Human resources for the control of road traffic injury

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Abstract The definition of the ideal numbers and distribution of human resources required for control of road traffic injury (RTI) is not as advanced as for other health problems. We can nonetheless identify functions that need to be addressed across the spectrum of injury control: surveillance; road safety (including infrastructure, vehicle design, and behaviour); and trauma care. Many low-cost strategies to improve these functions in low- or middle-income countries can be identified. For all these strategies, there is need for adequate institutional capacity, including funding, legal authority, and human resources. Several categories of human resources need to be developed: epidemiologists who can handle injury data, design surveillance systems, and undertake research; engineers and planners versed in safety aspects of road design, traffic flow, urban planning, and vehicle design; police and lawyers who understand the health impact of traffic law; clinicians who can develop cost-effective improvements in the entire system of trauma treatment; media experts to undertake effective behaviour change and social marketing; and economists to assist with cost-effectiveness evaluations. RTI control can be strengthened by enhancing such training in these disciplines, as well as encouraging retention of those who have the needed skills. Mechanisms to enhance collaboration between these different fields need to be promoted. Finally, the burden of RTI is borne disproportionately by the poor; in addition to technical issues, more profound equity issues must be addressed. This mandates that people from all professional backgrounds who work for RTI control should develop skills in advocacy and politics.

Keywords Accidents, Traffic/prevention and control; Wounds and injuries/therapy; Personnel management; Health manpower; Administrative personnel; Epidemiologic surveillance; Motor vehicles/standards; Health promotion; Policy making (*source: MeSH, NLM*).

Mots clés Accident circulation/prévention et contrôle; Plaies et traumatismes/thérapeutique; Gestion personnel; Personnel santé; Personnel administratif; Surveillance épidémiologique; Véhicule motorisé/normes; Politique gouvernementale; Promotion santé; Choix d'une politique (*source: MeSH, INSERM*).

Palabras clave Accidentes de tránsito/prevención y control; Heridas y lesiones/terapia; Administración de personal; Recursos humanos en salud; Personal administrativo; Vigilancia epidemiológica; Vehículos a motor/normas; Política social; Promoción de la salud; Formulación de políticas (*fuente: DeCS, BIREME*).

Arabic

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The burden of road traffic injury

Road traffic injury (RTI) has become a major health problem globally, causing over one million deaths each year. Although RTI is often considered to be a problem of countries with high income only, 90% of deaths caused by RTI occur in countries with low or middle incomes. Moreover, rates of mortality caused by RTI are increasing rapidly in most low-income and middle-income countries; during 1975–98, mortality attributable to RTI increased by 79% in India, 237% in Colombia, 243% in China, and 384% in Botswana. During the same period, mortality attributable to RTI declined substantially in most high-income countries. In countries with low or middle incomes, RTI is currently the second leading cause of death for older children and younger adults of working age, second only to childhood cluster diseases and human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), respectively (Table 1) (*1*, *2*).

Rates of mortality caused by RTI are now substantially higher in countries with low or middle incomes (20/100 000 per year) than in countries with high income (13/100 000 per year). This pertains to every region of the world (Table 2). RTI is also a major contributor to disability and health-related economic losses; RTI is ranked ninth among the leading causes of loss of disability-adjusted life years (DALYs) worldwide, and is anticipated to rise to become the third leading cause by 2020. Costs of treatment and lost productivity result in economic losses equivalent to 1–2% of the gross domestic product in most countries (*1*).

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Table 1. **Leading causes of death[a] in low- and middle-income countries in 2000, for the two age groups most affected by injury** (*2*)

Age 5–14 years	Age 15–29 years
Childhood cluster diseases (200 131)	HIV/AIDS (852 793)
Road traffic injuries (114 087)	Road traffic injuries (317 654)
Drowning (112 512)	Tuberculosis (237 757)
Lower respiratory infections (112 307)	Self inflicted injuries (196 246)
Diarrhoeal diseases (88 411)	Interpersonal violence (178 651)

[a] Cause of death (no. of deaths).

