Health Research Policy and Systems

REVIEW

Open Access

Transforming health in Nepal: a historical and contemporary review on disease burden, health system challenges, and innovations

Shiva Raj Mishra[1,2,16*], Kamal Ghimire[1,3], Vishnu Khanal[4], Diptesh Aryal[5,12], Bijaya Shrestha[6], Pratik Khanal[7], Sanjay Yadav[8], Vinita Sharma[9], Resham Khatri[10,11], Dan Schwarz[12,13] and Bipin Adhikari[14,15]

Abstract

Introduction Nepal witnessed a tumultuous journey over past two centuries, marked by significant political, social, and cultural shifts. From fighting British colonial encroachments in 1800s, the dynastic Rana regime (1846–1951), and democracy movements in the late 1950s, 1990s and 2000s, Nepal became a federal republic in 2008. The main objective of this review is to lay out an interpretative summary on Nepal's epidemiological transition (includes general trends and disease specific topics) followed by discussion on health system development over key periods: historical period (–1950s), modern period (1950–1990), post-democracy (1991–2016), and post-federalization (2016–).

Methods We conducted a scoping review of available literature using the Arksey and O'Malley framework to synthesize the key insights. Searches were performed in PubMed (via NLM), Embase and Google Scholar using a combination of search terms related to Nepal's health system, epidemiological transition, disease burden and emerging health issues. A total of 1204 records were identified, of which 123 documents – including peer-reviewed articles, government reports and grey literature – met the inclusion criteria.

Results Major advances in maternal and child health, nutritional health and reduction of infectious diseases have been observed in recent decades. The maternal mortality ratio (MMR) declined by 55% (1996–2016), and neonatal mortality halved (40 to 20 per 1000 live births) due to improved antenatal care, skilled birth attendance and family planning. Stunting rates fell from 66% (1996) to 25% (2022), yet rising non-communicable diseases (NCDs) pose new challenges. Communicable diseases, once dominant, have declined owing to expanded immunization and tuberculosis control. However, NCDs now account for over two thirds of deaths, driven by urbanization, ageing and lifestyle shifts. Health system gaps persist, with workforce shortages, rural–urban disparities and out-of-pocket health costs limiting access. Addressing rising health inequities, digital health innovations and service expansion is critical to achieving universal health coverage and sustaining Nepal's health gains.

Conclusions Nepal's health care landscape has continuously evolved over the past centuries, coinciding with key demographic and political changes. Advances through innovation are necessary for the country's overstretched health system to reduce the cost of health services whilst increasing quality and access.

Keywords Health system, Nepal, Inequities, Poverty, Digitalization, Innovation

*Correspondence:
Shiva Raj Mishra
shivarajmishra@gmail.com
Full list of author information is available at the end of the article

Introduction

Nepal witnessed a tumultuous journey over in the past 200 years from fighting British colonial powers in the Indian subcontinent in the 1800s to the dynastic regime of Rana rulers (1846–1951) [1]. Nepal had a short-lived functioning democracy in the late 1950s, followed by significant political turmoil – three decades of the Panchayat system without political parties, frequent changes in government during the multiparty democratic period, a decade-long Maoist insurgency, civil unrest and the movement to establish the Republic of Nepal [1, 2]. Nonetheless, evolution of the health system and its changing burden of disease has been rarely reported, particularly in relation to the political landscapes over the past century.

Despite all known challenges, the country has made substantial progress in many areas. The Universal Health Coverage (UHC) Index improved from 48 in 2017 to 53 in 2019, and the Human Development Index (HDI) improved from 0.395 in 1990 to 0.601 in 2019 [3, 4]. Similarly, as for two other key indicators of health: maternal mortality decreased by 55%, from 539 to 239 per 100 000 live births between 1996 and 2016; and neonatal mortality halved from 40 to 20 deaths per 1000 live births in the same period [5, 6]. Whist these changes occurred over the years, the population boomed from nearly 6 million in 1990 to 29 million in 2022 [2, 7]. The five-fold increase in the population has a bearing on the health system, disease epidemiology, climate and macro-social forces driving the determinants of health [7]. For example, the contribution of non-communicable diseases (NCDs) to overall mortality has surged from merely 30% of all deaths in 1990 to two thirds in 2015, reflecting a significant shift in disease epidemiology. Meanwhile, the health system continues to grapple with high rates of infectious diseases – including emerging threats and antimicrobial resistance – along with climate change-induced health burdens, collectively contributing to syndemics [8]. Nepal's health system and its prowess are thus unique, and require a contextual epistemic analysis that entails interpretative synthesis on the chronological development of health systems from scholars familiar with the social, political and cultural context of Nepal.

Building on our previous work that expands on the history and development of health systems in Nepal [7], the main objective of this review was to lay out an interpretative summary on the epidemiological transition (including general trends and disease-specific topics) followed by discussion on health system development over key periods: the historical period (–1950s), the modern period (1950–1990), post-democracy (1991–2016), and post-federalization (2016–).

Methods

Review design

We conducted a scoping review of available literature using the Arksey and O'Malley framework for scoping reviews [9], which authors have previously used in the health system and policy context [7, 8]. The Systematic Reviews and Meta-analyses extension for Scoping Review checklist was used to report the results (eSupplementary Table 1) [10]. Our research synthesis approach utilizes the following five steps: (i) identifying the key research questions through an iterative review/discussion; (ii) identifying the initial set of potential studies based on the discussion; (iii) searching literature in major medical databases; (iv) collating of data, synthesizing and reporting of the findings; and (v) discussion among researchers and experts and utilizing their feedback as a required step in the knowledge translation part of scoping review methodology. Using these steps, we identified selected themes that are discussed in detail in subsequent sections.

Search strategy and inclusion criteria

The literature searches were conducted in PubMed/Medline, Embase and Google Scholar to capture an array of medical as well as grey literature, capturing recorded events from the 1800s up until December 2023, using a combination of search terms and Boolean operators ("AND", "OR"): "Nepal", "Sustainable development goals", "SDG", "primary health care", "PHC", "health system", "health system strengthening", "health system integration", "governance", "accountability", "health financing", "human resources", "supply chain", "disease control", "vertical programs", "health outcomes", "challenges", "weaknesses", "progress", "success", "community health workers", "epidemiological transition", "nutrition", "child health", "maternal health", "reproductive health", "non-communicable diseases", "infectious diseases", "communicable diseases", "mental health", "climate change", "mountain medicine", "genomics", "ancestry", "pathogens", and "surveillance" (eSupplementary Table 2). We considered both peer-reviewed and non-peer-reviewed literature (websites, conference abstracts, and reports) for analyses. Altogether, 123 documents were identified in mutual consensus (S.R.M. and B.A.). We used inclusion criteria to screen literature during the review process. Inclusion criteria included primary research or case studies documenting literature relating to one or more of the following sections: (i) epidemiological trends in disease, conditions or risk factors; (ii) emerging issues affecting population health and wellbeing; and (iii) primary and community health services or health systems in general. Any non-English literature and conference abstracts were excluded.

