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HHRD'S INTEGRATED MOBILE MEDICAL UNIT INITIATIVE: REACHING THE LAST MILE FOR RURAL PRIMARY HEALTHCARE EQUITY IN PAKISTAN

Dr. Muhammad Arshad Sakhani[*1], Dr. Muhammad Anwar Ul Haq[2], Raheel Ahmed[3], Dr. Khola Imtiaz[4], Dr. Zahra Tasneem[5]

*[*1]PhD (Economics), International Institute of Islamic Economics, International Islamic University (IIUI), Islamabad*
[2]PhD (Sociology), Department of Sociology, PMAS Arid Agriculture University Rawalpindi
[3]PhD (Anthropology) Scholar, Department of Anthropology, PMAS Arid Agriculture University Rawalpindi
[4]MS (Public Health), Health Services Academy, Islamabad
[5]MBBS, Nishtar Medical University, Multan

[*1]arshadsakhani@gmail.com, [2]anwaarbhutta786@gmail.com, [3]raheel.a.bhatti@gmail.com, [4]khola1997@gmail.com, [5]zahratasnim307@gmail.com

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Corresponding Author: *
Dr. Muhammad Arshad Sakhani

Abstract

Access to primary healthcare services remains one of the most recurrent development problems for low- and middle-income countries, and Pakistan's case reveals why access to a facility based on geographical location alone does not work. This study assesses an innovative delivery approach by the Helping Hand for Relief and Development organization, which provides curative, preventive, promotive, and maternal and child health services along with medicines, health education, screening and referral services to vulnerable communities in Rajanpur (Punjab), Mirpur Khas (Sindh) and Jafferabad (Balochistan). Using the cross-sectional data from 400 beneficiaries and multiple regression analysis, the study explores the role of five implementation dimensions – accessibility, quality of care, maternal and child health, health awareness, and use of services – together in affecting health outcomes and beneficiary satisfaction. The model explained a striking 77.7% of the variation in outcomes ($R^2 = .777$, adjusted $R^2 = .774$, $F(5, 394) = 275.02$, $p < .001$). Maternal and child healthcare emerged as by far the strongest driver ($\beta = .623$, $p < .001$), followed by service utilization ($\beta = .245$, $p < .001$) and, more modestly, quality of care ($\beta = .056$, $p = .048$). Although accessibility and community awareness showed high bivariate associations, they failed to have any significance after controlling for the other constructs, indicating that accessibility and health knowledge play an important role insofar as they lead to quality utilization of services and not in their own right. This research provides a new paradigm shift in the understanding of the relevance of mobile clinics: Mobile clinics should not be viewed as a last resort when there is a lack of health infrastructure but as a part of the primary healthcare platform whose success depends upon what takes place beyond its doors, especially for women and children.

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1. Introduction

Close to 50% of the world's population currently lacks access to basic health services whenever they need them, while those who seek healthcare services are usually driven into poverty because of the financial strain of out-of-pocket payments (World Bank, 2024). This issue is not just a figure in rural Pakistan; rather, it is a reality confronting mothers in Rajanpur when faced with a decision between half a day's wages and travel costs versus a child's fever, or when farmers in Jafferabad are forced to decide whether their illnesses are severe enough to warrant the cost of traveling to the closest health facility. The realization of Universal Health Coverage and SDGs relating to health, namely SDG 3 on health and well-being, SDG 10 on inequalities, and SDG 17 on partnerships, depends on addressing precisely such an issue in areas where the expansion of health service facilities has proved difficult and costly.

The health situation in Pakistan demonstrates the severity of the issue, as well as how difficult it is to solve the problem just by developing the required infrastructure. The Universal Health Coverage Service Index of the country increased from about 40 in 2015 to 55 in 2024; however, it is too slow compared to the requirement to achieve 80% coverage according to the SDGs by 2030, and even the improvement has slowed down recently (Alwan, 2024). In addition, out-of-pocket payments comprise more than 50% of all health expenses in Pakistan, and, moreover, an estimated 11-15 million Pakistanis became poorer due to medical expenses in 2024 alone (World Bank, 2024). The data given above are averages of the whole country and do not demonstrate what rural districts or those that were affected by natural disasters have. In 2022, the catastrophic flooding in Pakistan destroyed up to ten percent of the health infrastructure of the country, leaving millions of its inhabitants without access to primary health services, while the risk of getting waterborne or vector-borne diseases was extremely high (World Health Organization, 2022). Recurrent flooding since then has kept parts of southern Punjab, Sindh, and Balochistan in a near-continuous cycle of infrastructure damage and health-system disruption, which is the operating environment in which Rajanpur, Mirpur Khas, and Jafferabad sit.