Table 2. **Rates of death from road traffic injury in 2002, by world region** (*1*)

Region[a]	Low- or middle-income countries (deaths/100 000 per year)	High-income countries (deaths/100 000 per year)
Africa	28	–
Americas	16	15
South-East Asia	19	–
Europe	17	11
Eastern Mediterranean	26	19
Western Pacific	19	12
Total	**20**	**13**

[a] Regions based on WHO Regions.

Strategies for the control of road traffic injury

Despite this huge burden, the policy response to RTI in countries with low or middle incomes has been limited. This is, in part, owing to the misconception that little can be done. In most countries with high income, however, rates of death from RTI have significantly decreased in recent decades. In the USA, mortality has decreased from a high of 30/100 000 per year in 1930 to 15/100 000 currently. Many European countries have lowered rates of mortality to well below 10/100 000 per year (*1*, *3*). This has been done by addressing the spectrum of injury control, including surveillance, prevention, and treatment (Fig. 1) (*4*), and has involved many categories of individuals, and well-planned control strategies.

In countries with low or middle incomes, control strategies are not as well defined for RTI as for other health problems and it is more difficult to define requirements for human resources. Personnel in the categories of skills and professions that have successfully implemented RTI control in high-income countries exist in most countries with low or middle incomes, but usually in insufficient numbers. Hence, broad ideas on human resource needs for RTI control can be described, even if the precise details of ideal numbers and distributions cannot yet be defined. Furthermore, we can identify factors leading to limitations in human resources needed and suggest corrective actions.

Road safety is part of the broader field of injury control, which deals with unintentional (e.g. RTI, falls, burns, occupational safety) and intentional (e.g. suicide, violence) injuries. Although injury control is often misunderstood to merely provide admonitions to be careful, it is a scientific field like that used to control any other health problem. As such, it involves the use of surveillance and research to understand the extent and nature of the problem, the determination of risk factors and targeting of these factors using scientifically-based prevention strategies, and finally, assessment of the outcome of such interventions, so that those that are successful are promulgated and those that are unsuccessful are discontinued or amended (*5*). In most countries with low or middle incomes there are deficiencies in these functions.

Surveillance

Few countries with low or middle incomes have formal RTI surveillance systems. Most do have some system for gathering information on injuries, typically using police reports and vital statistics. Several factors diminish the usefulness of such data, including poor access, delays in compilation, and underreporting. Studies in Ghana showed that only 8% of injuries to pedestrians were reported to the police, and only 10% of deaths from injury were accurately recorded in vital statistics (*6*, *7*). Surveillance could be improved with minimal expenditure. Upgrading pre-existing data sources is likely to be more cost-effective than creating entirely new systems (*7–11*).

Road safety

Road safety comprises three interacting components: infrastructure (roadway), vehicle design, and human behaviour. Scientifically-based, organized approaches to each component can decrease the incidence of RTI (*5*, *12*).

Infrastructure. Many features affect the safety of a road, including curvature, intersection design, signage, and traffic-calming measures to decrease vehicle speeds, as well as more general features of the road environment, such as whether high-speed roads pass through crowded neighbourhoods. Safety features need to be considered prior to construction and for ongoing maintenance, with safety improvements in hazardous areas being made on the basis of timely feedback from crash statistics (*13–16*).

Since most traffic engineering practices are based on experience in high-income countries, another priority is to delineate design features that are most effective in the different environments encountered in most countries with low or middle incomes, especially taking into account the predominance of vulnerable road users, such as pedestrians and cyclists, and the different patterns of land use (*17*, *18*).

Vehicle design and maintenance. Engineering factors include those that decrease the risk of crashes (crash avoidance) and factors that decrease the likelihood that injury will occur in crashes (crash-worthiness). Many advances in countries with high income have come about through the development of legally-mandated safety standards for motor vehicles (*19*, *20*).

Similar issues need to be addressed for vehicles manufactured in countries with low or middle incomes, including vehicles manufactured by subsidiaries of companies in countries with high income, and those designed and manufactured entirely locally, such as motorized rickshaws in Asia (*17*).

Equally important is upkeep. In most countries with high income, standards exist for safety-related maintenance

and inspection, especially for commercial vehicles. The status of such laws and their enforcement in countries with lower and middle incomes needs attention, especially in low-income countries, where much of the vehicle fleet is in a poor state of repair (*21–23*).