Data abstraction

We reviewed literature under three thematic groupings: epidemiological transitions, health system development, and emerging topics affecting population health. Both peer-reviewed and grey literature were analyzed and the following information was abstracted: author (year), study title, methods, major findings, limitations and the way forwards. A single reviewer (S.R.M.) synthesized the findings using tables and a descriptive summary, with consensus from all authors. Studies were categorized by common themes and research objectives, organizing findings into three main themes: (1) epidemiological transitions, (2) health system development, and (3) emerging topics, each with subthemes. Our synthesis followed a thematic structure, progressing from broad categories to specific insights. Study quality was not assessed, as it is not a requirement for scoping reviews. [9]

Synthesis and organization of findings

We followed an iterative process of data abstraction in consultation with relevant stakeholders, thus charting and synthesizing the findings using a prior framework by van Olmen et al. [11] and the WHO, with an emphasis on the contextual relevance to the healthcare landscape in Nepal [12]. Specifically, emergent themes, which are relevant for the healthcare landscape in Nepal and supported by the framework, were identified and used for the analysis. Three primary themes and their corresponding topics were then selected on the basis of their relevance and importance, and these are presented in the main text.

Themes	Topics
A: Epidemiological transitions	Communicable diseases
	Non-communicable diseases
	Mental health
	Maternal and reproductive
	Nutrition and health
B: Emerging topics in health	Climate change and health
	Mountain medicine
	Genomics, ancestry and pathogen surveillance
	Indigenous health and stewardship
	Digital technology in health
C: Health system development	Historical period (up to 1950)
	Modern period (1950–1990)
	Post-democracy (1991–2016)
	Post-federalization (2016–)

Results

Characteristics of included studies

Of the 1204 studies identified through database searches – 135 from PubMed (via NLM), 500 from Embase and 569 from additional searches in Google Scholar – 143 were selected for full-text screening, with 123 included in the final analysis. The included studies, spanning 1970–2024, addressed Nepal's health and nutrition challenges through diverse research methods, including reviews (56%), primary studies (37%) and commentaries (7%). Publication dates peaked in the 2010s–2020s, reflecting growing attention to NCDs and UHC. Sources ranged from global journals to local policy documents.

Epidemiological transitions

Epidemiological transition is a process that describes the shift in the pattern of disease and mortality that occurs as society develops. Nepal has undergone a significant shift in its health and epidemiological landscape over the past centuries (with data available to capture trends over the past three decades, Fig. 1). In the 1950s, Nepal began a process of economic development that has led to significant changes in its health landscape. As the country progressed economically, it leveraged the access to education, improved sanitation and a reduction in poverty. These changes contributed to a shift in the country's disease and mortality pattern, marking the beginning of the epidemiological transition [7].

A high burden of infectious diseases characterized the first stage of the epidemiological transition. During this stage, infectious diseases such as tuberculosis, diarrhoea and malaria were the leading causes of mortality in Nepal [13]. However, as the country developed, there was a relative reduction in the prevalence of these infectious diseases owing to improved sanitation, increased access to clean water and the use of vaccines. This reduction in infectious diseases marked the beginning of the second stage of the epidemiological transition, which is characterized by a shift from infectious diseases to NCDs as the leading causes of mortality. NCDs such as cardiovascular diseases, cancer and diabetes have become increasingly prevalent in Nepal in recent decades [8]. This shift can be attributed mainly to massive changes in lifestyle and population ageing [8]. Nepal's transitioning demographic structure, also known as demographic ageing, has brought an unprecedented increase in the prevalence of syndemic diseases among older individuals. Combined with changes in family structure – reducing access to residential care in old age – limited access to healthcare services, and a higher incidence of poverty, these factors are exacerbating health challenges among the elderly in Nepal [14]. Regardless of the age groups, lifestyle factors such as diet and physical activity have also contributed

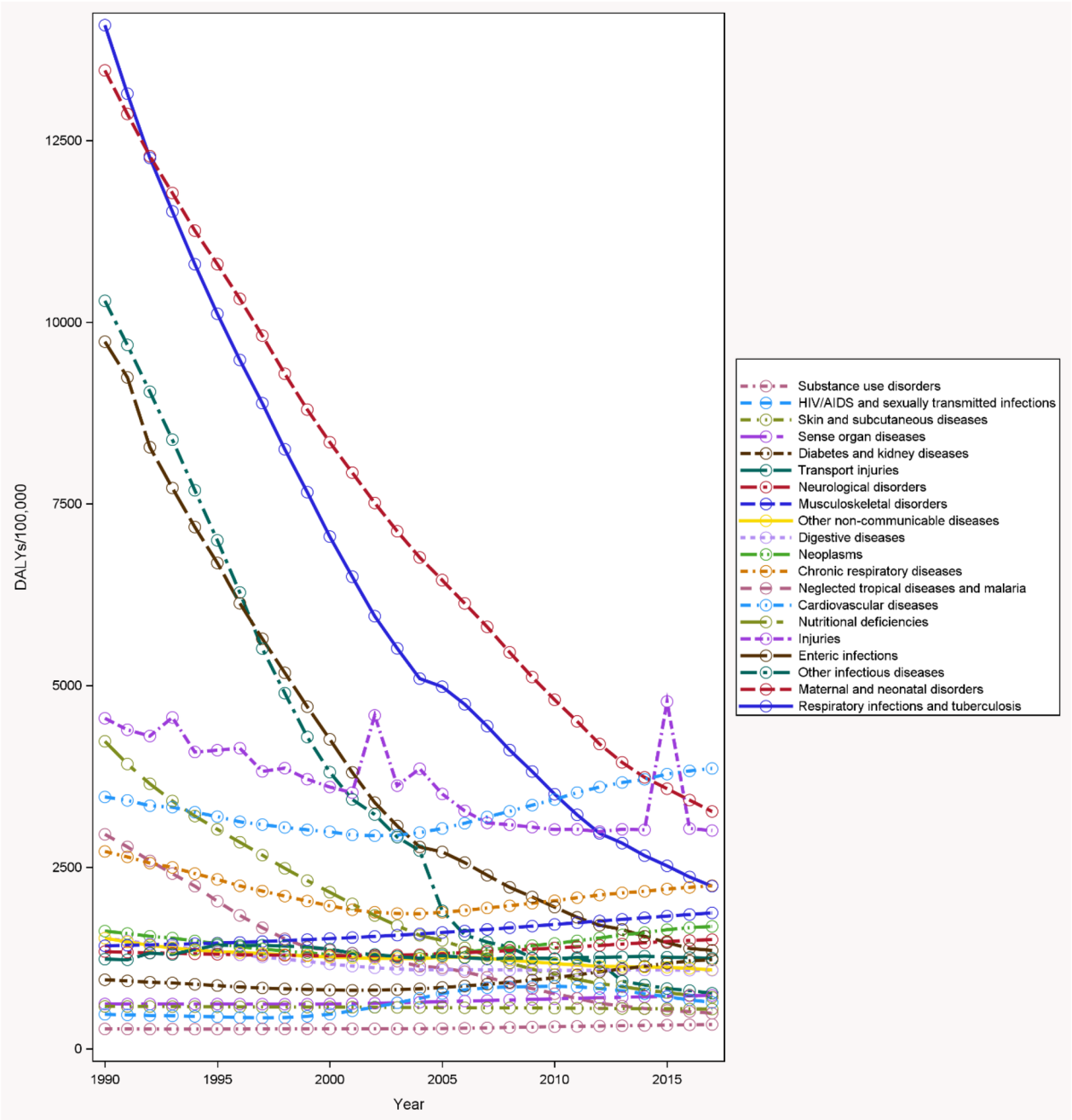

Fig. 1 Epidemiological transition in Nepal from 1990 to 2019 [7, 15]. The legends are ordered on the basis of descending disability-adjusted life years (DALYs) per 100 000 in 1990. The figure shows the shift in the burden of major causes of DALYs in Nepal. Dominated by maternal and neonatal disorders, and communicable disease in 1990s – the burden of disease shifted over the next 20 years (to 2019), when cardiovascular disease became the leading cause of DALYs [7]. Data for this visualization were derived from the Global Burden of Disease Study, Institute of Health Metrics and Evaluation (https://vizhub.healthdata.org/gbd-compare/)

