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National healthcare programs and policies in India: an ontological analysis

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ABSTRACT

Background: The healthcare system in India is facing multitude of challenges owing to the changing epidemiology of health as well as diseases. Despite having the distinction of being one of the largest public healthcare delivery systems in the world, our health indicators reflect a grim picture in comparison to global targets. India has large number of national healthcare programs and sub-programs, policies, and legislations. Though they are meant to be inclusive and comprehensive the results are far from the desired vision.
Methods: Using a logically constructed ontology based on the common body of knowledge as a lens, we map all the programs and policies to reveal the 'bright', 'light', and 'blind/blank' spots in them. The ontological maps are constructed at different levels of granularity–monads and dyads. They provide a synoptic, systematic, and systemic assessment of the policies while highlighting their emphases and biases.
Results: In terms of the Focus, the dominant focus of the programs and policies is on information (30) and education (39), drugs (26), administration (31), finance (24), and treatment (28). These are the 'bright' spots. Their secondary focus is on technology (18), personnel-staff (12), personnel-physician-specialist (7), and personnel-nurses (8). These are the 'light' spots. The tertiary focus is on insurance (4). These are the 'blind/blank' spots.
Conclusions: The coverage of the National Programs/Policies on healthcare, viewed through the lens of the ontology is patchy. Yet, overall, almost all elements in the ontology find expression in at least one program/policy – an indicator of their extensive coverage. There is absence of frequent co-occurrence of the outcomes, except quality and accessibility. This paper presents the first step in a program of research which can be used to analyse and direct healthcare policy globally, nationally, and locally.

Keywords: Assessment, National healthcare policy, Ontology

INTRODUCTION

Sir Joseph Bhore Committee (1948) report for primary health care elucidated a detailed implementation plan for delivery of comprehensive health care to the masses; we are yet to realize the same in letter and spirit. Being the state's responsibility, healthcare is one of the priority sectors for the government. Several national health programs are being conceived and implemented to tackle the healthcare problems in the country as per national guidelines and policies in order to synchronize them with international regulations and requirements.

If one traces the evolution of post-independence health care delivery in India, several distinct phases emerge. The initial phase consisted of continuum of the colonial systems with emphasis on tackling the major infectious diseases. This included malaria, small pox, diarrheal diseases and tuberculosis. Alongside, the rising population of the country was a matter of concern. Hence, India prided itself as a pioneer by introducing the family planning program for the nation. This led to a mixed response as the program gained sufficient disrepute for promoting forced terminal methods of family planning based on pre-determined targets.

Following the conference for primary health care at Alma Ata, the focus shifted more towards providing comprehensive health care at an affordable cost. Infrastructure for the delivery of care was established and the three tier system of care was conceived and implemented.

While infectious diseases, which were once controlled, showed resurgence with vengeance, non-communicable disease epidemics of coronary heart disease, diabetes mellitus and cancer added to the burden of morbidity and mortality.

Successive governments tried to tackle the issues of maternal and child health, nutritional deficiencies and other morbidities by introducing national health programs and budgeting the same through the five year plans of the country.

Implementation of the National Rural Health Mission was considered to be one of the most important phases in the health care delivery system of the country. It provided a framework for consolidating the gains thus far. Recent developments include the issuance of the draft national health policy 2015.

Ontology of healthcare programs and policies

An ontology of healthcare programs and policies is shown at the top of Table 1. Three illustrative components derived from the ontology are listed below it. The categories constituting the dimension are self-explanatory. In the following text we will discuss the construction of the ontology. A detailed description of ontological meta-analysis and synthesis is provided by Ramaprasad.[1-4]

Healthcare policies are complex and fragmented. An ontology is a way of structuring and deconstructing their combinatorial complexity. The dimensions (columns) of the ontology are derived directly from the construct. Healthcare entails different forms of Care of different Populations. Thus, Care and Population form the two right most dimensions (columns) of the ontology (Figure 1). A Policy/Program is defined by its Scope, Focus, and Outcomes. These three form the three dimensions on the left of the ontology. Thus the ontology has five

dimensions: Scope, Focus, Outcomes, Care, and Population.