Human behaviour. Two major driver behaviours to be addressed are speed control and driving under the influence of alcohol. Both are best approached by a combination of legislation and law enforcement, and social marketing.

Vehicle speed is a major determinant of injury risk, both for the occupants of vehicles in crashes and for pedestrians struck by vehicles. Speed control is one of the more readily controllable factors affecting pedestrian injury in countries with low or middle incomes (*24–26*). An entire field of traffic engineering is dedicated to speed control through laws, enforcement, education, and traffic-calming infrastructure; this field needs to be developed and applied more extensively in most countries with low or middle incomes.

Efforts to combat drinking and driving have been a cornerstone of road safety in most countries with high income, and evidence indicates that they should also be a priority in countries with lower incomes; a review of 26 publications on this topic (*27*) suggested that almost all indicated high rates of alcohol involvement, with 30–50% of drivers involved in crashes being intoxicated. An implication is that countries worldwide should undertake research regarding the extent of drinking and driving on their roads. This might include, among other methods, random roadside surveys using breathalysers and testing for blood alcohol in fatally injured drivers. If high rates of drinking and driving were confirmed, the intensification of legal and educational activities against it would be warranted.

There are numerous other safety-related behaviours to address, such as increasing use of seatbelts and helmets. Finally, the working conditions of truck, bus, and other commercial drivers in much of the world promote unsafe behaviours, such as driving while exhausted, and need to be addressed (*28*).

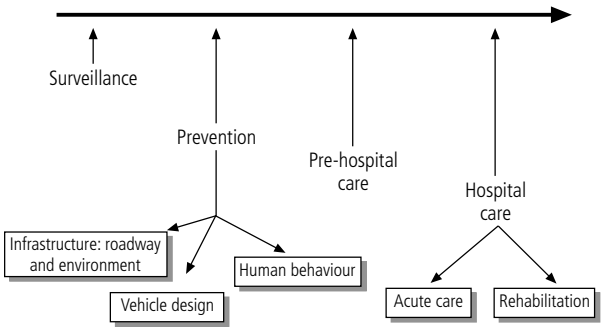
Cross-cutting issues. Road transport is only one means of achieving mobility. There may be safer alternative modes of transport, such as rail, that should be promoted. Decreasing the need for mobility must also be considered. The trend worldwide has been towards the development of large sprawling cities, which promote car dependency. Efforts to promote urban planning that decreases such dependency on cars are needed (*29*).

Trauma care

Advances in trauma care have played a role in decreasing rates of death from RTI in countries with high income (*30*). It is likely that many medically preventable deaths caused by RTI occur in countries with low or middle incomes, and that the number of these could be decreased by low-cost improvements in treatment services. One study has shown that mortality among persons with life-threatening, but potentially survivable, injuries was six-fold lower in countries with high income (6%) than in countries with low income (36%) (*31*).

Part of the reason for such discrepancies lies in the greater resources available in countries with high income. However, some of these discrepancies could be eliminated by low-cost interventions, including consideration of the availability of clinical expertise and expertise for planning. Concerning clinical expertise, trauma care in countries with high income is usually seen as the domain of surgeons and intensive-care nurses in the hospital, and paramedics in the field. There are, however, logarithmic differences between countries at different economic levels, with regard to the availability of such highly-trained personnel. There are approximately 50 surgeons per 100 000 population in the USA, 7 per 100 000 in Latin America and 0.5 per 100 000 in Africa (*32*). Furthermore, in many rural areas, if an injured person receives any medical care it is often at primary health-care sites from personnel who are not doctors (*33*). Hence, consideration must be given not only to the availability of surgeons, but also to that of general practitioners and non-doctor providers.

Fig. 1. **The spectrum of injury control**



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Consideration must also be given to increasing the expertise necessary for planning of trauma services, including hospital designation and inspection (verification), planning of emergency medical services, pre-hospital triage, and patient transfer protocols (*34*). There is considerable evidence that improved organization of trauma services decreases mortality by 15–20% for treated trauma patients in general and decreases medically preventable deaths by 50% (*35*).

In countries with low or middle incomes, evidence suggests that there are indeed affordable ways to improve existing capabilities for both pre-hospital and hospital-based care.