to the increase in NCDs. Over the past decades, a transition towards diets high in fat, sugar and salt has become commonplace, contributing to a rising prevalence of conditions such as obesity, hypertension and diabetes, while sedentary lifestyles are becoming more prevalent due to shifts in occupational and leisure activities [8].

The third stage of the epidemiological transition is characterized by a decrease in the overall mortality rate and an increase in the prevalence of chronic conditions

and injuries. Nepal is still in the early stage of this epidemiological transition. The decrease in the overall mortality rate is due to improvements in healthcare services, increased access to education and poverty reduction [8].

While the disease epidemiology trend was distorted by the coronavirus disease 2019 (COVID-19) pandemic and associated infectious diseases in 2022, the major burden continues to be dominated by a mix of both communicable and NCDs, and will largely follow the past trends in NCDs. Nepal faced a major challenge in tackling the unprecedented burden of COVID-19, which underscores the need for increased preparedness against such a disease epidemic. Besides inferring the need for strengthening of the health system, a renewed impetus is critical to understand and address how such disease epidemics are configured by social, cultural, geographical and political contexts affecting responses and preparedness, as has been known throughout the country's history. In urban areas, NCDs have driven most deaths, whereas in rural areas, communicable diseases and maternal–neonatal conditions continue to contribute to high morbidity and mortality, including the burgeoning burden of NCDs. By virtue of geographical characteristics, Nepal is also a vulnerable country for disaster-related risks including earthquakes, floods and landslides, and wide arrays of injuries including road traffic accidents (RTAs). In the future, the health system must evolve to manage NCDs, disasters, maternal and child health, and nutritional problems.

Communicable diseases

Historically, leprosy, tuberculosis, diarrhoea and/or dysentery, typhoid fever and other respiratory infections were widely reported in Nepal. In terms of proportion of disease burden, communicable diseases have shown a dramatic decrease- reducing from about 70% in 2000, to 21.3% in 2021 [15, 16]. Nepal reported 13 cases of leprosy per 10 000, and 1300 per 10 000 of smear-positive pulmonary tuberculosis in the 1990-, one of the highest in the world [17]. The country also had one of the highest rates of food-borne infectious diseases such as typhoid, diarrhoea and intestinal parasitic infections such as *Ascaris lumbricoides*, which combined have declined by 81.8% between 1990 and 2021, largely due to strong community-based public health programs [16, 18].

Recent decades have seen the expansion of tuberculosis and HIV/AIDS programmes contributing to better screening, reporting and bridging the gaps in prevention and treatment coverage and care. For example, directly observed treatment, short-course (DOTS) for tuberculosis treatment was started throughout the country in 2001; currently providing services through > 4000 DOTS centres [19]. Among under-5 year olds, the government runs a programme to tackle many endemic infectious diseases such as diphtheria, pertussis, tetanus, polio, measles and mumps. Due to these efforts, communicable diseases have seen a sharp decline over time [8]. Notwithstanding the current efforts, distribution of communicable diseases are undergoing geographic expansion due to changing climate, population migration and overcrowding. Exerting pressure on already stretched health systems, communicable diseases surpassed the syndemic potential, and are seen alongside NCDs [8, 14]. Therefore, a multi-pronged approach is needed for these diseases that often interact biologically, as well as with sociocultural, economic and physical environments [14].

With the lessons learned from the COVID-19 pandemic [1], the characteristics of infectious disease epidemiology of Nepal bears several implications. The foremost being the need for a strong in-country disease surveillance system that can monitor and mitigate escalating threats in the future. The second step would be to strengthen infectious diseases management centres to ensure quality of care is improved. For instance, establishment of over two dozen infectious diseases hospitals was a commendable act during COVID-19, but their continuity and funding sustainability, remains precarious. Echoing several other cross-border collaborations that are often inadequate and ineffective, Nepal and India further need to continuously monitor the porosity of the border that runs over 1000 km on all sides except the northern Nepal [1].

Non-communicable diseases

Although non-communicable diseases (NCDs) have only recently gained attention in Nepal's health system, as early as the 1950s, they were already responsible for nearly a third of all fatal events [8, 23]. Historically, the higher death and disease rates from communicable diseases, maternal and neonatal health issues, and malnutrition overshadowed the impact of NCDs. Recent dwindling in communicable diseases, and maternal and neonatal disorders, brought NCDs back to the top (including a surge in NCD risk factors, adding fatal events attributed to these risk factors) [8]. Several studies globally evaluated the surge in NCDs in low-income populations, such as Nepal, and stressed a few factors: migration of populations from rural to urban areas (reducing the opportunity for incidental physical activity), changes in lifestyle (a high dependence on high-carbohydrate rich food) and stressful lifestyles (reducing the opportunity for going out and exercise) [14, 20, 21]. An *urban-sedentary complex* refers to a setting in which individuals adopt sedentary behaviours due to limited opportunities for physical activity - whether in office spaces or in urban environments that are too crowded or polluted to allow walking commutes between home and work [8, 14].

The burgeoning of urban concrete complexes, and the destruction of green spaces, remains a major barrier for outdoor activities of a population (physical activities, recreation and restitution) [22].

Currently, cardiovascular diseases and chronic respiratory diseases are Nepal's leading cause of deaths amongst men and women [8, 23]. NCD plans and policies over the past 10 years have touched upon these growing drivers of ill health, however, they largely focus on tertiary care. Primary and secondary prevention (reducing the risk of exposure to urban-sedentary complexes) has not received much attention [7]. The package of essential non-communicable disease interventions (PEN) implemented in primary health facilities since 2016, has limited health facility readiness, affecting its overall effectiveness and coverage. There is a wider availability of literature on NCD epidemiology [8, 23] and NCD policies, including our own [8, 14, 24, 25]. We have decided to focus more on exploring other diseases (e.g. mental health) and topic areas (e.g. science and technology) in this review due to space limitations.

Mental health

Mental health is an emerging concern in Nepal, with a significant burden of mental health conditions impacting individuals, families and communities. A cross-sectional study in districts representing different ecological regions recorded the prevalence of mental disorders among adults and children at 13.2% and 11.2%, respectively [50]. The prevalence of mental health conditions is often associated with poverty, violence and social exclusion [46, 50]. Past studies suggest a large displacement of population (~2 million) and loss of 17 000 civilian lives during Nepal's civil war [27], affecting thousands of families, and consequentially increasing the burden of post-traumatic stress disorder (PTSD) and other mental health conditions [26]. Conflict-related violence during the civil war (1996–2006) in particular, may have contributed to the high burden of adverse mental health conditions among those affected and displaced during conflict [26]. Previous work, including our own, on the mental health landscape of Nepal during and post-civil unrest, univocally highlighted the critical need for better programmes and policies for mental health in in the country [26, 28].