Mobile health delivery has become one of the more consistently cited responses to this kind of access gap, and the evidence base, while uneven, is not thin. Mobile clinics and community health worker programmes have been shown to widen maternal and child health coverage, extend rehabilitation and chronic disease services into places fixed facilities cannot reach cost-effectively, and, during acute shocks such as the COVID-19 pandemic, sustain essential care where formal systems buckled (Bonnechère et al., 2023; Kaseje et al., 2024). Community health worker cadres have repeatedly proven capable of extending the reach of maternal, newborn, and child health services in low-resource settings at comparatively low cost (Kaseje et al., 2024). Yet the same literature is candid about mobile and outreach models' limits. Reviews of primary care access among structurally marginalized groups of older adults, for instance, find that geographic reach is only one of several access barriers, and rarely the decisive one once affordability, service quality, and trust are accounted for (Dableh et al., 2024). A qualitative study of a mobile clinic in rural Philippine barangays found that the programme was well received, but that health literacy varied sharply across the same population it served, meaning identical services were not experienced identically by everyone who received them (Weiner et al., 2024). In particular, research at the community level conducted in Pakistan over a period of 10 years has continuously found low awareness, rather than distance, as the primary factor influencing the utilization of antenatal care, delivery in health facilities, postnatal care, and immunization, while distance and dysfunctional facilities become relevant in emergencies but not for preventive services (Memon et al., 2016). Also, attempts to link family planning with maternal and child health service delivery in rural Sindh have been founded on the idea that linking services and not proximity to people can alter service utilization (Memon et al., 2022).

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This literature is unable to provide the basis for bringing all the pieces together into a cohesive whole. The majority of published studies on mobile or outreach health programs focus on a single type of intervention immunizations, antenatal care, a specific disease intervention programme, or a humanitarian response window but not an overall package of curative, preventive, promotive, maternal/child, and referral services that are provided in an ongoing way to the same communities. Moreover, even fewer studies move beyond the realm of correlational and purely descriptive designs to answer the question of what components of this integrated approach make a difference when the other components are controlled for. This is important because accessibility, quality, maternal/child services, awareness, and utilization of services are not separate knobs that can be turned on their own, but levers that affect each other and that a policymaker must determine are making the difference when considering how to allocate limited resources. Evidence on quality-of-care compounds this problem: studies of patient satisfaction in other primary care systems show quality effects that are real but frequently modest relative to service comprehensiveness and continuity, and the drivers of satisfaction shift over time and across subgroups in ways that a single cross-sectional service-quality score can obscure (Aljohani, 2026). Pakistan-specific research on the *relative* contribution of accessibility, quality, maternal and child services, awareness, and utilization measured together, in the same beneficiaries, for an integrated mobile programme is close to absent. This is the gap this study addresses. It is against this backdrop that Helping Hand for Relief and Development (HHRD), a Pakistani humanitarian and development organization, designed and rolled out its Integrated Mobile Medical Unit initiative. The premise behind the initiative was straightforward but, as the review above suggests, not obvious in practice: that a mobile clinic delivers value only to the extent it functions as primary healthcare, not as episodic outreach. In practical terms, this meant equipping each MMU to provide curative consultations, preventive screening, maternal and child health services, essential medicines, nutrition counselling, and health education in the same visit, backed by a referral pathway to secondary facilities where a beneficiary's needs exceeded what the unit could provide onsite. These units move through predetermined underprivileged villages in Rajanpur, Mirpur Khas, and Jafferabad, repeating visits in the same villages regularly, instead of having each visit as a one-time encounter – a feature deliberately built into the design, because the continuity of care is what makes the difference in the broader literature on mobile health. Assessing whether this design decision pays off and what elements of it really make the difference is exactly what this study seeks to do empirically.