Pre-hospital care. In middle-income countries with existing emergency medical services, sustainable, low-cost improvements in training, equipment, and infrastructure can decrease mortality (*36*). For example, in Mexico increases in the number of ambulance dispatch sites and the institution of regular in-service trauma training for ambulance attendants decreased mortality among transported trauma patients from 8.2% to 4.7% (*37*).

The situation in low-income countries is different. While formal emergency medical services may not be cost-effective (*38*), building upon existing, although informal, systems of pre-hospital transport is an alternative. For example, in mine-infested areas of Iraq and Cambodia, one programme created a two-tiered system, consisting of several thousand lay first-responders who received a two-day course in first aid. They referred severely injured patients to 50 more highly trained paramedics. Mortality among severely-injured persons decreased from 40% to 9%. The programme provided training and basic supplies, but no ambulances. Transport relied on existing private and public vehicles (*39*).

Hospital care. Low-cost improvements in training have lowered mortality caused by injury. In Trinidad, regular implementation of the two-day in-service course in Advanced Trauma Life Support (ATLS) decreased mortality among the most severely injured from 67% to 34% (*40*, *41*).

Several studies have identified critical deficiencies in low-cost physical resources. In Ghana, of 11 rural hospitals located on major roads and dealing with high numbers of trauma cases, none possessed chest tubes and only four had airway equipment, low-cost items that are necessary for the treatment of life-threatening injuries. Lack of planning, rather than resource restrictions, were the main reasons for the absence of such vital equipment (*42*).

Improved administration could also strengthen utilization of resources. In Khon Kaen, Thailand, administrative changes included improving communication with radios within hospital, stationing fully-trained surgeons in the emergency room during peak periods, improved trauma orientation for junior doctors, and improved reporting through a trauma registry. Mortality among admitted trauma cases decreased from 6.1% to 4.4% (*43*).

Capacity for control of road traffic injury

The above efforts depend on the availability of sufficient human resources within institutions with sufficient funding and legal authority, including universities, road safety agencies, ministries of health and transport, and others (*17*). The road safety situation in most countries with low or middle incomes is considerably different from that in countries with high incomes, and injury control strategies from the latter cannot be applied by rote in the former. There is a need for adaptation and the development of completely new strategies. This requires the development of expertise in several categories of personnel.

- Epidemiologists who can understand and handle injury data, develop surveillance systems, conduct research to elucidate injury-related risk factors, and assess the outcome of intervention efforts.
- Engineers from a variety of backgrounds who can deal with highway design, traffic flow, and vehicle-safety design, as well as broader infrastructure issues, such as promoting safer alternative means of transport, and mobility management and urban planning to decrease dependency on cars.
- Police, lawyers, and others involved in legislation who are able to see traffic safety from a broader view-point. Traffic law is usually thought to comprise catching and punishing those who commit infractions. While this is necessary, the concept of assessing traffic laws in terms of safety and health effects must, however, be promoted.
- Clinicians from multiple specialities who can understand the public health view-point and develop cost-effective improvements in the entire system of trauma treatment.
- Psychologists, sociologists, and media experts with a background in safety-related behaviour change.
- Economists to assist with studies of cost-effectiveness on road safety and trauma care modalities.

Most of the above areas of expertise are in limited supply in most countries with low or middle incomes. While working out the ideal numbers and distribution of personnel, some attention can, nonetheless, be directed towards identifying the causes of limitations, and developing strategies to confront these limitations. Two broad sets of limitations are lack of adequate training programmes and difficulties with retention of trained personnel.

Many of the trained personnel listed above are in short supply in general, regardless of their expertise in RTI. Furthermore, those who are trained in the above professions receive very little formal training in RTI control. In schools of public health, little instruction is typically given on injury control, whether for surveillance or prevention. In engineering schools, even when roadway design is covered, safety aspects receive little attention. In law schools, traffic law may indeed be taught, but primarily by way of law enforcement and punishment, without concern for safety impact (*44*). In both medical and nursing schools, as well as in general postgraduate and in-service training, limited attention is given to trauma care (*45*). Finally, administrative aspects of trauma care are rarely covered for clinicians, health planners, or hospital administrators.