Availability of mental health services is still evolving and there is a dire need of comprehensive service expansion throughout the country. The first psychiatric outpatient department in Nepal was established in 1962 at Bir Hospital, Kathmandu. A subsequent addition of a four-bedded psychiatric unit at the same site in 1964 marked the first inpatient mental health services for the country [29]. A dedicated 25-bedded mental health hospital came into existence in 1985 in Lagankhel, Lalitpur [30]. To address growing drivers of mental health conditions, the government of Nepal has implemented several initiatives and policies in collaborations with non-governmental organizations, medical colleges, private hospitals and clinics. A National Mental Health Policy was first developed in 1996 [29, 31]. Many attempts were made to revise the policy in the following 20 years, but with little success [31]. Eventually, Community Mental Health Care Package Nepal, was developed by the Ministry of Health and Population (MoHP) in 2017 to facilitate the implementation of the National Mental Health Policy. The WHO Mental Health Gap Action Programme (mhGAP) calls for the integration of mental health into primary care [30]. Further, the MoHP's Basic Health Service Package 2018, now includes epilepsy, depression, psychosis, and alcohol use disorder, and aims at providing health services for these health issues at no cost [32].

Maternal and reproductive health

Historical perspective on maternal and reproductive health

Historically, Nepal has witnessed a high burden of maternal deaths, however, systematic research and documentation were lacking prior to the 1950s. Before 1950, Nepalese society was less spread and was restricted within the country (Nepalese people travelled less, except for a few elites) under the regime of the kings and the Rana elites [2]. This information was neither documented, nor made public. The first account of maternal deaths available from the courts of former Shah kings and Rana elites' hints at the general lack of midwife services across all socio-economic strata [33]. Overall social phenomenon and preparation was plagued by a fatalistic view of the self, and disease aetiology, including maternal death, was generally attributed to superstition, myths and religion [33].

Maternal health and reproductive conditions were the most prevalent fatal diseases affecting women in Nepal for nearly two centuries. Figure 2 shows the statistical data over the last 50 years, before which no data are available. The earliest data we could identify from credible sources was the WHO report of 1991 [34]. This reported that the maternal mortality ratio (MMR) was 2083 per 100 000 live births in 1977 in the Dhankuta district of Nepal, which is located in the eastern hilly region of the country. Subsequent data from 1981 identified a MMR of 1657 per 100 000 live births in rural areas. Due to such a high MMR, and high infant mortality rate, the life expectancy of Nepalese people was 40.6 years for both males and females [35]. A major political change in the 1990s opened up the country to restructure its health system and implement a series of policies and programmes, including earlier interventions focused on maternal

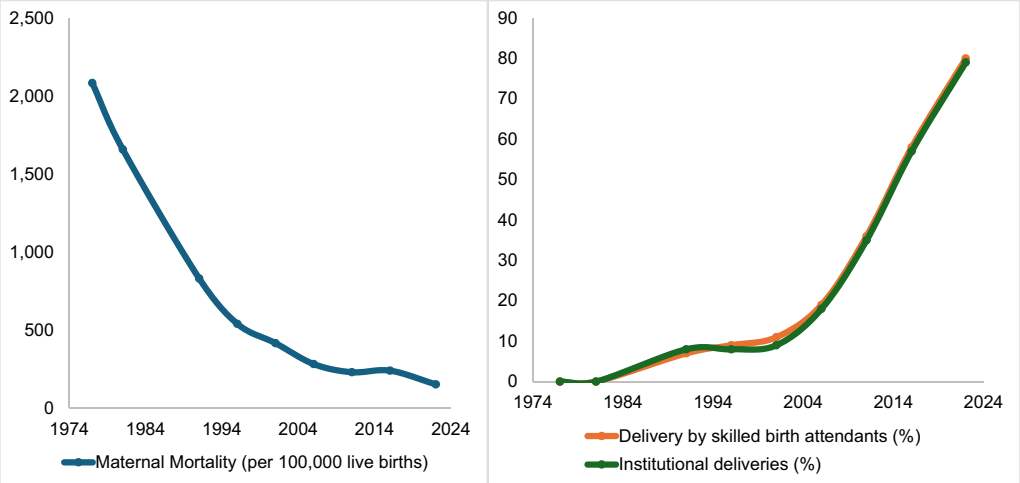

Fig. 2 Maternal mortality ratio over 50 years in Nepal. *The datapoints for this figure were obtained from the references below: WHO 1991* [36]*, WHO 1991* [36]*, NDHS 1991, NDHS 1996, NDHS 2001, NDHS 2006, NDHS 2011, NDHS 2016 and NDHS 2022* [37]

health (eSupplementary Tables 3). The decline in maternal deaths was rapid during 2000–2016.

Reproductive health is an umbrella concept in primary health care systems. In Nepal, family planning, safe motherhood, child health (newborn care), prevention and management of complications of abortion, sexual and reproductive infections (e.g. HIV), prevention and management of sub-fertility, adolescent reproductive health, and problems of elder women were included as part of an integrated reproductive health package in 1998 [38]. However, due to various priorities, individual areas have begun their own trajectory of growth, including maternal health initiatives, as explained above. A detailed appraisal of each aspect is out of the scope of this review.

There have been remarkable changes in the access to and utilization of reproductive health services. In 1966, Nepal started family planning services as a fundamental human right and female sterilization became the main method for modern contraception. The contraceptive prevalence rate was 3.0% in 1970s, which slowly progressed to 28.5% in 1996, 48.0% in 2006, and 57.2% in 2022 [39]. Such progress in family planning was responsible for a 53% decline in maternal mortality between 1976 and 2019 in Nepal. Likewise, total fertility rate (TFR) was 6.3 per woman in the 1970s, 4.6 in 1996, 3.1 in 2006, and 2.1 in 2022, reaching replacement level fertility. The progress was also partly due to legalized safe abortion services in addition to successful family planning program [39].

Government policies and interventions

eSupplementary Table 3 provides an account of the development of the major policies and programmes that shaped maternal health programmes in the country. Broadly, we can see three stages: (i) before the 1990s; (ii) between 1990 and 2015; and (iii) post-2015 and post-Millennium Development Goals (MDGs). Before the 1990s, some initiatives had started emerging, lifestyles and living conditions were traditional, and the data were not reported at the national level. The political change in 1990 led to an open society aligning with globalization, and increased attention to education and health. During the 1990s, several policies and major movements started leading to the building of the structure of the current health system and setting the foundation for strong maternal health programmes. One of the most significant was the safe motherhood programme being at the forefront, and safe abortion rights being at the centre of discussion. The start of the MDGs, and with a clear focus on maternal mortality, helped the international community support the MoHP for necessary action. There was a sharp decline in MMR between 2000 and 2011 (Fig. 2). The national goal to reduce MMR to 239 per 100 000 live births by the end of 2015 was achieved well on time. A large number of contextual factors can be attributed to maternal deaths in the country, which despite substantial progress in recent years, remains high. Since the Gorkha earthquakes in 2015, there has always been a threat of losing momentum linked to the events of a disaster [40]. Access to emergency obstetric care has remained a major challenge due to inadequate and unskilled human resources, lack of competencies among trained skilled birth assistants, unavailability of 24/7 birthing services, and poor retention of the medical and nursing workforce [7, 41]. Further, there exists a stigma around abortion

at a health centre, leading to unsafe abortions and high maternal deaths.