Each dimension of the ontology is expressed by a taxonomy of its constituent elements (Table 1). The taxonomies are derived from the common terminology in body of knowledge on each dimension, especially in the healthcare policy domain. A few categories/subcategories (for example: Pregnancy, Palliative, Adolescents) were added during coding to accommodate the associated policy emphasis. Thus, the Scope of a policy may be geographically defined as Global, National, Local-Urban, Local-Rural, or restricted to the Provider without a geographical boundary. The Focus of the Policy may be Drugs, Education, Finance, Insurance, Information, Personnel, Regulation, Technology, Treatment, or Administration. The Personnel focus may be on the Physicians, Nurses, or Staff; and further the Physicians may be Generalists or Specialists. The Outcomes of the Policy may be Accessibility, Cost, Quality, Satisfaction, Safety, Parity, or Timeliness of healthcare. Further, the Care could be Preventive, for Well-ness, Pregnancy, Illness (Episodic or Chronic), or Palliative. Lastly, the Population cared for may be the Individual, Family, or Community. The Individuals may be Children (Pre-natal or Post-natal), Adolescents, Adults (Mothers, Workers), and Aged. The sub-categories and the sub-sub-categories in the Population taxonomy indicate the fine-grained attention to these groups in the policies and programs.

The five dimensions are arranged left to right with adjacent symbols, words, and phrases such that reading left to right concatenating a category from each dimension forms a natural English sentence. Each such sentence is a potential component of healthcare program/policy. Three illustrative components are shown in Table 1 – the sub-categories of a taxonomy are shown as subscripts. They are:

- National financial programs/policies on accessibility of preventive care for family – these may include programs/policies to provide financial incentives for families to travel to obtain preventive care.

- Local urban regulatory programs/policies on cost of palliative care for individual aged –these may include programs/policies to limit the cost of palliative care of senior citizens.
- Provider administration programs/policies on cost of illness episodic care of individual adolescents – these may include providers' programs/policies on cost of care of ill teens.

These three and 21,837 others encapsulated in the ontology are logically the potential components of healthcare programs/policies. The ontology presents the combinatorial complexity of healthcare policies concisely and thus helps us take a systemic view of the problems they address.

A component may or may not be instantiated in a program or policy. Further, only a fragment of a component may be instantiated in a program/policy. Thus, for example, in the first illustration above, a fragment would be simply 'National financial programs/policies on accessibility of preventive care' – not specially focused on the Family. The fragments may be dyads (consisting of elements from two dimensions), triads (from three dimensions), and tetrads (from four dimensions). The components are pentads including all the five dimensions. Thus, there is a very large number of potential fragments (of the 21, 840) components encapsulated in the ontology.

Table 1: Ontology of healthcare programs and policies.

Policy/Program				
Scope	**Focus**	**Outcomes**	**Care**	**Population**
Global [+] National Local Urban Rural Provider	Drugs Educational Financial Insurance Information Personnel Physician General Specialist Nurses Staff Regulatory Technology Treatment Administration	[policies/programs on] Accesibility Cost Quality Satisfaction Safety Parity Timeliness	[of/with] Preventive Wellness Pregnancy Illness Episodic Chronic Palliative	[care for/of] Individual Children Pre-natal Post-natal Adolescents Adults Mothers Workers Aged Family Community

Studying across programs and policies, some components/fragments may be instantiated frequently, some infrequently, and others not at all. We will label the frequently instantiated components/fragments the 'bright' spots; the infrequent ones the 'light' spots, and the overlooked ones the 'blind/blank' spots.

The luminosity of each spot is a product of two opposing dynamics. A 'bright' spot may be so because it is effective and important; it may also be a consequence of habit and herd effect, irrespective of whether it is effective or not. A 'light' spot may be so because it is ineffective and unimportant; it may also be a consequence of difficulty of implementing it, irrespective of its potential effectiveness or importance, or its recent emergence in importance. A 'blind/blank' spot may have been simply overlooked by design or by accident; or, it may be infeasible.

Knowing the 'bright', 'light', and 'blind/blank' spots in the policies and the antecedent reasons will help develop more systemic and systematic approaches to address the challenge of healthcare policies. In the following we present an ontological map of healthcare policies in India, highlight the 'bright', 'light', and 'blind/blank' spots, and discuss possible reasons for the same. Before presenting the results, we will first describe the method we used for mapping. In the conclusion we will present the potential implications of this program of research and the planned extensions to what is presented here.

