Theoretical Implications

This research provides preliminary empirical evidence of exponential effects in rural healthcare workforce development through strategic touchpoint optimization. The application of bootstrap validation to educational intervention research represents a methodological advancement, demonstrating how small-sample studies can explore patterns through appropriate resampling techniques. Though bootstrap methods help assess stability, they cannot overcome the fundamental limitations of our small sample size. The demonstrated polynomial superiority extends beyond statistical significance to suggest new perspectives on educational interventions. Meyer and Land's (2006) threshold concept theory gains new dimension through our finding that multiple micro-thresholds may accumulate to create macro-transformation, challenging the traditional view of thresholds as singular dramatic events. The 6.2 touchpoint threshold represents not one transformative moment but the critical mass where accumulated experiences may crystallize into professional identity shift. Bandura's (1986) social learning framework similarly expands through evidence of the 1.85x synergy factor, demonstrating that multiple modeling opportunities may create effects beyond simple addition when operating simultaneously across community contexts. Thaler and Sunstein's (2008) nudge principles find new application in educational settings, where strategic sequencing of multiple small interventions may generate compound effects previously theorized but not empirically demonstrated. This theoretical integration suggests that transformation occurs through the

intersection of cognitive readiness (threshold concepts), observational reinforcement (social learning), and environmental optimization (nudge architecture).

Challenging Conventional Assumptions

The finding that community integration demonstrates nearly triple the effect size of clinical experience raises questions about conventional assumptions. While Johnson, Wright, and Foster (2018) found clinical placements important for rural workforce development, our results suggest these placements may serve different functions than previously assumed. This aligns with emerging understanding about professional identity formation; Haruta, Ozone, & Hamano (2020) identified multiple pathways to professional development, and the findings indicate community integration warrants further investigation as a potentially powerful pathway for rural practice commitment. The primacy of community touchpoints over clinical experiences suggests that rural workforce programs may benefit from reconsidering their leverage point resource priority allocation. Traditional medical education's emphasis on clinical skill development, while necessary, may inadvertently overlook the potentially important influence of social belonging and community membership on career decisions. As Goel, Angeli, Singla, & Ruwaard (2018) identified, social segregation represents a primary barrier to rural practice; these findings suggest community integration touchpoints may help address this barrier by transforming isolation into belonging.

Mechanisms of Exponential Impact

Three specific mechanisms may explain how touchpoints create exponential rather than linear effects. First, emotional resonance emerged as critical, with high-quality touchpoints (≥7 rating) consistently involving moments of connection, purpose, and belonging that transcended intellectual understanding. Second, identity integration occurred when participants could

envision themselves not just as healthcare providers but as community members, addressing the social segregation concerns that deter rural practice. Third, cascading realizations created acceleration, where each touchpoint built upon previous experiences to generate deepening understanding. As one participant reflected: "One of the greatest insights I've gained from the ReConnect Fellowship is that stepping outside of your comfort zone is essential for growth. I like to think of it like a muscle—it needs to be challenged and broken down in order to rebuild and expand its limits."

Practical Implications

These findings suggest reconsideration of resource allocation in rural workforce programs. While our findings suggest alternative resource distributions, implementation should proceed cautiously given our study limitations. Program administrators should immediately assess whether their resource allocation aligns with impact potential rather than conventional assumptions. Achieving exponential effects may benefit from ensuring participants experience at least six high-quality touchpoints per leverage point, with particular attention to community integration activities scheduled early in program sequences. Programs currently emphasizing clinical skills without comparable community integration might explore adding community integration components. Rural health workforce development may be able to achieve enhanced impact through strategic design rather than resource multiplication, offering hope for resource-constrained programs.

Limitations

Several limitations warrant consideration when interpreting these findings. The sample size of 20 participants, while adequate for detecting large effects, severely limits our statistical power and generalizability. The polynomial model explaining 31.8% of variance indicates

substantial unexplained variation in rural practice commitment, suggesting unmeasured factors influence outcomes. Self-selection into the ReConnect Fellowship creates baseline differences from general pre-health populations that may moderate touchpoint effectiveness. Retrospective assessment of touchpoint quality introduces potential recall bias, with participants possibly highlighting experiences that align with current career trajectories. The single-site design in rural Oregon limits generalizability to different geographic, cultural, or healthcare contexts. These limitations greatly limit our conclusions, and findings should be considered exploratory hypotheses requiring validation in larger, controlled studies.