Reproductive health-specific programmes and policies have undergone recent developments. The 1991 National Health Policy and the Second Long Term Health Plan (1997–2017) mandated that reproductive health services are delivered at community level, all the way from the Primary Health Care Outreach Clinics to district hospitals. These policies emphasized delivery of maternal health and family planning services, with a target to achieve a contraceptive prevalence rate of 58.2% by 2017. Consequently, the National Reproductive Health Strategy 1998 was developed to guide the implementation of these policies. This strategy (for the first time) set the indicators of reproductive health [38], and is a crucial milestone in putting an integrated reproductive package first in the national policy agenda.

Around the same time, there was widespread demand for safe abortion services provided legally, as a measure to curb high maternal mortality in the country. Consequently, in March 2002, abortion became legal in Nepal [42]. The first ever comprehensive abortion care started in 2004 in Kathmandu. Around the same time (i.e. 2000), the concept of adolescent and reproductive health also started taking shape, and the first ever National Adolescent Sexual and Reproductive Health Strategy was developed [43]. An evaluation in 2015 revealed that there were significant gaps in access to the service: weak capacity of the providers, poor supervision and monitoring, poor ownership of the programme, poor coordination, poor linkage to existing health programs, and very limited behaviour change communication [43]. While the health services are driven by individual programmes within the reproductive health space, an update in the 1998 National Reproductive Health Strategy has not been made. At present, Nepal has sufficient policies and strategies, however, successful implementation remains a major issue. There is wider acknowledgement among health workers, managers and consumers that stagnation in progress is not due to a lack of policies but due to the lack of focus and implementability. The latter for example is affected by the conflicts of interest embedded in political agendas, and power and corruption between and within the key stakeholders [44].

Nutrition and health

Historical perspective on child malnutrition

Healthy nutrition and child health are identified as priority areas for intervention in Nepal. Undernutrition contributes to nearly 25 000 child deaths, accounting for nearly 52% of all child deaths in Nepal [45]. The common forms of malnutrition include protein-energy malnutrition (PEM), which includes wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age), and micronutrient-related malnutrition, which includes, iodine deficiency disorders, iron deficiency anaemia and vitamin A deficiency [46]. More recently, overnutrition, which includes overweight and obesity, is increasing rapidly in Nepal. Underweight (of children < 5 years) served as a key indicator of both poverty and hunger in the MDG 1 of the United Nations [47]. Ending all forms of malnutrition by achieving global targets of reducing stunting and wasting, and improving nutritional status of pregnant and lactating women, adolescents and older people is one of the targets of Sustainable Development Goal (SDG) 2. [48]

The earliest reports available from 1970s described that Nepal had the highest rate of child mortality and malnutrition in the form of stunting (70%), and stunting and wasting combined (80%), predominantly in the remotest regions of the country [49]. The Nepal Nutritional Status Survey (NNSS) was the first large-scale nutrition study conducted in Nepal in 1975. Over the next 50 years, further research explored the individual and geographic variation in nutritional indicators (including the large demographic health surveys between 1996 and 2022) [50]. Malnutrition was associated with hunger and poverty, which created a vicious cycle reinforcing each other [51].

Causes and drivers of malnutrition

Poor agricultural productivity (lacking irrigation), fertilizers, and dependency on harsh climates often leading to poor harvests have historically been described as major drivers of nutritional deficiencies in Nepal [50]. Both macro- and micro-nutrition deficiency appeared as the major cause of ill-health (though longitudinal examination of the effect on health has not been conducted till this date, leaving us to rely on epidemiological data from elsewhere). Iodine deficiency, for example, affected nearly 27% of school-going children in the 2000s [52], and goitre was an endemic health issue in the hilly and mountainous areas of the country, while the effect of iodine induced thyroid dysfunctions in recent years is yet to be evaluated [53]. The Nepal Family Health Survey (NFHS) 1996 indicated that 57% of children under 5 years were stunted, 15% were wasted, and 42% were underweight [54]. The vitamin A supplementation coverage for children aged 6–35 months was 32.2%, and night blindness among pregnant women aged 15–49 years was 18% [54]. Similarly, a subsequent Micronutrient Status Survey of 1998 reported a very high prevalence of anaemia among preschool children and women of reproductive age (15–49 years), of 78% and 76%, respectively [55].

The Nepal Demographic Health Survey 2001 reported that two thirds (68%) of infants under 6 months were

exclusively breastfed, 40% of newborns received prelacteal feedings, and two thirds (66.2%) of children aged 6–9 months received breast milk along with timely complementary feeding [56].

Nutrition transition, policies and interventions

Nepal has made some progress in nutrition-related indicators, particularly those targeted towards women and children under 5 years old. For instance, the stunting rates have declined from 66% (1996) to 25% (2022), and wasting has declined from 11% (1996) to 8% (2022) [54, 58]. While there is still much work to be done on continuous monitoring of nutritional status among the marginalized and remote populations, including children, pregnant women and the elderly, the current policies and initiatives are important steps towards addressing the issue of malnutrition in Nepal [57].

There was a strong shift of the population from rural to urban centres from the 1970s to the early 2000s, in part due to transition away from an agrarian economy and internal conflicts. This closely follows global trends in urbanization. During this period, the country has undergone significant changes in food habits, lifestyle – as results of marginal improvement in economic status, and an increased purchasing power of households [59, 60]. The consumption of processed foods (and beverages) high in sugar, salt and saturated fat, as well as the culture of dining out, have become a popular phenomena in the country, resulting in a dietary transition [59, 60]. As a consequence Nepal is now facing the double burden of undernutrition as well as overnutrition [61].

Nepal's nutritional transition shows shifting dietary patterns among the growing urban population. The Nepal Demographic and Health Surveys indicated an increasing trend of being overweight and obesity among women (aged 15–49 years), rising from 9% in 2006 to 13% in 2011, to 22% in 2016 [62] and 35% in 2022 [63] (among women aged 20–49 years). A 2017 study conducted among school children (6–13 years) in the Lalitpur district, showed that 25.7% of children were either overweight or obese [64]. The corresponding data for men aged 15–49 was 17% in 2016 [62] and 32% in 2022 [63]. High consumption of salt leading to increased blood pressure was also observed. The COBIN Salt Survey 2018 [65] and the STEPS survey 2019 [66] reported that the average dietary salt intake of the Nepali population was 13.28 g/day and 9.1 g/day, respectively, which is double the WHO recommendation of < 5 g/day. High salt intake, being overweight, and obesity are the risk factors for diet-related NCDs such as hypertension, heart disease, stroke, diabetes and cancers. These conditions are growing concerns and contribute to the higher morbidity and mortality rates in Nepal [67]. Alongside increased population demands for food, there has been a rise in the use of pesticides, leading to higher levels of pesticide residues in consumables [68]. High residual pesticides in food are linked to wide range of health impacts including development of cancers, hormonal dysfunctions, increased risk of infectious diseases, antimicrobial resistance and neurological disorders [68].