The conceptual underpinnings of the research come from two complementary perspectives. First, there is the theory of primary health care, introduced at Alma-Ata in 1978 and revised in Astana in 2018, which describes equitable access, community engagement, and a combination of preventive and curative care as inextricable prerequisites for a resilient health system, not distinct options of policies. Second, there is Andersen's Behavioral Model of Health Services Use – the most prevalent model of understanding why people seek or do not seek care, based on predisposing, enabling, and need-based factors of usage and, thus, outcomes (Andersen, 1995). The most recent adaptations of the model have proven its main assumption again, namely, that the enabling factors like physical and financial access are important, but they function primarily as mediators, influencing the actual usage of services, and not health (Xin & Ren, 2023). This is like the role of community awareness, especially evident in health literacy research, where awareness impacts health results only through promotion of preventive behaviors and seeking services (Fenta et al., 2024). Read together, these frameworks predict something specific and testable: that accessibility and awareness should matter, but that their statistical footprint should shrink once utilization and the substantive content of care here, maternal and child services and quality — are included in the

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same model. This study is, in effect, a field test of that prediction inside a real humanitarian programme.

From a development economics perspective, the stakes extend past clinical outcomes. Investment in maternal and child health is among the more thoroughly documented human-capital investments in the development literature, with downstream effects on cognitive development, educational attainment, and labour productivity that compound over a generation (Sakhani et al., 2026). Reducing catastrophic and impoverishing health expenditure — the mechanism through which Pakistan's out-of-pocket-dominated system currently punishes rural households for falling ill (World Bank, 2024) is itself a poverty-reduction intervention, not only a health one. Community mobilization and awareness-building, similarly, have been shown in other Pakistani rural settings to strengthen resilience well beyond the specific service it was designed to promote (Rehman et al., 2026). An integrated MMU model, in other words, is not simply a clinical delivery mechanism; it is also, in principle, an instrument of inclusive growth, and evaluating it on those terms rather than on service counts alone is part of what this study attempts. This study makes six contributions to the literature on primary healthcare delivery in humanitarian and resource-constrained settings. First, it provides quantitative, beneficiary-level evidence on an integrated MMU model one that bundles curative, preventive, maternal and child, and referral services within a single delivery platform rather than evaluating a single disease programme or service line in isolation, which is how most of the existing mobile-health literature is structured. Second, it estimates the *independent*, rather than merely correlational, contribution of five implementation domains simultaneously, allowing a direct answer to the practical question of where additional investment would do the best. Third, it offers rare Pakistan-specific, cross-provincial evidence spanning Punjab, Sindh, and Balochistan, three provinces with materially different administrative, security, and climate-risk contexts, strengthening the generalizability of the findings beyond a single district. Fourth, it empirically applies Andersen's Behavioral Model to the humanitarian mobile health setting, taking a model that is mostly facility-based and applying it to a situation in which the facility becomes mobilized to reach people. Fifth, it proves, through empirical evidence, that accessibility and community awareness are not direct determinants but rather enabling and predisposing factors that work via utilization and quality of care, with important consequences for prioritization and sequencing by humanitarian agencies. Finally, it provides an insight from the program level into the broader SDG and UHC policy agenda and presents evidence that humanitarian organizations can leverage to argue the case for mobile healthcare in addition to, and not instead of, health systems strengthening.

2. Materials and Methods

A quantitative cross-sectional study design was adopted to assess the impact of the Integrated MMU Model developed by HHRD among 400 beneficiaries who have been served under the program in the three districts of Rajanpur (Punjab), Mirpur Khas (Sindh), and Jafferabad (Balochistan). These particular three districts were chosen purposively since they possess the same combination of characteristics as intended to be addressed by the MMU model, namely dispersed rural population, limited fixed health infrastructure facilities, recurrent floods and high poverty level, yet differ in administrative and geographical terms sufficiently not to allow the results to reflect peculiarities of only one province. The structured questionnaire assessed the perceptions of beneficiaries in five dimensions of MMU implementation such as Accessibility of MMU Services (AMS), Quality of Healthcare Services (QHS), Maternal and Child Healthcare Services (MCHS), Community Health Awareness (CHA), and Health Service Utilization (HSU), together with a composite outcome measure, Health Outcomes and Beneficiary Satisfaction (HOBS).