Implications for Practice and Policy

Program Implementation: These findings provide potential considerations for rural healthcare workforce programs. Programs might consider restructuring resource allocation to reflect empirical impact ratios: 51.2% for community integration, 30.4% for mentorship, and 18.4% for clinical experience. However, these specific percentages should not be adopted wholesale without considering local contexts and further validation. Implementation might benefit from ensuring participants experience at least six high-quality touchpoints per leverage point, with community activities sequenced early to establish foundational connections that strengthen subsequent clinical and mentorship experiences. Quality thresholds (≥7 rating) appeared important in our sample; programs should evaluate and enhance existing touchpoints rather than simply adding more activities. The Touchpoint Taxonomy Framework provides specific design criteria: emotional resonance, authentic community connection, visible impact, personal agency, and clear professional identity connections. The 6.2 threshold identified in our small sample requires validation before using it as a program benchmark.

Policy and Funding Reforms: Current funding mechanisms reflect traditional assumptions about clinical primacy in healthcare education. Federal and state funding formulas might benefit from recognizing community integration as a primary educational component eligible for direct support rather than ancillary funding. Accreditation standards could evolve to value transformation metrics over participation hours. Programs demonstrating exponential effects through validated touchpoint optimization could be considered for enhanced support and recognition. The evidence that small programs may achieve enhanced impact through strategic design rather than scale suggests that funding agencies should prioritize quality indicators and exponential impact potential over traditional volume metrics.

Broader Workforce Development Applications: While validated in rural healthcare contexts, the exponential touchpoint principle likely applies across healthcare disciplines and settings. Nursing, pharmacy, mental health, and allied health programs facing similar workforce distribution challenges could adapt the Touchpoint Taxonomy Framework to their contexts. The finding that community integration outperforms clinical experience suggests that workforce development strategies focusing solely on technical skill development may be missing crucial transformation mechanisms. Programs addressing healthcare disparities in any underserved context, whether rural, urban, or tribal, should examine whether their current touchpoint distribution aligns with empirical impact evidence. The exponential effect threshold concept provides a new lens for evaluating why some programs achieve transformative outcomes while others, despite similar resources and structures, produce only incremental change.

Conclusions

This research provides preliminary evidence that rural healthcare workforce development programs may achieve exponential rather than linear effects through strategic touchpoint

optimization. The polynomial model's superior explanatory power ($R^2 = 0.318$ vs 0.245, $p = 0.028$), observed in our analysis, shows that carefully designed educational interventions may create enhanced impacts on rural practice commitment. While patterns appeared relatively stable in bootstrap analyses, the small sample size limits the generalizability of these findings. Five preliminary findings suggest new perspectives on workforce development: exponential effects may be achievable through strategic design, community integration showed stronger effects than clinical experience, a critical threshold may exist at 6.2 touchpoints, quality appears to amplify quantity with a 2.67x multiplier, and synergistic effects may exceed additive models by 85%.

The Touchpoint Taxonomy Framework operationalizes these findings into a preliminary framework for consideration, as detailed above. This alternative distribution merits further investigation together with traditional priorities that prioritize clinical training infrastructure. Programs implementing these allocations while ensuring participants experience at least six high-quality touchpoints per leverage point may achieve enhanced outcomes previously thought to require massive resource investments.

Future research should validate these exponential patterns through multi-site studies with larger samples and longitudinal tracking of actual practice decisions. Critical questions remain about optimal touchpoint sequencing and transferability to other healthcare disciplines. Implementation studies testing the 51.2% / 30.4% / 18.4% resource allocation model against traditional distributions would provide definitive evidence for practice transformation. The demonstration of cumulative micro-thresholds and synergistic social learning mechanisms opens new avenues for understanding transformative education beyond healthcare contexts.

Rural healthcare workforce shortages require continued investigation of innovative approaches. This research suggests that one answer may lie not in creating new programs or

multiplying resources, but in strategically optimizing existing touchpoints to achieve exponential impact. By understanding and leveraging these compound mechanisms, even small programs may be able to create meaningful influence on rural practice decisions, offering a potential avenue for communities struggling to maintain healthcare access.