The Government of Nepal has implemented several nutrition-related policies and initiatives to improve the nutrition status of its population since the 1970s. These policies and strategies are focused on improving access to nutritious foods, promoting healthy behaviours and practices, and improving access to essential health services [57]. Some of Nepal's nutrition-related policies, strategies, guidelines and acts are summarized in eSupplementary Table 3. The emergence of nutrition policies, including the fortification of salt (iodization) and wheat flour (with iron, vitamin A and folic acid), nutritional supplementation (vitamin A, iron and folic acid), measures to support better cooking practices, the establishment of nutritional rehabilitation centers, and awareness-raising and behaviour change communication interventions, has significantly shifted nutrition dynamics in Nepal [57]. The government has also launched some targeted programmes to improve access to essential health services for pregnant and lactating women and children under 5 years of age [57].

Child health programmes and interventions

Apart from nutrition sector, several initiatives have taken place in child health. Child health programmes in Nepal focus primarily on immunization, nutrition and control of diarrhoeal and acute respiratory infections, mainly around acute conditions [69]. Attributed to these successful programs, Nepal has made substantial progress in the last 80 years in reducing neonatal mortality from 97 to 21 per 1000 live births in 2022. Nonetheless, it is still a major challenge for the country to achieve its Sustainable Development Goal target of 12 per 1000 live births by 2030. One of the early child health interventions was the introduction of the vitamin A supplementation programme in Nepal. This programme was based on the findings that there was four times higher mortality among children with vitamin A deficiency compared with their counterparts [70, 71]. The vitamin A supplementation programme was formally adopted by the Government of Nepal in 1992, with some trials, it was expanded to all districts of Nepal in 2002 [71]. Female Community Health Volunteers (FCHVs) played extremely important roles in reaching the children (aged 6 months to 5 years). In 1999, deworming was also added to the programme, with the aim to reduce child anaemia. [71]

The burden of respiratory illness and diarrhoea among Nepalese children were historically high, and are still considered major killers. A pilot study (1986–1989) [72] in the Karnali region of Nepal demonstrated that community-based volunteers could correctly identify and treat pneumonia if trained well, and followed up correctly using a locally adapted algorithm. The result from the programme showed that there was 28% reduction in child mortality [71], and eventually evolved one of the most successful interventions in community-based management of childhood illness (CB-IMCI) in Nepal in 1999. These efforts culminated in the National Newborn Health Strategy (NNHS) 2004 which strongly advocated for and outlined future actions to prevent deaths from severe bacterial infection in newborns. The CB-IMCI programme included a broad spectrum of child healthcare from communities to health facilities that included acute respiratory illness, childhood diarrhoea, malnutrition, and malaria. A trial was conducted in the eastern Terai region of Nepal, which included FCHVs assessing for possible severe bacterial infection using an algorithm, initiating treatment using oral antibiotics, and facilitating referral to first level health facilities [73]. This eventually evolved as a community-based newborn programme (CB-NCP as a parallel programme to CB-IMCI) in 2007. Due to their overlapping components, the IMCI and NCP programmes were eventually combined as one programme (named as CB-IMNCI) after rigorous evaluation of the initial results from scale-up of CB-NCP in 2014. It has to be noted that these community-based programmes were founded on the FCHV programme which commenced in 1988 with the aim to increase social participation in maternal and child health [71]. Key policies, and activities that affect child health programs are outlined in e-Supplementary Table 5.

It is crucial for the government to prioritize efforts in managing both forms of malnutrition (under and overnutrition), immunization and community-based newborn and child health programmes. Addressing the growing concerns of overnutrition in recent times, Nepal's Multisectoral Action Plan for the Prevention and Control of NCDs (2014–2020) (extended version 2021–2025) has laid the foundation for further development of plans, policies and activities to mitigate the threat of the growing burden of obesity and being overweight [74].

Emerging topics in public health

Climate change and health

The diverse climatic zones and topography are sensitive to global climate cycles. Nepal has a special topographic feature that makes it vulnerable to climatic changes more than any other country. Since Nepal hosts glaciers, snow-capped mountains, and high-altitude regions with the world's top eight mountains (with altitudes > 8000 m), it inevitably incurs a potential danger of climatic impacts. For instance, the surge in global temperature has affected Nepal's macro and microclimates [75]. Recent studies showed depletion in vegetation, and depleting snow covers in mountains due to the rising climate crisis. Further, melting glacier ice will lead to the formation (and increases in water levels) of glacier lakes. With 2315 glacier lakes, and 20 in danger of a glacier lake outburst flood (GLOF), further research is needed to understand the effect of GLOF events on human and planetary health in valleys downstream [76].

In recent years, Nepal has experienced a range of climate-related events, including flooding, landslides and droughts, which have led to significant health impacts for the population [77]. As temperatures rise and precipitation patterns change, diseases such as malaria and dengue fever are becoming more common in areas where they were previously uncommon. Recent epidemiological analysis of the dengue incidence in Nepal showed the increasing prevalence of dengue and its vector across geographic regions [78, 79]. The vector for dengue and visceral leishmaniasis was found to be ascending towards higher altitude areas previously considered non-endemic [78]. The increased incidence of these diseases is putting a significant strain on Nepal's health system and is leading to increased morbidity due to infectious diseases (e.g. dengue) [75]. Nepal must take action to mitigate the impacts of climate change and adapt to the changing climate to protect the health and wellbeing of its population. This will require a concerted effort from all sectors, including government, civil society and the private sector, to promote sustainable development, and increase resilience to climate-related events. By taking action to address the health impacts of climate change, Nepal can help to protect the health and wellbeing of its citizens and build a more sustainable future for all. [80]

Mountain medicine

In total, 80% of the area of Nepal is rich in climate and topography. Despite a significant proportion of the population living at higher elevations, the exploration and understanding of altitude medicine as a problem of explorers and trekkers was a major understatement that triggered Nepali researchers to challenge such a cliché [81]. The first transformative evidence was produced on how lower doses of acetazolamide is adequate to prevent altitude illnesses compared with previous high-dose recommendations [82]. High-altitude populations have unique adaptations acquired over generations due to exposure to a hypoxic environment. Research has evaluated these unique adaptations among the native

population, including those among incoming travellers, collectively known as mountain medicine. With the availability of specialist training, such as a diploma in mountain medicine (DiMM) [83], this field will further benefit a large number of travellers and people living at high altitudes in Nepal and elsewhere (around 83 million people live at > 2500 m above sea level, globally) [84]. By providing education, prevention and treatment, mountain medicine practitioners play a vital role in helping travellers while minimizing the risks associated with living in high-altitude environments.