Perception-based questions on each of the domains were used and responses to those were pooled into one score for that particular domain as it was decided that none of the five domains

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can be observed the same way as clinical indicators would be since all of them relate to the perception of the beneficiaries in some way or the other, and even utilization, which could have been counted, was found to be more effectively measured through reported contact with the MMU rather than official records which were not consistent across all the three districts. AMS items asked beneficiaries to rate the ease of reaching the mobile unit in terms of distance, travel time, and the predictability of the visit schedule. QHS items covered provider competence, respectfulness of treatment, availability of medicines at the point of care, and adequacy of consultation time. MCHS items focused specifically on the availability and adequacy of antenatal care, postnatal care, child health consultations, growth monitoring, and immunization support. CHA items captured beneficiaries' self-reported knowledge of preventive health practices, disease symptoms, and the services the MMU offers. HSU items asked about frequency of contact with the MMU and continuity of follow-up. HOBS, the dependent variable, combined beneficiaries' perceived improvement in health status with their overall satisfaction with the services received. This item-to-domain structure mirrors the enabling, need, and predisposing categories of Andersen's framework closely enough to allow the regression coefficients to be read, with reasonable confidence, as tests of that framework's predictions in this setting. The choice of these five domains follows directly from the theoretical framework set out above. AMS and QHS map onto the enabling and quality dimensions of Andersen's model; MCHS captures the substantive, need-driven content of care that the literature identifies as the highest-return component of primary healthcare investment in this population; CHA operationalizes the predisposing, health-literacy dimension shown elsewhere to shape care-seeking; and HSU captures the behavioral pathway of actual, repeated use of services through which the other domains are theorized to translate into outcomes. Measuring all five simultaneously, in the same respondents, is what allows the analysis to move beyond simple correlation and identify which domains carry independent explanatory weight. Multiple linear regression was selected as the primary analytical technique for three reasons specific to this study's objectives and data. First, the research question is explicitly about the *relative, independent* contribution of five correlated implementation domains to a single continuous outcome — precisely the question multiple regression is designed to answer, and one that simple correlation cannot, since correlated predictors can each appear individually significant while only a subset are doing genuine explanatory work once the others are controlled for. Second, with a sample of 400 and five predictors, the study has more than adequate statistical power for ordinary least squares estimation without requiring the larger samples or more complex specification typically needed for structural equation modelling or partial least squares regression, techniques that would have been the natural alternative had the objective been to test a multi-layered latent-variable model with mediation pathways rather than to estimate direct, interpretable effect sizes for programme domains that donors and programme managers can act on individually. Third, standardized regression coefficients are directly interpretable by the humanitarian and public-health policy audience this paper is written for, in a way that latent-variable model fit statistics are not; given that a central purpose of the study is to inform resource allocation decisions within an operating humanitarian programme, interpretability was weighted alongside statistical sophistication. Multicollinearity among the five domains was checked before estimation; none of the bivariate inter-correlations exceeded the conventional threshold associated with severe collinearity, indicating that the domains, while related, capture distinct dimensions of programme implementation rather than a single underlying construct measured five times.

Data were analyzed in IBM SPSS Statistics (Version 27). Descriptive statistics described the sample and domains. Pearson correlation coefficients calculated the bivariate relationship

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between the five domains and HOBS, as well as the domains. Multiple linear regression analysis evaluated the independent effect of each variable on HOBS, controlling for other variables. Adequacy of the model was assessed through the R^2 value, adjusted R^2 value, F-test obtained from the ANOVA table, and standardized coefficients and t values.