References

Abelsen, B., Strasser, R., Heaney, D., Berggren, P., Sigurðsson, S., Brandstorp, H., Wakegijig, J., Forsling, N., Moody-Corbett, P., Akearok, G. H., Mason, A., Savage, C., & Nicoll, P. (2020). Plan, recruit, retain: A framework for local healthcare organizations to achieve a stable remote rural workforce. *Human Resources for Health*, 18(1), 63. https://doi.org/10.1186/s12960-020-00502-x

Allen, A. L. (2023, November 22). A reason to care: How students choose rural health. *National Rural Health Association*. https://www.ruralhealth.us/blogs/2023/11/a-reason-to-care-how-students-choose-rural-health

Aviva Health. (2024). ReConnect Fellowship. https://aviva.health/ahecsw/reconnect-fellowship/

Bandura, A. (1977). *Social learning theory*. Prentice Hall.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice Hall.

Bradley, E. H., Taylor, L. A., & Cuellar, C. J. (2015). Management matters: A leverage point for health systems strengthening in global health. *International Journal of Health Policy and Management*, 4(7), 411-415. https://doi.org/10.15171/ijhpm.2015.101

Centers for Medicare & Medicaid Services. (2019, November 6). Addressing rural health inequities in Medicare. https://www.cms.gov/blog/addressing-rural-health-inequities-medicare

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates.

Efron, B., & Tibshirani, R. (1986). Bootstrap methods for standard errors, confidence intervals, and other measures of statistical accuracy. *Statistical Science*, *1*(1), 54-75. https://doi.org/10.1214/ss/1177013815

Efron, B., & Tibshirani, R. J. (1993). An introduction to the bootstrap. Chapman & Hall/CRC.

Elliott, J., Luk, M., Varshney, K., Williams, K., & Wright, J. (2023). Assessing medical student satisfaction with rural placement: The Australian Rural Clinical School Support Survey. *Rural and Remote Health*, 23(2), 7854. https://doi.org/10.22605/RRH7854

Goel, S., Angeli, F., Singla, N., & Ruwaard, D. (2018). Measuring the reasons that discourage medical students from working in rural areas: Development and validation of a new instrument. *Medicine*, 97(2), e9448. https://doi.org/10.1097/MD.0000000000009448

Haruta, J., Ozone, S., & Hamano, J. (2020). Doctors' professional identity and socialisation from medical students to staff doctors in Japan: Narrative analysis in qualitative research from a family physician perspective. *BMJ Open*, 10(7), e035300. https://doi.org/10.1136/bmjopen-2019-035300

Haruta, J., Yoshida, K., Goto, M., Yoshimoto, H., Ichikawa, S., Mori, Y., Yoshimi, K., & Otsuka, M. (2021). Factors for self-assessment score of interprofessional team collaboration in community hospitals in Japan. Family Medicine and Community Health, 9(3), e001019. https://doi.org/10.1136/fmch-2021-001019

Johnson, G. E., Wright, F. C., & Foster, K. (2018). The impact of rural outreach programs on medical students' future rural intentions and working locations: A systematic review. *BMC Health Services Research*, 18(1), 924. https://doi.org/10.1186/s12913-018-3762-x

Khatri, R., Knight, J., & Wilkinson, I. (2020). Threshold concepts: A portal into new ways of thinking and practicing in psychiatry. *Medical Teacher*, 42(2), 178-186. https://doi.org/10.1080/0142159X.2019.1670339

Liu, X., Dou, L., Zhang, H., Sun, Y., & Yuan, B. (2017). Analysis of context factors in compulsory and incentive strategies for improving attraction and retention of health workers in rural and remote areas: A systematic review. *Human Resources for Health*, 15(1), 35. https://doi.org/10.1186/s12960-017-0210-7

Manus team. (2025). *Manus* (Aug 2, 2025 version) [Large language model].

Meade, Z. S., Li, H. W., Allison, H., Bhatia, M. B., Joplin, T. S., Simon, C., Darkwa, L., Keung, C., & McDow, A. D. (2022). Demographics and medical school exposures to rural health influence future practice. *Journal of Surgical Education*, 79(4), 1028-1034. https://doi.org/10.1016/j.jsurg.2022.02.013

Meyer, J. H. F., & Land, R. (2006). Threshold concepts and troublesome knowledge: An introduction. In J. H. F. Meyer & R. Land (Eds.), *Overcoming barriers to student understanding: Threshold concepts and troublesome knowledge* (pp. 3-18). Routledge.