Loss of existing trained personnel is also problematic, especially in the curative sector in low-income countries. Typically, the dual considerations of pay and professional advancement account for this "brain drain". The problem has become especially severe in the case of nurses; recruitment by agencies in countries with high income has led to critical shortages of nurses in many African countries.

Strategies to alleviate constraints

The WHO *World report on traffic injury prevention* includes among its recommendations developing and allocating sufficient human resources (*1*). A major step will be to better define ideal numbers and distributions of personnel for RTI control. Meanwhile, action can nonetheless be taken to confront deficiencies that are readily apparent. First is to provide instruction in the necessary elements of RTI control as part of existing training for several categories of professionals. This pertains to curricula for both basic education and in-service training. In broad terms, the training to be promoted includes:

- epidemiology and public health: injury control and road safety, working with injury data, and social marketing to promote safe behaviours;
- engineers: safety-conscious road system design, especially addressing the needs of vulnerable road users such as pedestrians;
- lawyers: safety-related legislation and litigation;
- police: effective enforcement of road safety laws, especially control of speed and driving while under the influence of alcohol; and
- clinicians: trauma treatment for generalists; specialization in traumatology for locations dealing with a high volume of RTIs; and skills for planning and administration of trauma services.

It should be emphasized that the above points concern skills and expertise to be developed and promoted, and not necessarily professions to be advanced. It is necessary to think beyond paradigms developed in high-income countries. The needed skills could be promoted in innovative ways, such as by community planners or developers who could integrate road safety into poverty reduction and crime prevention programmes.

It is likewise important to emphasize that the skills noted above are traditionally found in different sectors and government ministries. Hence, there is a need to promote multisectoral and multidisciplinary collaboration in bringing these skills to bear most effectively.

We must also consider the capacity needed to treat medical conditions that increase crash risk, such as epilepsy, sleep apnoea, and vision deficits. There is a tremendous burden of ophthalmologic disease in many countries with low or middle incomes. Screening drivers, especially commercial drivers, for

visual defects is an important component of driver licensing and regulation. Correcting any visual defects found is likely to require increased capacity in the ophthalmologic workforce (*46–48*).

Furthermore, the burden of suffering from RTI is borne disproportionately by the poor (*18*, *49*). These are people with the least power to improve an unsafe environment, even when the risks are known. This is especially the case for pedestrians and other vulnerable road users, who comprise nearly half the victims of RTI worldwide. In addition to specific technical issues, addressing these more profound equity issues is a necessary component of RTI control. This mandates that people from all professional backgrounds who work in injury control should develop skill in advocacy and politics.

Preliminary progress on some of the above items has been made. WHO has developed a model curriculum (TEACH-VIP) for injury control for schools of public health. Likewise, better definitions of trauma care skills needed are being provided through the Essential Trauma Care Project, a collaborative effort by WHO and the International Society of Surgery (*50*).

Strategies to promote retention of trained personnel in countries with lower incomes are desperately needed. This especially applies to clinicians, who have the most marketability in high-income countries. Such issues obviously pertain to the general health-care system; however, loss of trained clinicians has become such a huge problem that no discussion of human resources for RTI control is complete without addressing it. Clearly, improving working conditions and job satisfaction are important. Barriers should also be created to prevent the early loss of graduates from medical and nursing schools. In most cases, the education of these individuals has been subsidized by the government; the definition of some requirement for service to the country and some mechanism for enforcement of this requirement needs consideration. One potential strategy would be to embargo providing transcripts to foreign institutions until graduates have documented a period of service in the country in which they were trained. This would provide a disincentive to leaving, as employment opportunities abroad would be hindered. The recruitment of nurses by foreign agencies should be strongly confronted and regulated.

With regard to the police, a frequent problem is that experience in road safety is given less priority in career advancement than is criminal investigation. Members of the police who receive extra training in road safety often spend a limited time in road-safety units before being transferred. Efforts to increase retention of those with skills acquired in road-safety units are needed.

