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EQUITY IN HEALTH AND HUMANITARIAN LOGISTICS: A BENEFICIARY PERSPECTIVE

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Equity in Health and Humanitarian Logistics: A Beneficiary Perspective

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In recent years, academics and health and humanitarian organizations are calling for 'people-centered' approaches, making beneficiaries' preferences central to decisions making. While substantial progress has been made in capturing beneficiaries' needs in resource allocation models, the approach to equity remains essentially 'top-down'. That is, while diversity in needs is captured, the diversity in equity perceptions is not acknowledged. In this article, we argue there is a need for a complementary 'bottom-up' view on equity, taking the perspective of the beneficiary. This will help academics and organizations to better account for the diversity in culture, experience, and social status present in most beneficiary populations. We present the 3P framework (People, Past, and Present) to help systematically think of drivers of beneficiaries' distributional preferences. Furthermore, we illustrate how these preferences can be integrated into utility-based modeling and why accounting for preferences is important.

Key words: Equity, Health and Humanitarian Logistics, People-Centric, Distributional Preferences

1 Introduction

Health and Humanitarian Logistics (HHL) are characterized by scarcity of resources and limited funding (Besiou and Van Wassenhove 2020, De Vries et al. 2021). Resource allocation is fundamental in these contexts to ensure people are served as well as possible. Besides the overall utility arising from allocated resources, multiple criteria—in particular equity—come into play. Essentially, equity can be categorized as horizontal and/or vertical. The former concerns equal treatment of all people whereas the latter considers varying treatment among people based on certain characteristics. In

HHL, horizontal equity typically concerns equal access (see, e.g., Yadav 2010 or Gralla et al. 2014 for discussions), while vertical equity ensures those most in need are prioritized (see, e.g., Breugem and Van Wassenhove 2022). Equity considerations can lead to difficult trade-offs which are aggravated by resource scarcity due to lack of funding. Karsu and Morton (2015) provide an extensive overview of approaches to equity in Operations Research.

While substantial progress has been made in the modeling of beneficiary needs, e.g., in patient-centric care (Bretthauer and Savin 2018) or deprivation cost (Holguín-Veras et al. 2013, Shao et al. 2020), the approach to equity remains essentially 'top-down', not acknowledging the diversity of preferences in the beneficiary population. Even approaches such as vertical equity, that do account for varying needs, do not account for beneficiaries' equity preferences.

In this article, we argue there is a need for a complementary 'bottom-up' view on equity, taking the perspective of the beneficiary. This will help NGOs (Non-Governmental Organizations) and academics to better account for the diversity in culture, experience, and social status present in most beneficiary populations. We show that ignoring this diversity can lead to suboptimal decisions and, consequently, substantial utility loss. We focus our discussion on HHL, where equity concerns are particularly salient, but believe our findings hold true in a variety of settings, impacting the diversity discussions in the Operations Management (OM) community more generally.

Recent examples show the increased importance of a beneficiary perspective on equity. The COVID-19 pandemic and Ukraine refugee crisis clearly show the impact of cultural and social backgrounds on perceptions of equity and the willingness to help others. For example, the welcoming culture displayed by some European countries towards Ukrainian refugees stands in stark contrast to their barbed-wire fences and border hunters to keep African and Afghan refugees out (The Washington Post 2022, The Conversation 2022). During the COVID-19 pandemic, European solidarity promised equitable internal access to vaccines (see, e.g., European Commission 2020) while there remained substantial inequity worldwide. Similar examples could be observed in other parts of the world.

In general, three observations can be made. Firstly, equity issues are everywhere. Secondly, people are negatively impacted by inequity and are willing to act upon this (e.g., by sheltering refugees or re-allocating vaccines). Thirdly, this willingness depends on their own situation/characteristics and that of the other person. These observations are known in literature as distributional preferences, and have been extensively studied (see, e.g., Cooper and Kagel 2016 for an overview). This stream

of research shows how a person's distributional preferences dictate how his/her utility is influenced by whether s/he receives more or less than others. Therefore, it makes sense to see equity as a combination of individual distributional preferences rather than a centrally decided concept. Only by accounting for the diversity in distributional preferences can one determine a utility maximizing allocation, i.e., one that accounts for the direct utility from receiving resources and the indirect (dis)utility from comparing with others.

While research on equity considerations in HHL has been substantial, very little attention has been given to distributional preferences. To substantiate this claim, we reviewed all papers with keywords 'allocation' and 'fairness/equity' and 'disaster/humanitarian/health care' on Web of Science. We limited ourselves to papers published in the 25 major OM journals suggested in Gupta et al. (2016) and dropped the papers with little relevance to equity. This filtering led to a total of 56 papers. Except for Rodríguez-Pereira et al. (2021), who consider cost allocation among Caribbean countries and incorporate inter-country solidarity, we found no other paper explicitly discussing beneficiaries' distributional preferences.