METHODS

Kishore exhaustively enumerates the current national healthcare programs and sub-programs (N = 43), policies (N = 21), and legislations (N = 14) in India. These represent the population of programs, policies, and legislations.[5] One of the authors, a physician and a specialist in India's public healthcare, coded the programs and policies onto the ontology using an Excel tool developed by another author. The legislations were not coded. The coding was based on Kishore's[5] extensive summary and description of each program/policy as well as information from other electronic sources.[6-9]

A policy/program is coded on an element only if that element is explicitly part of it, not implied or inferred from it. For example, it may be argued that all National policies should be coded for Local-Urban and Local-Rural. But they are coded only for National unless the latter two are explicitly part of the policy. We sought to balance the errors of commission (over-coding) with the errors of omission (under-coding). The coder tried to balance over-reading the program/policy and thus over-coding, and under-reading the same and thus under-coding. The coder's knowledge of the domain, as a

trained practicing physician and a faculty member, helped manage the errors in coding.

We note that a program or policy may instantiate multiple components, a component, parts of multiple components, or part of a component of the ontology. Thus, there was no restriction on how many elements of the ontology could be encoded with reference to a policy, or a requirement that a policy should be encoded with reference to all the dimensions of the ontology. Thus a policy could be encoded to: (a) an element from each dimension, (b) multiple elements from each dimension, (c) an element from some dimensions, or (d) multiple elements from some dimensions. We also note that the coding was binary – whether the element (or its synonym) was present or not in the program or policy. The coding was not weighted; each program/policy and each element was assigned equal weight.

Of 64 policies coded, 30 were coded on all dimensions. A total of 2,271 components out of the possible 21,840 in the ontology are instantiated in the corpus. The 2,271

instantiated components occur 4,381 times in the corpus. The 201 partial components occurred 239 times in the corpus.

RESULTS

The ontological map of monads – individual categories in the ontology – is shown in Figure 1. The number in parentheses adjacent to the category indicates its frequency of occurrence in the 64 programs and policies. The bar below the category is a visual indicator of the same scaled to the maximum number of occurrences of any one category (National – 64). The 'bright' spots are other categories with the larger numbers and bars; the 'light' spots are the ones with the smaller numbers and bars, and the 'blind/blank' spots are the ones with close to zeroes and no virtually no bars. There are no objective frequency cut-offs between 'bright', 'light', and 'blind/blank' spots. Yet, the visualization in Figure 1 clearly highlights the areas of emphases and of limited or no emphasis. In the following we will discuss each dimension in sequence.
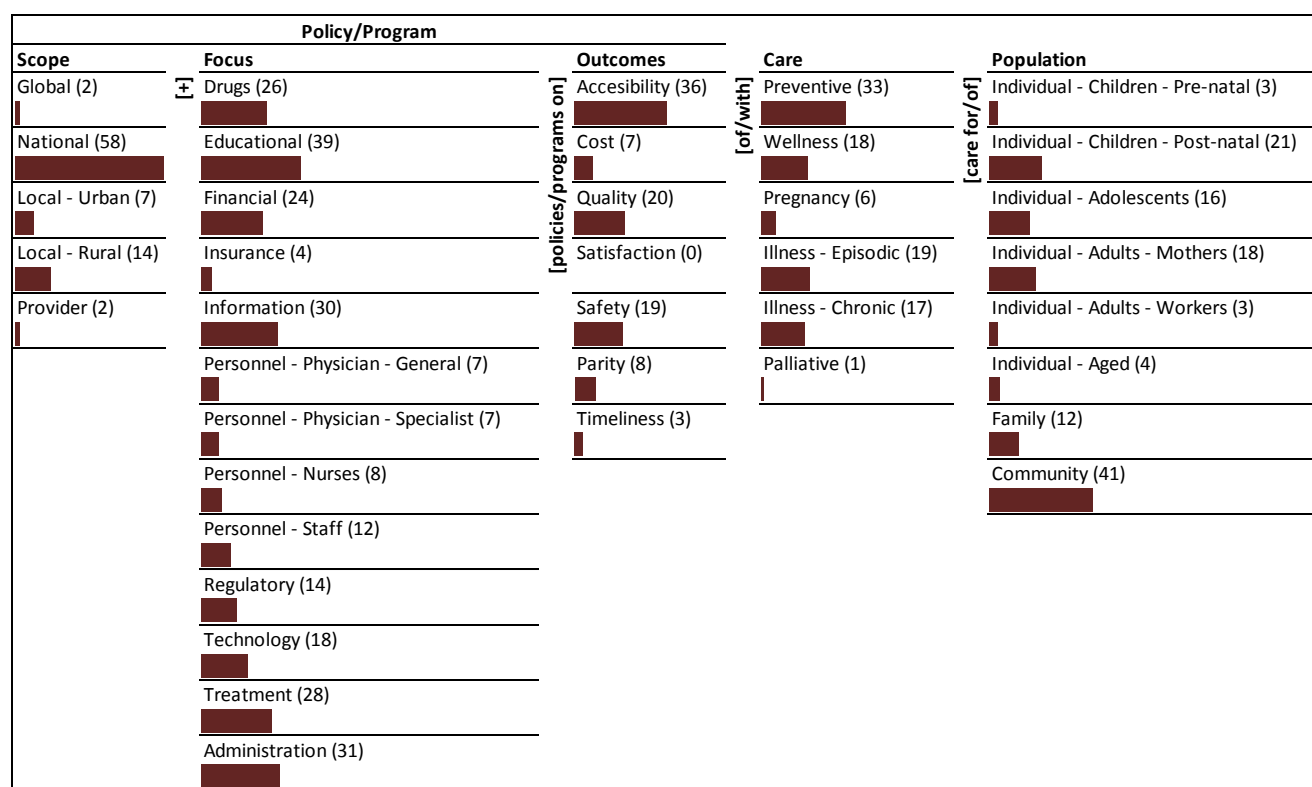
Figure 1: Ontological map of India's national healthcare programs and policies (Monads).