Genomics, ancestry and pathogen surveillance

Genomics, ancestry and pathogen surveillance are all nascent areas of study in Nepal. Genomics research is helping better understand the genetic basis of various health conditions, while ancestry research is helping to shed light on the genetic history of different communities in Nepal [85–87]. Pathogen surveillance, conversely, is helping to track the spread of infectious diseases and better understand how they are transmitted. For example, the first case of COVID-19 was detected in a returning Nepali student from Wuhan to Kathmandu [88]. The accurate and early reporting of this case marked the surveillance preparedness of the government's specialized infectious disease centre: Sukraraj Tropical & Infectious Disease in Kathmandu. The complete genome analysis of COVID-19 also demonstrated the promptitude in adopting early surveillance for disease epidemics among healthcare workers and researchers [89].

Indigenous health and stewardship

Nepal's indigenous population experience structural disadvantages in accessing health services. The indigenous population may present with a contrasting disease epidemiology compared with their counterparts. For example, sickle cell anaemia is a prevalent condition among Tharu ethnic groups, who have the highest prevalence rates in the country (positive rate: 4.5%) [90]. Despite the ethnic and known genetic diversity, very few large-scale research has been conducted to understand the differences in disease epidemiology, risk factors, health services utilization and outcomes in the indigenous population in Nepal [90]. Additional research on indigenous health, traditional medical practice, and their harmonized living with nature is of immense value and requires more attention.

Digital technology in health

The first used case of digital technology in health was reported in 1999, when satellite phones, data sharing and tele-consultations were used for the mountaineers in the Everest base-camp [91]; not a systematic effort to improve access to basic health services for the general population who were living in remote settings. A recent review summarized over a dozen digital health interventions that have been used to date [91]. The digital health interventions included: tele-consultation and video conferencing (for epilepsy management, supporting emergency services), patient tracking and data collection (e.g. Bahmni, Dimagi), smartphone-based devices (for screening ear health – potential diagnosis and referral), image sharing and decision support (supporting rural health workers and specialists in the higher centre – supporting primary health care in rural and remote mountains for basic health services) [91].

The COVID-19 pandemic, and the period that followed, led to innovations in digital technology that benefitted a wider audience than ever before. For instance, during the peak pandemic period, from March 2020 through to August 2021, a virtual healthcare system was established in Nepal that offered telehealth consultations to provide health services to Nepalese migrant labour workers living overseas [92]. The service included mental health and other specialists, and offered both urgent and non-urgent care. This service could not be called a real "telemedicine" or "telehealth service" due to trans-border accreditation issues. Similarly, physician's Viber phone numbers were placed on hospital websites, posted on social media and distributed to each follow-up patient via a phone call for blood cancer patients based in Nepal [93]. A triage and clinical service based on home-based telehealth was offered to domestic patients who had COVID-19-like symptoms [94]. More recently, text messaging focusing on specific health issues such as hypertension and mental health issues, has been trialled and evaluated [95, 96]. However, such initiatives have not yet become the mainstream practice. Overall, small-scale studies were implemented on the basis of special health issues, and none of these considered offering basic primary health services. Despite having enormous potential for improving access to health services, digital health technologies remain undervalued, underfunded and mostly left in the hands of people without the required skills and experience.

The Nepalese health system has recently acknowledged the importance of digital health technologies and their potential benefits. The Nepal Health Sector Strategy (NHSS) 2015–2020 stated, "*use of technologies, such as telemedicine and m-Health, to increase access to health care services*" to increase access to healthcare [97]. In line with the NHSS, the National e-Health Strategy (2017) [98] has included almost all digital technologies that have been piloted in Nepal and other possible interventions that have been used globally. Furthermore, the Nepal eHealth Strategy Implementation Roadmap has also been developed, which provides guidance and

overall stewardship moving forwards [99]. The MoHP recently achieved a significant milestone by initiating the interoperability of patient information between hospitals and other health facilities. The directive on electronic medical archive system operation and management, 2025, ensures that the MoHP owns the data; and both private and public health facilities are obliged to maintain patient data on an electronic medical archive system [100]. While these are very important steps, the health system also needs to be careful that such a use of and dependence on information and communication technology does not create a digital divide, aggravating further gaps in access to and utilization of basic health services in Nepal. There is also a need to look beyond the pilot studies and find a way to transform service delivery using the available technologies.

Nepalese health system

Historical period (–1950s)

Nepal has a rich history of traditional healing practices that have existed for centuries. These practices are deeply rooted in the country's culture and are often based on religious beliefs. Traditional healers, known as *"Vaidhyas"*, *"Dhamis"* and *"Jhankris"*, have been the primary providers of healthcare in Nepal for centuries. During several dynasties that ruled the country for the past 1500 years, primarily the *Lichchhavi* kings during the ancient period (1–879 AD) and *Malla* Kings (medieval period 880–1765 AD) popularized the Ayurvedic system [2]. *Aarogyashala* (translated as wellness center) was established in the Kathmandu valley and continued during the reign of the Malla kings [101]. Particularly notable was the Malla King *Jayasthiti Malla*, who introduced birth attendants and formulated a code of conduct that such services should be provided to everybody without caste/ethnicity-based discrimination. This period is later known for pioneering *Baidyas* (Ayurvedic practitioners) which continued for several centuries. Another Malla King, *Pratap Malla* established a state-owned dispensary in Kathmandu. Whilst in the golden age of the Ayurvedic system, allopathic medicine was slowly introduced mostly through Christian missions. At the reign of King Pratap Malla, three allopathic clinics were established in Kathmandu, Bhaktapur and Lalitpur. Later during the reign of the modern Shah kings and Ranas (1766–1951), smallpox vaccination was started, the first notable public health intervention in the country. Leprosy asylums started to emerge in 1857 to isolate and host leprosy patients; this was probably the country's first health institution ever established. The first mention of a doctor trained in modern medicine was Dr H.A. Oldfield, who served under British residency in Kathmandu [101]. Later Rana rulers established dozens of health outposts or dispensaries in 35 districts, mainly providing treatment for infectious diseases such as cholera, tuberculosis, and maternity services. During this period, malaria control units were also introduced in Terai plains. Unsurprisingly, such public services during the Rana regime came through a hefty land tax [101]. Health system development has since accelerated in the post-democracy period (1952 onwards).

Historically, Nepal had a high burden of infectious diseases such as tuberculosis, diarrhoea and malaria. The life expectancy at birth was low (mean of ~30–40 years in 1880, increasing to ~40–45 in the 1990s, and 70 years in 2022) [102], and the mortality rate was high, with a significant number of deaths occurring in children under the age of 5 years. Contrarily, the healthcare system was weak and access to healthcare services was limited to the ruling class [2, 7]. It was not until 1889 that the first hospital, Bir Hospital (named after the Rana Premier Bir Shamsher), with a capacity of 15 beds in the country's capital, and a few drug dispensaries in Terai plains were established [101]. After nearly 40 years of having the first hospital, the Civil Medical School and Dispensary Office were established to produce compounders and dressers in 1934, including the training of Ayurvedic physicians [101]. Ayurvedic systems saw a parallel expansion, but it was not until 1915 when the first Rajakiya Ayurvedic Bidyalaya (Royal Ayurvedic School) was established in Kathmandu.