In recent years, organizations and academics are calling for 'people-centered' approaches, making the beneficiaries' demands and preferences central to decisions making (World Health Organization 2016, Besiou and Van Wassenhove 2020). In line with this call, we present a beneficiary perspective on equity. Section 2 presents the 3P framework (People, Past, and Present) to help systematically think of drivers of beneficiaries' distributional preferences. Section 3 illustrates how distributional preferences can be integrated into utility-based modeling and why accounting for preferences is important. Section 4 concludes with a summary of our main findings, a brief discussion on data collection and the calibration of parameters, and promising avenues for further research.

2 What Drives Distributional Preferences?

Accounting for distributional preferences allows for better modelling of each individual's utility. However, it raises a natural question: what drives distributional preferences? To answer this question, we suggest gathering beneficiary information along three dimensions: *People, Past,* and *Present*, i.e., the 3Ps.

The first dimension, *People*, relates to the cultural and social backgrounds of beneficiaries. Evidence suggests that people are quick to categorize themselves and others—based on religion, ethnicity,

social status—and form groups with people they can easily identify with (Chen and Li 2009). Research shows individuals who interact with members of their group are more willing to cooperate, show more solidarity, and experience less envy than when they interact with non-members (Chen and Li 2009, Bader and Keuschnigg 2020, Li 2020). These effects partially explain why European countries act more 'kindly' towards Ukrainian (in-group) than African and Afghan (out-group) refugees or why European solidarity remained primarily focused on Europe during COVID-19.

The second dimension concerns the *Past*, i.e., experiences of beneficiaries. In HHL, some areas are frequently hit by disasters such as floods, hurricanes, earthquakes, or disease outbreaks. Hence, people living in these areas typically experienced one or more disasters. There are numerous papers showing past experience shapes the feelings and actions of individuals (see, e.g., Batson et al. 1996, Eklund et al. 2009, Hodges et al. 2010). Barnett et al. (1986) show in a survey experiment that individuals who experienced rape are more empathic towards rape victims. Li et al. (2013) highlight that the time passed since a traumatizing event plays a critical role. Specifically, they find that 9 year old children are significantly more altruistic one month after an earthquake than one month before; however, after three years their altruism is almost back to the pre-earthquake level. Bansak et al. (2016) show that not only the past of the person or institution who's altruism is evaluated matters but also the past of the person that may be subject to the altruism. Specifically, they find countries are more willing to give asylum to refugees that are particularly vulnerable, e.g., ones that experienced torture or lost family members. This shows past experience impacts both one's own preferences and the willingness of others to help.

The final dimension, the *Present*, considers the current situation and mindset of beneficiaries. The *Present*, opposed to the *Past*, represents the here-and-now, meaning it is dynamic. Chang (2010) provides a good example of this dynamic nature. The author shows that the immediate exposure to a flood increased the affected community's cohesion and altruism in a non-uniform way. Cohesion increased in initial stages, but, as flood severity increased, people focused on their individual interests, leading to decreased cohesion. An even more striking example for the dynamic nature of the present is provided by Cappelen et al. (2021). They conducted a survey experiment showing that informing participants of COVID-19—an event strongly connected to solidarity—affects moral views, and increases fairness, altruism, and solidarity.

The 3Ps are grounded in the extant literature and provide a starting point for discussing distributional preferences. This simple framework is based on the concepts we found most critical to HHL

in our review of sociological, economic, and psychological literature. It is by no means exhaustive. Instead, it serves to support the initial assessment of distributional preferences and provide a basis for discussion for academics, organizations, and policy-makers.

3 How and Why Incorporate Distributional Preferences?

Next, we show how the concepts introduced in Section 2 can be operationalized. For clarity, we focus on group effects (*People*) only. Section 3.1 shows how to integrate group effects into utility-based modeling and Section 3.2 illustrates why accounting for group effects is important by showing these effects lead to structurally different allocations and substantial utility loss if not appropriately accounted for.

3.1 The How

We consider a stylized resource allocation problem incorporating group affiliation effects. We do this following the model introduced in Fehr and Schmidt (1999), where players experience disutility when benefiting less (envy) or more (guilt) than others. Specifically, we assume players experience envy in out-of-group comparisons but not in within-group comparisons. For simplicity, we assume there is no guilt.