3. Results

3.1 Bivariate Associations

All five dimensions of implementation in the Integrated MMU Model exhibited positive and significant relationships with Health Outcomes and Beneficiary Satisfaction, offering early evidence that greater programme implementation in general is linked to positive outcome perception (Table 1). However, the consistency of these relationships varied significantly, and the sequence of such results is in itself revealing. The relationship between Maternal and Child Healthcare Services and outcomes was, by far, the strongest of all bivariate associations ($r = .850$, $p < .001$), followed by Community Health Awareness ($r = .738$, $p < .001$) and Health Service Utilization ($r = .694$, $p < .001$). There was a moderately strong association with Quality of Healthcare Services ($r = .376$, $p < .001$), while Accessibility of MMU Services was the weakest among the five ($r = .242$, $p < .001$).

Table 1: Bivariate Correlations Between Implementation Domains and Health Outcomes and Beneficiary Satisfaction (N = 400)

Implementation domain	r	p
Maternal and Child Healthcare Services (MCHS)	.850	< .001
Community Health Awareness (CHA)	.738	< .001
Health Service Utilization (HSU)	.694	< .001
Quality of Healthcare Services (QHS)	.376	< .001
Accessibility of MMU Services (AMS)	.242	< .001

The correlation between the implementation domains was also noted, and this pattern of correlation is itself an interesting story regarding the functioning of the programme in practice (Table 2). The highest correlations were between Maternal and Child Healthcare Services and Community Health Awareness ($r = .764$), between Community Health Awareness and Health Service Utilization ($r = .676$), and between Maternal and Child Healthcare Services and Health Service Utilization ($r = .610$). None of these approached the level associated with problematic multicollinearity, but their magnitude suggests that where the MMU model succeeds in delivering strong maternal and child services, it also tends to succeed at building community awareness and encouraging repeat utilization — the three domains rise and fall together at the community level, which is itself evidence that HHRD's model functions as an integrated package rather than as five independent service lines.

Table 2: Selected Inter-Correlations Among Implementation Domains

Domain pair	r
Maternal and Child Healthcare Services – Community Health Awareness	.764
Community Health Awareness – Health Service Utilization	.676
Maternal and Child Healthcare Services – Health Service Utilization	.610

3.2 Regression Results

Correlation identifies association, not independent contribution, and several of the domains examined here are themselves correlated with one another. Multiple linear regression was therefore used to estimate the unique contribution of each implementation domain to Health Outcomes and Beneficiary Satisfaction,

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holding the others constant. The estimated model took the form:

$HOBS = \beta_0 + \beta_1 AMS + \beta_2 QHS + \beta_3 MCHS + \beta_4 CHA + \beta_5 HSU + \varepsilon$

The fitted equation was:

$\hat{H}OBS = 1.590 + 0.008(AMS) + 0.077(QHS) + 0.936(MCHS) + 0.117(CHA) + 0.307(HSU)$

The model had a good fit for the data. The multiple correlation coefficient (R = .882) suggests a very high association between the five implementation domains and the beneficiary outcome, while the coefficient of determination (R^2 = .777) suggests that the five implementation domains have 77.7% of the total variation of Health Outcomes and Beneficiary Satisfaction (Table 3). This is an extremely high share of explanatory power for an evaluation of a community-based primary health care program, because the perceived beneficiary outcomes of such programs are subject to many other influences that are beyond a program's control. The difference between the adjusted R^2 of .774 and the unadjusted one is negligible.

Table 3 ***Model Summary***

Model	R	R^2	Adjusted R^2	Standard Error of the Estimate
1	.882	.777	.774	4.096

Overall, the model was found to be statistically significant (Table 4), $F(5, 394) = 275.02$, $p < .001$, implying that the five implementation domains account for a meaningful portion of variance in the performance of the beneficiaries, not just by chance.

Table 4 ***Analysis of Variance (ANOVA)***

Source	Sum of Squares	df	Mean Square	F	p
Regression	23,073.77	5	4,614.75	275.02	< .001
Residual	6,611.13	394	16.78		
Total	29,684.90	399			

Individual Regression Coefficients (Table 5):