Due to our selection (of the programs and policies mapped), the Scope of all of them is National. A few of them explicitly emphasize the Providers (2), and very few of them are explicitly Global (1) or Local in scope. A similar mapping of WHO (World Health Organization)

programs/policies or of each state's programs/policies will likely reveal a very different profile. In terms of the Focus, the dominant focus of the Programs and Policies is on information (30) and education (39), drugs (26), administration (31), finance (24), and treatment (28).

These are the 'bright' spots. Their secondary focus is on technology (18), personnel-staff (12), personnel-physician-specialist (7), and personnel-nurses (8). These are the 'light' spots. The tertiary focus is on insurance (4). These are the 'blind/blank' spots.

In terms of the Outcome – the dominant element is Accessibility (36). It is the 'bright' spot. The 'light' spots are quality (20), cost (7), and safety (19) – relatively, they are very lightly emphasized. The 'blind/blank' spots are, timeliness (3), satisfaction (0), and parity (8). Thus, the dominant focus of the National programs/policies appears to be on Information/Education/Drugs Accessibility.

Further, the dominant focus of care is preventive (33), followed by illness-episodic (19), illness-chronic (17), and wellness (18). These are the 'bright' spots. Pregnancy (6) care appears to be the 'light' spot, and palliative (1) care appears to be a 'blind/blank' spot in the programs/policies.

Last the dominant focus of the Programs/Policies is on the community (41) followed by individual-children-post-natal (21), individual-adolescents (16), individual-adults-mothers (18), individual-aged (18), and individual-adults-workers (3). These are the 'bright' spots. The 'light' spots are individual-children-pre-natal (3) and family (12). There are no 'blind/blank' spots.

In summary, the coverage of the National Programs/Policies on healthcare, viewed through the lens of the ontology is patchy. Yet, overall, almost all elements in the ontology find expression in at least one program/policy – an indicator of their extensive coverage.