We model group effects via the parameter λ. For the sake of exposition, consider first resource allocation between two players i and j. Let x_i denote the amount allocated to player i. Each player derives a benefit u_i per unit of resource. Let α_{ij} denote the envy parameter for player i when comparing with j. We note there is substantial literature on how to estimate α_{ij} values by means of experiments (see,e.g., Fehr and Schmidt 1999, Blanco et al. 2011, Yang et al. 2016). In our illustrative model, we simply set $\alpha_{ij} = \lambda$ if i and j are not in the same group and $\alpha_{ij} = 0$ otherwise. This modeling of group effects is similar to Chen and Li (2009). Hence, the utility for player i for a given allocation is given by:

$$\underbrace{U_i(x_i, x_j)}_{\text{utility}} = \underbrace{u_i x_i}_{\text{benefit}} - \underbrace{\overbrace{\lambda \mathbb{I}(i,j)}^{\alpha_{ij}} [u_j x_j - u_i x_i]^+}_{\text{envy}}, \tag{1}$$

with $\mathbb{I}(i,j)$ indicating whether i and j are in different groups and $[a]^+ := \max\{a, 0\}$. That is, the utility of player i depends on player j and is the sum of the direct benefit from the allocation and the

disutility from envy depending on group affiliation. Definition (1) naturally extends to n players. As suggested in Fehr and Schmidt (1999), envy is then averaged over the number of comparisons. The problem of allocating an amount of resources B over n players to maximize overall utility is now given by:

$$\max \quad \sum_{i=1}^{n} u_i x_i - \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{\lambda \mathbb{I}(i,j)}{n-1} \left[u_j x_j - u_i x_i\right]^+ \tag{2}$$

subject to $\sum_{i=1}^{n} x_i \leq B$ and $x_i \geq 0$ for $i = 1, \ldots, n$. The objective function (2) depends on the heterogeneity of preferences via parameters α_{ij}. This makes the functional form fundamentally different from the typical objective functions for resource allocation considered in the literature, where equity considerations do not distinguish between beneficiaries and hence are not able to take the variety in parameters α_{ij} into account.

3.2 The Why

To motivate the beneficiary perspective, we apply the model of Section 3.1 to resource allocation among eight areas partitioned into three groups, as shown in Figure 1. The areas are classified as high, medium, or low priority, indicated in black, gray, and white, respectively. Resources allocated to higher priority areas have a higher coefficient u_i. For example, such areas are more deprived or lack in local capacity, giving a higher benefit per unit of resource.

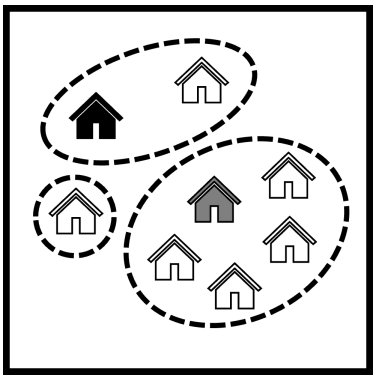

Figure 1: Stylized resource allocation problem among eight areas partitioned in three groups. The areas are classified as high, medium, or low priority, indicated in black, gray, and white respectively.

Table 1 shows the allocation, benefit, envy, and relative loss for each approach for varying λ and benefit coefficients $u_i = 4$ for high, $u_i = 3$ for medium, and $u_i = 1$ for low impact areas. We consider λ values 0, 0.25, 0.5, 0.75, and 1, this range is similar to the ranges for envy parameters

found in Fehr and Schmidt (1999), Blanco et al. (2011), and Yang et al. (2016).

		Envy parameter λ				
		0	0.25	0.5	0.75	1
Ignoring envy	Allocation	H	H	H	H	H
	Benefit	4.0	4.0	4.0	4.0	4.0
	Envy	0.0	0.9	1.7	2.6	3.4
	Loss (%)	0.0	0.0	11.1	33.3	66.6
Ignoring heterogeneity	Allocation	H	H	H	HM	HML
	Benefit	4.0	4.0	4.0	3.4	1.2
	Envy	0.0	0.9	1.7	1.3	0.0
	Loss (%)	0.0	0.0	11.1	0.0	29.1
Optimal	Allocation	H	H	HM	HM	M
	Benefit	4.0	4.0	3.4	3.4	3.0
	Envy	0.0	0.9	0.9	1.3	1.3

Table 1: The allocation, total benefit, total envy, and relative loss for each approach for varying λ and benefit coefficients $u_i = 4$ for high, $u_i = 3$ for medium, and $u_i = 1$ for low impact areas. The indicated allocations are: allocate resources only to the high priority area (H), allocate resources only to the high and medium priority area (HM), allocate resources to all areas (HML), and allocate resources only to the medium priority area (M).