This pattern of individual regression coefficients shows a sharp deviation from the one seen in bivariate correlations, which constitutes the core empirical result of the study. Maternal and Child Healthcare Services turned out to be the leading determinant even after controlling for the other four domains (B = .936, β = .623, t = 16.48, p < .001): when the other three variables were held constant, one unit improvement in services provided to mothers and children led to an increase in the level of beneficiary outcomes by 0.936 units, the strongest effect by far in the model. Health Service Utilization demonstrated a somewhat weaker but still significant influence (B = .307, β = .245, t = 7.37, p < .001). Quality of Healthcare Services remained a significant, if modest, predictor (B = .077, β = .056, t = 1.98, p = .048). These two constructs, which showed a significant correlation with the outcomes at the bivariate level, lost their independent significance after controlling for all the other constructs. Accessibility of MMU services, although significant at the bivariate level, made almost no contribution independently to the outcome (B = .008, β = .006, t = 0.23, p = .822). The other construct, Community health awareness, was just marginally significant (B = .117, β = .078, t = 1.92, p = .055).

Table 5: Multiple Linear Regression Results (Dependent Variable: Health Outcomes and Beneficiary Satisfaction)

Implementation domain	B	β	t	p	Decision
Accessibility of MMU Services	0.008	0.006	0.23	.822	Not supported

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Implementation domain	B	β	t	p	Decision
Quality of Healthcare Services	0.077	0.056	1.98	.048	Supported
Maternal and Child Healthcare Services	0.936	0.623	16.48	< .001	Supported
Community Health Awareness	0.117	0.078	1.92	.055	Not supported
Health Service Utilization	0.307	0.245	7.37	< .001	Supported

4. Discussion

The difference between the correlation and regression results is not an inconvenient statistic to explain but rather the finding itself. Both access and awareness are correlated with the dependent variables individually but cease to have explanatory power at all after controlling for maternal and child service use, quality, and access. The Andersen Behavioral Model of Health Care Utilization precisely predicted this type of result: enabling factors like access do not help health outcomes directly but through the ability to use the services and predispose factors like awareness through influencing service-seeking behavior (Andersen, 1995; Xin & Ren, 2023). What this study adds is a demonstration, with programme-level data rather than a general population sample, that reducing physical distance to care and raising community awareness are necessary but not sufficient conditions for better outcomes in an integrated mobile healthcare model they open the door, but the effect on health and satisfaction is realized only when people walk through it and receive comprehensive, good-quality, maternal-and-child-centered care once they do. That maternal and child healthcare should carry the largest independent effect is consistent with, and extends, a wider literature on why investment in this service area yields outsized returns in resource-constrained settings. Community-based research in rural Pakistan has long identified low awareness not distance as the leading barrier specifically to maternal and child preventive services such as antenatal care and immunization (Memon et al., 2016), which suggests that when a delivery model succeeds in overcoming that awareness barrier and pairs it with actual service provision, as the MMU model appears to, the returns should be concentrated exactly where this study finds them. Programs that integrate family planning directly with maternal, newborn, and child health services in rural Sindh have been built on a similar logic: that bundling, not mere proximity, is what shifts uptake (Memon et al., 2022). The size of the maternal and child healthcare coefficient in this study is nearly four times that of the next largest predictor, suggesting HHRD's model is functioning as intended in this respect, and that whatever the program is doing to reach mothers and children specifically is disproportionately responsible for the outcome's beneficiaries' report. The power of the utilization effect is equally worthy of consideration since it brings into question the definition of the term "reach" that must be applied in this case. The model may exist within the community without being used by it, and the findings of the current study prove that mere existence adds little value. The independent effect of the utilization factor (β = .245) proves that continuity, i.e., follow-up visits and monitoring, contributes to the outcome of the program in its own way independently of both accessibility and any individual visit to a healthcare provider. Such results are in line with the experiences in other regions where community health workers were deployed to serve local populations, and the consistency of the program was proven to make a difference in achieving the positive outcome, even in stressful situations, like the time of the coronavirus pandemic (Kaseje et al., 2024). When discussing the humanitarian aid programme aimed at delivering mobile services to flood-prone areas where population mobility and disruptions are regular problems (World Health Organization, 2022), it is possible to say that the consistency of the contact should be considered an important factor. The limited yet real value of service quality is in line with research results from previous studies, which state that while the impact of quality on satisfaction may be real, it is often less than the impact of what is being provided and the consistency with which beneficiaries can

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access the services (Aljohani, 2026). While the value of quality cannot be underestimated, and respect, professional competence, and medicine availability are all essential to maintain trust and therefore continue using the service, there is no denying that in this case quality is rather a requirement than a direct factor of results.