	Policy - Scope					Policy - Focus													Outcomes							Care						Population							
	Global	National	Local - Urban	Local - Rural	Provider	Drugs	Educational	Financial	Insurance	Information	Personnel - Physician - General	Personnel - Physician - Specialist	Personnel - Nurses	Personnel - Staff	Regulatory	Technology	Treatment	Administration	Accessibility	Cost	Quality	Satisfaction	Safety	Parity	Timeliness	Preventive	Wellness	Pregnancy	Illness - Episodic	Illness - Chronic	Palliative	Individual - Children - Pre-natal	Individual - Children - Post-natal	Individual - Adolescents	Individual - Adults - Mothers	Individual - Adults - Workers	Individual - Aged	Family	Community
Global																																							
National	1																																						
Local - Urban		4																																					
Local - Rural		9	6																																				
Provider	1	2																																					
Drugs	1	26	3	5	1																																		
Educational	1	37	3	10	2	16																																	
Financial	1	21	4	9	1	9	14																																
Insurance		3	2	2		2	2	4																															
Information	1	29		5	2	14	22	12	2																														
Personnel - Physician - General		6		4		3	5	4	1	6																													
Personnel - Physician - Specialist	1	7	2	1		3	6	5	1	5	4																												
Personnel - Nurses		7		3		4	6	3	1	6	6	3																											
Personnel - Staff		11	1	5		6	10	5	2	6	6	5	7																										
Regulatory	1	14	1	1		7	6	8	1	6	1	3	1	1																									
Technology	1	18	2	1		8	13	13	1	9	2	4	3	3	8																								
Treatment	1	27	4	6	2	15	20	12	2	18	5	6	6	10	4	7																							
Administration	1	30	3	7	2	16	20	14	3	18	4	4	5	8	8	13	18																						
Accesibility	2	33	4	8	1	18	23	16	2	19	5	5	6	8	6	13	18	20																					
Cost	1	6	1	2	1	4	3	7	1	3	1	2		1	4	5	3	5	5																				
Quality	1	18	2	6	1	10	13	10	1	8	3	3	3	6	7	10	10	14	15	4																			
Satisfaction																																							
Safety	1	18		2	1	10	10	8	1	12				1	7	7	6	9	12	3	8																		
Parity	1	7				4	4	4	2	4	1	1	1	1	2	4	2	6	7	1	4									4									
Timeliness		3					2	2		1		1			2	2			1		1					1													
Preventive	1	32	3	9	1	18	24	14	3	20	7	5	8	11	5	10	21	18	26	4	12		10	4	1														
Wellness	2	15	2	5	1	7	11	10	3	11	2	4	2	4	2	5	9	8	12	1	7		7	6		10													
Pregnancy		6	2	2		4	5	2	2	3				1					1	3	5		5	2		2	1					5	3						
Illness - Episodic	1	19	2	3	1	12	14	6	2	11	4	3	4	7	2	3	14	11	14	3	6		4	2	1							18	6	3					
Illness - Chronic	1	16	1	4	1	8	13	10	1	11	5	6	4	6	4	6	14	9	12	2	8		7	3	1	12	6							6					
Palliative		1							1	1	1	1			1	1	1		1							1							1						
Individual - Children - Pre-natal	1	3	1	1	1	2	3	2	1	2							1		1	1	1		3	2		2	1		3		1		3	3	2	3	1		
Individual - Children - Post-natal	2	19	3	6	1	8	15	10	3	10	1	3		3	3	5	10	8	15	4	9		7	5								15		11	3	6	7		3
Individual - Adolescents		16	3	4		7	14	6	2	8	1	3	1	3	1	5	10	7	9		6		4	4	1							10	10		3	4	7	2	12
Individual - Adults - Mothers	2	15	3	6	1	8	10	10	4	10	1	2	1	2	3	4	8	9	13	3	6		7	4		12	9	5	4	5		3	13	8					
Individual - Adults - Workers		3		1		2	3		1	2	1	1	1	1	1	3	1	2	1		2					3	1					1		3			1	2	1
Individual - Aged		4		2		1	3	2		4					1	1		3	3							2	2	1				2			2		2		
Family		9	4	5		5	8	6	1	4	1	2	3	4	5	8	3	3	3	1	1					4	3	3	3	3		1	2	3	4		2		
Community	2	37	5	10	1	21	28	20	4	22	7	7	8	12	8	12	23	20	28	6	14		12	5	3	28	13	5	17	16	1	3	15	11	13	2	4	9	

■ Highest Frequency (37)   □ Zero Frequency

Figure 2: Dyad (s) maps of the ontology.