Conclusions

Several low-cost strategies to strengthen the spectrum of injury control in countries with low or middle incomes can be identified; all require sufficient human resources. Several specific categories of human resource need to be better developed. RTI control will be strengthened by enhancing training for these disciplines, and encouraging retention of those with the needed skills. Along with specific technical details, broader environmental and mobility management issues must be considered. Finally, the poor are disproportionately affected by the burden of RTI; addressing issues of equality is a necessary component of RTI control. ■

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Résumé

Ressources humaines pour lutter contre les accidents de la route

On n'a pas autant progressé dans la définition de la répartition et des effectifs optimaux des ressources humaines nécessaires à la lutte contre les accidents de la route que dans la résolution d'autres problèmes sanitaires. Il est néanmoins possible d'identifier les fonctions à assurer parmi le spectre d'activités intervenant dans cette lutte : surveillance, sécurité routière (y compris les infrastructures, la conception des véhicules et les comportements) et prise en charge des traumatismes. On peut également définir de nombreuses stratégies peu coûteuses pour améliorer ces fonctions dans les pays à revenus faibles et moyens. Toutes ces stratégies nécessitent que l'État dispose de moyens suffisants, notamment en matière de financement, d'autorité légale et de ressources humaines. Les moyens humains devant être constitués feront appel à plusieurs catégories de personnel : épidémiologistes capables de traiter les données d'accident, de concevoir les systèmes de surveillance et de réaliser des recherches, ingénieurs et planificateurs spécialisés dans les aspects relatifs à la sécurité de la conception des routes, de l'écoulement du trafic, de l'urbanisme et de la conception des véhicules, policiers et hommes de loi comprenant l'impact sanitaire des règlements de la circulation, cliniciens capables de mettre au point des améliorations rentables du système complet de traitement des traumatismes, spécialistes des médias à même de modifier efficacement les comportements et d'assurer un marketing social, et économistes en mesure de contribuer aux évaluations coût-efficacité. On peut rendre plus efficace la lutte contre les accidents de la route en améliorant la formation dans ces disciplines et en retenant les personnes possédant les compétences requises. Il convient de favoriser les mécanismes permettant de renforcer la collaboration entre ces différents domaines. Enfin, la charge d'accidents de la route porte de manière disproportionnée sur les plus démunis. En dehors des questions techniques, il faut s'attaquer aux problèmes plus profonds d'inéquité. Cela suppose que les personnes de toutes professions qui participent à la lutte contre les accidents de la route acquièrent des compétences en matière de promotion et de défense des droits et d'action politique.

Resumen

Recursos humanos contra los traumatismos causados por el tránsito

La definición de las cifras y distribución ideales de los recursos humanos requeridos para combatir los traumatismos causados por el tránsito (TT) no ha avanzado en la misma medida que para otros problemas de salud. No obstante, podemos identificar las funciones que deben abordarse en todo el espectro de lucha contra los traumatismos: vigilancia; seguridad vial (lo que incluye infraestructura, diseño de vehículos y comportamiento), y atención traumatológica. Se pueden identificar muchas estrategias de bajo

costo para mejorar esas funciones en los países de ingresos bajos o medianos. Para todas esas estrategias, se necesita capacidad institucional suficiente, lo que abarca financiación, autoridad legal y recursos humanos. Hay que formar varios tipos de recursos humanos: epidemiólogos capaces de manejar los datos sobre traumatismos, diseñar sistemas de vigilancia y emprender investigaciones; ingenieros y planificadores conocedores de las implicaciones para la seguridad del diseño de carreteras, la circulación del tráfico, la planificación urbana y el diseño de vehículos; policías y abogados que comprendan el impacto sanitario de las leyes de tráfico; médicos que puedan introducir mejoras costoeficaces en todo el sistema de tratamiento de los traumatismos; expertos en los medios para impulsar cambios de comportamiento y fórmulas de mercadotecnia social efectivos; y economistas que ayuden a realizar las evaluaciones de costoeficacia. La lucha contra los TT puede reforzarse fomentando la formación en esas disciplinas y la retención de quienes tengan las aptitudes necesarias. Es preciso promover mecanismos que mejoren la colaboración entre esos distintos campos. Por último, la carga de TT recae desproporcionadamente en los pobres; además de los temas técnicos, deben abordarse algunos aspectos más profundos relacionados con la equidad. Ello exige que todas las personas implicadas en el control de los TT, con independencia de cuál sea su preparación profesional, desarrollen aptitudes para la promoción y la acción política.

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