Naturally, the approach ignoring envy allocates all resources to the high priority area (denoted allocation H), independent of the envy parameter. Not surprisingly, this myopic focus on benefit results in growing envy and, in turn, growing utility loss in λ.

The approach ignoring heterogeneity does a better job accounting for envy. We observe three possible allocations that become more inclusive the higher the envy parameter λ: if envy is small ($\lambda \leq 0.5$), all resources are allocated to the high priority area (H); if envy is intermediate ($\lambda = 0.75$), resources are allocated to the high and medium priority area (HM); if envy is large ($\lambda = 1$), resources are allocated to all areas (HML). As such, the approach makes a trade-off between benefit and envy. For example, the last allocation (HML) sacrifices substantial benefit (1.2 instead of the possible 4) to eliminate envy.

Contrary to the other two approaches, the optimal approach recognizes that the medium impact area belongs to a large group, implying there is relatively little envy when allocating resources to this area (due to in-group solidarity). When $\lambda = 0.5$ or $\lambda = 0.75$, this means allocation HM leads

to higher utility than H because there is a limited reduction in benefit moving from H to HM but a substantial decrease of envy. For $\lambda = 0.5$, the other two approaches lose 11.1% of potential utility by not accounting for this correctly. For $\lambda = 0.75$, the increase in envy moves the second approach to HM as well, coinciding with the optimal allocation, even though the second approach does not consider the large in-group solidarity. For $\lambda = 1$, the disutility from envy towards out-group areas has substantial negative impact. Thus, the optimal approach allocates the goods exclusively to the largest group, that is, to M, which reduces disutility from out-group envy. This result is particularly striking because allocation M would not be found in any approach that ignores heterogeneity (since in these approaches allocation H would be wrongfully assumed to lead to equal envy and higher benefit). The other two approaches lead to a substantial loss of 66.6% and 29.1%, respectively.

In summary, our numerical example shows that distributional preferences add a layer of complexity necessitating structurally different allocations to maximize utility. Furthermore, the optimal allocation depends on problem-specific parameters such as group size. The results show that the loss from not correctly accounting for distributional preferences can be substantial.

4 Implications and Next Steps

While centralized approaches treating all beneficiaries equally seemed acceptable until one or two decades ago, they are now often perceived as paternalistic and should therefore be reconsidered. Modern communication systems, like social media, allow beneficiaries to compare their situation with others. At the same time, modern data collection and analysis systems allow for individualized solutions. Consequently, with equity being an important criterion in resource allocation, there is the need and the potential for a beneficiary perspective on equity by taking beneficiaries' distributional preferences into account.

Our paper provides a high-level discussion on how taking a beneficiary perspective impacts resource allocation, thereby delivering on three broad objectives. First, we show a beneficiary perspective is salient in HHL, suggesting decision makers (e.g., NGOs) and OM researchers should take beneficiaries' equity preferences into account in allocation decisions. Second, we propose the 3P framework to help identify drivers of distributional preferences. Essentially, the framework introduces three dimensions that should be evaluated within a given beneficiary population: (i) the *People* and their cultural and social background, (ii) their *Past* experience, (iii) and their *Present* situation.

Third, we show how to integrate these dimensions into utility-based modeling and illustrate that not integrating these dimensions can lead to substantial utility loss.

Although the calibration of parameters in a utility approach is difficult, we argue these obstacles can be overcome. First, the psychological, sociological, and economic literature provides ballpark figures that can provide first estimates (cf. the discussion in Section 3). Second, building on the experiments and methods used in this literature, researchers from academia or NGOs can run field and lab experiments to estimate parameters that are more specific to HHL. Finally, NGOs can draw upon their experienced practitioners who can evaluate the situation and make educated guesses. All these efforts can help develop a knowledge base on distributional preferences across contexts such that even in resource- and time-constrained situations appropriate allocation decisions can be made.

In terms of future research, we see three promising avenues. First, there is a clear potential for empirical research to understand distributional preferences in the HHL context. This includes field research but potentially also lab experiments, leveraging best practices from extant literature. Second, there is the need for new methodology to deal with the different type of objectives resulting from distributional preferences. This methodology can be tailored to specific types of preferences, such as the group effects of Section 3. Finally, we showed in Section 3 that a beneficiary-centric approach does not necessarily lead to equal access or prioritization of those most in need. This might not align with the preferences of centralized decision makers, hence work remains to be done on how to integrate centralized and beneficiary perspectives, and on the potential trade-offs that arise.

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