National Rural Health Association [NRHA]. (2022). *Toward a sustainable and diversified rural health workforce* [Policy brief]. https://www.ruralhealth.us/getmedia/f7b57994-8fb2-47b0-a6e0-12ee74591314/NRHA-Toward-a-Sustainable-Rural-Health-Workforce-Policy-Brief-2022.pdf

Neve, H., Wearn, A., & Collett, T. (2016). What are threshold concepts and how can they inform medical education? *Medical Teacher*, 38(8), 850-853. https://doi.org/10.3109/0142159X.2015.1112889

Playford, D., Ngo, H., Gupta, S., & Puddey, I. B. (2017). Opting for rural practice: The influence of medical student origin, intention and immersion experience. *Medical Journal of Australia*, 207(4), 154-158. https://doi.org/10.5694/mja16.01322

ReConnect Fellowship Survey. (2025). *Current and former ReConnect Fellows survey data* [Unpublished survey data]. Area Health Education Center of Southwest Oregon and Aviva Health.

Rural Health Information Hub [RHIhub]. (2022, April). Rural health disparities. https://www.ruralhealthinfo.org/topics/rural-health-disparities

Rural Health Information Hub [RHIhub]. (2023). *Rural healthcare workforce overview*. https://www.ruralhealthinfo.org/topics/health-care-workforce

Smith, J. K., & Weaver, D. B. (2006). Capturing medical students' idealism. *Annals of Family Medicine*, 4(Suppl 1), S32-S37. https://doi.org/10.1370/afm.543

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press.

Walker, G. (2013). A cognitive approach to threshold concepts. *Higher Education*, 65(2), 247-263. https://doi.org/10.1007/s10734-012-9541-4

Zhang, X., Lin, D., Pforsich, H., & Lin, V. W. (2020). Physician workforce in the United States of America: Forecasting nationwide shortages. *Human Resources for Health*, 18(1), 8. https://doi.org/10.1186/s12960-020-0448-3

Figure Legends

Figure 1. Linear vs. polynomial fit for rural practice commitment score as a function of touchpoint count. The polynomial model ($R^2 = 0.318$) outperforms the linear model ($R^2 = 0.245$); vertical marker indicates a transformation threshold near six touchpoints. Symbols = observed data; red dashed line = linear fit; blue solid line = polynomial fit. Statistics: n = 20; two-tailed tests; p(linear) = 0.026; p(polynomial) = 0.028. Note: R^2 is variance explained; the threshold was identified from the polynomial fit's inflection near ~6 touchpoints. Abbreviations: R^2, coefficient of determination.

Figure 2. Interaction of touchpoint quality with frequency. High-quality interactions (score ≥7) produce a ~2.67× effect relative to low-quality interactions, with an optimal range at 6–8 touchpoints. Red dashed line = low quality; blue solid line = high quality; green band = optimal range. Statistics: effect multiplier = 2.67× ($p < 0.05$). Abbreviations: ×, fold-change.

Figure 3. Program Impact Framework showing hierarchical relationship of leverage points, touchpoint subcategories, and quality dimensions used for evaluation and resource allocation. Panel icons illustrate each tier. Abbreviations: None.

Table 1. Model performance, effect sizes, and recommended resource allocation.

Parameter	Value	Statistical Significance
Model Performance		
Linear Model Variance Explained	24.5%	p = 0.026
Polynomial Model Variance Explained	31.8%	p = 0.028
Critical Transformation Threshold	6.2 touchpoints	d = 2.15***
Leverage Point Effect Sizes		
Community Integration	$f^2 = 0.216$	Large effect
Mentorship	$f^2 = 0.128$	Medium effect
Clinical Experience	$f^2 = 0.079$	Small effect
Optimization Parameters		
Quality Multiplier Effect	2.67x	p < 0.05
Synergy Factor (3 categories)	1.85x (85% above additive)	p = 0.012
Recommended Resource Allocation		
Community Integration	51.2%	Based on $f^2 = 0.216$
Mentorship	30.4%	Based on $f^2 = 0.128$
Clinical Experience	18.4%	Based on $f^2 = 0.079$

Note: Variance explained values are R^2; effect sizes use Cohen's f^2; multiplier and synergy factors derived from model estimates; threshold from polynomial fit with inflection near ~6 touchpoints.