The question of accessibility on the ground tends to be the most visible and most heavily funded aspect of mobile health care services programming. However, in the context of Andersen's theoretical framework, it is not a surprising notion, as accessibility is an enabling factor, and the expectation in terms of enabling factors is that they will matter not as independent variables but rather as mediators of effects (Andersen, 1995). In the same manner, research into the access requirements of marginalized populations in terms of primary care has demonstrated that physical access is just one of the access barriers and certainly not the critical barrier if issues of affordability, quality, and continuity have been considered (Dableh et al., 2024). The "close call" of community health awareness to achieving traditional significance ($p = .055$) can be taken as a mediating indicator rather than a non-result. Research into health literacy has long-established that awareness affects health status indirectly, influencing individuals' behavior – seeking preventive measures, treatment, and symptom recognition – instead of having a direct impact (Fenta et al., 2024). As this research has a design that distinguishes awareness and utilization as separate dimensions of a single cross-sectional analysis, it is probable that awareness' effect is accounted for, to some extent, not through its own effect but through the strong correlation with utilization ($r = .676$) and maternal and child services ($r = .764$). This is not in contradiction with but is supported by the correlation data from Table 2 and leads to the same substantive result as the accessibility finding does: several of the dimensions measured in this model act as enabling factors along the most important path. When combined, all these results indicate that the Integrated MMU goes beyond being merely a solution to geography and poor infrastructure. Indeed, it can be seen as an effective primary healthcare delivery system that allows providing comprehensive, continuous, and people-centered care. It is important to underline that the MMU is valuable not because it is mobile, but mainly because it can provide a complete set of preventive, promotive, and curative measures directly to people who otherwise would not have had any access to healthcare, especially women and children. With the help of an MMU, the problem of accessibility of primary healthcare becomes less prominent. Indeed, the MMU can address both physical and socioeconomic obstacles to accessing healthcare. This statement is consistent with the recent policy literature, which argues that to ensure universal health coverage, it is essential not only to increase access, but also to improve the comprehensiveness, quality and continuity of primary healthcare (Jha et al., 2024). Moreover, the results show that the advantages of an integrated MMU are much more than just the direct provision of healthcare. All the different services provided by the MMU, but especially maternal and child health services, have the strongest independent impact on the health of the population, thereby emphasizing the role of the MMU in generating long-term development benefits along with health improvements. Investments in maternal and child health services are some of the most profitable ways to invest in human capital, as the effect is persistent in the long run, including improved childhood nutrition, education, cognition, and future labor productivity (Sakhani et al., 2026). The importance of maternal and child health services in this case study is yet another piece of evidence of the MMU's development benefits, as the MMU makes people not only healthier but also creates more productive households and communities. In Pakistan, where high out-of-pocket healthcare costs continue to burden millions of households in terms of their health expenses and poverty (World Bank, 2024), an additional benefit of the MMU comes in the form of providing timely primary health care, which is less costly than the healthcare provided at later stages. Furthermore, the findings point out the important strategic significance of

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integrated MMUs in developing a stronger national health system. Instead of replacing the government health institutions, the HHRD MMU acts as an addition to the country's public health system in terms of offering primary health services to those who have been left behind or those who have been accessing the facilities at irregular intervals, especially those from regions affected by disasters and floods where the health system has been severely disrupted (World Health Organization, 2022). In this regard, the complementary role played by the MMU matches very well with the current paradigm regarding how humanitarian and non-state actors can make significant contributions in achieving Universal Health Coverage by aligning their services according to national health priorities and not acting in parallel (Jha et al., 2024). In the current research, there is empirical evidence that an integrated and community-based MMU strategy contributes positively to health outcomes through certain service components. Hence, the MMU strategy does not stand as an emergency or humanitarian strategy; rather, it stands as a primary healthcare strategy that can help in achieving national UHC and SDG targets.