The ontological map of dyads (Figure 2) profiles the programs/policies at a different level of granularity. The frequency of occurrence of each dyad is marked in the cell. The darkness of the cell indicates its relative frequency. As might be expected from the map in Figure 1 (but may not necessarily be so), the five dyads formed by National-Scope and information-focus (29), community-population (37), accessibility-outcome (33), preventive-care (32) and educational-focus (37) are the most frequent. At the second level we observe national-scope and drugs-focus (26), technology-focus (28), treatment-focus (27), individual-children-post-natal (19), and individual-adolescents (16). At the same level are drugs-focus and information-focus (14), and community-population (28); educational-focus and information-focus (22), accessibility-outcome (18), and community-population (21); information-focus and accessibility-outcome (19), preventive-care (26), and community-population (22); accessibility-outcome and preventive-care (26), and community-population (28); and preventive-care and community-population (28). These dyads, like the monads, highlight the emphases of the national programs/policies on Education, Information, Drugs, technology, Treatment, Accessibility, Prevention, and Community.

Another interesting observation is the absence of frequent co-occurrence of the outcomes, except quality and accessibility (15). It suggests an emphasis on the outcomes independently rather than in conjunction with each other. The programs/policies do not seem to recognize the latent interdependence of the Outcomes.

It is noted that a very large number of the possible dyads find expression in at least one policy – another indicator of their extensive coverage.

DISCUSSION

Health of the nation largely depends on its policies and programs as well their successful implementation. In this context, the national health programs and policies in India are truly comprehensive is so far as vision and objectives are concerned. However, when it comes to implementation, there are several bottlenecks. Most of the programs in our analysis were geared to tackle national health issues thus regional specificities and needs were homogenized. The focus on technology adaptation for augmenting services and monitoring of delivery is found lacking in many programs. Only selective components of the programs have been assigned quality indicators and timely execution. The parity of almost all the programs and policies is largely restricted to documents rather than practice at ground level.

The issue of government run insurance schemes is being considered in the revised national health policy and presents an optimistic picture.

The 'big picture' of India's national health programs and policies as portrayed by the ontological analysis provides a strategic perspective on its strengths as well as its shortcomings. It helps the strategist and the policy maker to consider national health systemically and systematically, instead of asystemic and selective consideration. It can be used to enhance the coherence of the country's approach to national healthcare and hence its effectiveness. The ontological framework itself can be used to assess the programs logically, as a tool to encapsulate and manage knowledge about health policies.

CONCLUSION

India is one of the most promising economies in the modern world. Health policies and programs of the country have a significant role in shaping the future of the population. It is imperative that the national health programs and policies adapt the best practices from across the globe and modify the same to suit the local requirements.

In this context, the current ontological analysis provides a detailed description of the positives as well as areas of improvement. In this paper we have focused on presenting the ontological framework and analysis of India's national health policies at two levels of granularity – monads and dyads. The framework and the analysis can be extended and refined in a number of ways.

First, the ontology itself is extensible and reducible. Additional dimensions (and associated taxonomies) can be appended to extend the domain of its coverage. Two have the present authors have used the ontology to map Chile's national health policies and are in the process of mapping Australia's programs and policies. We have found the ontology to be adequate in these disparate contexts. By the same token, eliminating one of its dimensions can logically reduce the ontology. However, given our experience with India, Chile, and Australia[10], we would not recommend it. An abbreviated ontology, although simpler, would not adequately represent the domain.

Second, the ontology can be refined or coarsened by modifying the taxonomies. Adding categories, sub-categories, and sub-sub-categories would refine it; combining them would coarsen it. For example, in the Australia, the Population taxonomy has to be extended to include the category of Indigenous People as there are specific healthcare programs and policies targeted at them. Thus, the ontology can be adapted to different contexts.

Third, the coding of the policies can be validated further using additional coders. It can also be refined by scaling the coding to multiple levels instead of using a binary scale. In addition to improving the validity of the

findings, the refinements can provide additional insights into the national health programs and policies of India.

Fourth, the analysis of the data can be extended to triads and tetrads to obtain further insights. Tools such as cluster analysis can also be used to analyze the data in greater depth. In the same vein, the data can be mapped over different temporal cross-sections to obtain a portrait of the temporal progression of the programs and policies.

Lastly, the coding and analysis of the data can be extended to the healthcare programs and polices of individual states in the country. We have already extended the national level analysis to other countries like Chile and Australia. Such an analysis will provide nationally and globally comparative perspectives on healthcare programs and policies.

Thus, this paper presents the first step in a program of research which can be used to analyze and direct healthcare policy globally, nationally, and locally.

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