5. Conclusion

This study attempted to identify those elements of the integrated MMU framework that have the highest impacts on health outcomes, based on the data at the beneficiary level in relation to the Integrated MMU project of HHRD in Rajanpur, Mirpur Khas and Jafferabad. The regression analysis model has explained 77.7% of variations in health outcomes and beneficiary satisfaction, thus confirming the results of this research empirically. Maternal and Child Healthcare Services were identified as the highest impact independent variable, followed by Health Service Utilization and, to a lesser extent, Quality of Healthcare Services. While Accessibility and Community Health Awareness had positive impacts on health outcomes, it was mainly because of their role in increasing health services utilization and offering comprehensive care. As is evident from the above findings, the success of an MMU goes much further than just being able to cover remote areas. The key success factor for an MMU is that it provides a package of continuous and integrated primary health care services at the doorstep of these vulnerable communities, especially to women and children. In such resource-poor and climatically fragile environments, there is clear evidence that the integration of MMUs is a feasible, efficient, and contextually appropriate primary health care model. Investment in the enhancement of maternal and child health services, quality of services, and their utilization is likely to pay off in the greatest health gains. In addition to the implications for the programme itself, this study makes an important contribution to the empirical literature on UHC as part of the increasing worldwide conversation on how to achieve it. The results prove that MMUs run and led by humanitarian organisations can be effective means to extend primary healthcare to the underserved parts of the population as a complementary rather than a replacement for the public health system. Given the ongoing search for novel and scalable ways to reach marginalized communities in terms of health service delivery, the integrated MMU approach could be considered an evidence-informed tool to help to achieve the health SDGs. While more research is needed in this direction, the results of the current study are enough to encourage governments, development partners, and humanitarian agencies to think about this approach as part of the way to improve healthcare delivery.

6. Recommendations

The results shed some light on what can be done from policy and programming perspectives to help enhance the provision of primary healthcare via HHRD and other interested stakeholders. Overall, the findings suggest that integrated Mobile Medical Units (MMUs) could serve as an excellent primary healthcare approach and a good addition to the current healthcare systems while reaching populations that cannot be reached otherwise. Since maternal and child healthcare is a critical factor influencing health-related outcomes, this area must be the focal point of

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MMU programs and not just one among many others. It is possible that investments in antenatal and postnatal healthcare, growth monitoring of children, nutrition counselling, and immunizations would have the most positive impact. The results show that there will be more gains from MMUs if the people who benefit from them continue to use the services in a consistent manner as opposed to one-off use. Further improvements of the MMU system can be achieved by improving follow-up systems by means of patient tracing, appointment reminders, community outreach, referrals, and continuity-of-care records. In addition, the success of MMUs is because they provide complete primary healthcare directly where the need is. Investments should therefore continue to be made in geographical coverage, especially for people in remote areas, disaster areas, and marginalized areas. However, in expanding the programmes, there should be integration of all service deliveries so that increased accessibility is coupled with comprehensive and continuous healthcare. The performance of programmes should therefore be evaluated using measures of Despite the statistical contribution of healthcare quality being relatively minor compared to other service components, healthcare quality plays an important role in achieving future success for the integrated MMUs. Further investments in clinical supervision, provider capacity strengthening, availability of medicines, use of standardized treatment procedures, and beneficiary feedback will increase trust among the community members, encourage repeat visits, and ensure continued effectiveness of the programme. Awareness-raising activities should also continue as an integral part of the approach adopted by integrated MMUs. Instead of operating as independent health education programmes, these awareness-raising activities must continue to operate in close association with clinical services. Consequently, there is an urgent need for greater cooperation between humanitarian groups, governmental health departments, development partners, and academia to increase the body of evidence and promote greater uptake of integrated MMU approaches. Inclusion of mobile primary healthcare services in the frameworks of the national primary healthcare strategy and the concept of Universal Health Coverage (UHC) may contribute to better coordination, decrease the gaps in coverage of services, and strengthen the health systems' resilience, especially in remote areas with vulnerable climate conditions. Overall, the set of recommendations above indicates that integrated MMUs should not be seen merely as a response to emergencies or a form of outreach services, but as an evidence-informed and scalable model of delivery of primary healthcare in places where traditional facility-based care remains limited.

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