Unsurprisingly, the parallel evolution of modern medicine and Ayurvedic systems are shaped by ethno-cultural and religious practices, and echoes the broader regional development of health systems [103]. The country's diverse cultural practices influenced healthcare practices and pluralistic health care practices that co-exist, including the use of traditional medicine along with modern medicines. In modern times, many Nepalese still prefer traditional healing practices, and the use of traditional medicine continues to be widespread in the country [2, 104]. Although the traditional health system is heavily superseded by modern medicine, owing to the Western epistemic dominance. [105]

Modern period (1950–1990)

Health workforce and hospital services

In 1954, a mission hospital was established in Tansen (western Nepal) under United Mission to Nepal (UMN), and established women's and children's welfare clinics in the Kathmandu [2]. Two years later, the government declared to establish one health centre in each of 109 electoral constituencies, initiating health services to the subdistrict level, and made a policy decision to establish hospitals in 35 districts. In 1961, the government established zonal hospitals in all 14 zones to provide secondary

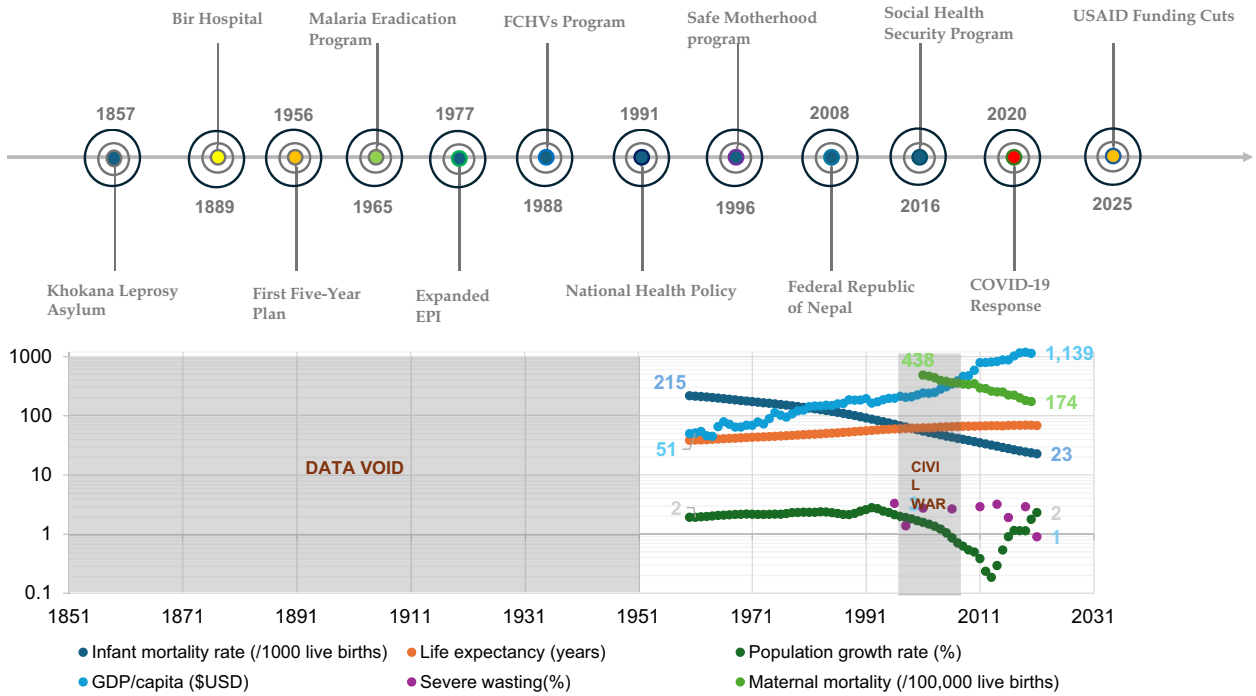

Fig. 3 Chronological development of Nepal's health and political landscape (1800s–2020s). This is based on further expansion of the authors' earlier work [1]. The use of // is used to show that the gaps between these milestones are not exactly proportional compared with those between other milestones. *EPI* expanded programme in immunization, *FCHVs* female community health volunteers

care [2]. The key historical milestones are summarized in Fig. 3.

In 1972, the government established a medical and nursing training school to produce paramedics and nurses. The Institute of Medicine (IoM) under Tribhuvan University started certificate-level programmes in nursing, general medicine, health laboratory, pharmacy, radiotherapy, physiotherapy, health education and sanitation [2]. In 1978, IOM enrolled the first batch of medical graduates. In the mid-1980s, an in-service health training centre was established in Kathmandu, and a regional hospital was established in Pokhara. In the 1970s, vision care was expanded across the country with the establishment of the Nepal Eye Hospital in 1973. [101]

Public health

In 1956, Nepal's first public health project (the Malaria Eradication Project) was started. In 1975, with the production of mid-level health workers, the Government of Nepal established 1462 health posts to progressively scale-up basic health services. The Alma-Ata declaration of 1978 further solidified the focus on preventive and promotive healthcare [106], embracing principles of primary healthcare and initiating actions to integrate vertical projects. In 1988, the organization of local mothers groups and female community health volunteer programmes were initiated. During this period, the first Long-Term Health Plan (FLTHP) of Nepal (1975–1995) came as a landmark policy initiative driving the country's healthcare infrastructure, improving health care access through gradual expansion of primary healthcare services and strengthening of community-based healthcare.

Post-democracy (1991–2016)

After adopting economic liberalization post-democracy in 1991, the first National Health Policy was approved. This health policy opened options to establish primary health facilities in all 4000 local administrative units (previously recognized as village development committees) [7]. The government adopted a liberal economic policy that opened the door for private providers such as private hospitals and medical colleges. Although private providers are recognized to enhance the health services, their sprouting growths were concentrated in urban areas, further deepening the health service differences between urban and rural regions [2, 104]. Despite awareness of the distorted health services landscape brought by private providers, mitigation strategies are inadequate and their paradoxical number alone (not the quality and their

coverage for rural populations) continues to deceive the health services landscape of Nepal [107].

There was some organogram development within the MoHP in the 1990s. For instance, some centres and departments were established, including the National Health Training Center (1993), the Logistic Management Division (1993) and the Integrated Health Management Information System (1994) at the central level in Kathmandu. District health offices in all 75 districts and regional health directorates across the five development regions were also established. In 1996, autonomous hospitals were established including Sahid Gangalal National Heart Center in 1995 and BP Koirala Memorial Cancer Hospital in 2004. The Second Long Term Health Strategy (SLTHP) (1997–2017) that came in this period was a milestone in terms of setting up vision for improved health services – particularly among women, children and disadvantaged groups, reducing inequalities [2, 104], improving health care quality and strengthening partnerships between the private sector, NGOs and international development partners. The SLTHP provided foundation for Nepal's subsequent policies, including the development of Nepal Health Sector Strategies (NHSS) between 2015–2020 and 2023–2030 [108, 109].

Post economic liberalization (1991–2016), there was a change in the health system structure; the involvement of private sectors in health workforce development [through public and private training schools under Council for Technical Education and Vocational Training (CTEVT)] and several medical/dental colleges affiliated with public and private universities; privatization of health services (private hospital services for tertiary care); and the influence of external development partners in health systems.

Post-federalization (2016–)

Restructuring of the health system

Nepal has a three-tier federal health system in line with the governance system: federal, provincial, and local or municipal governments. Nepal's current health system has decentralized the resources and authorities to provincial and local governments. All central-level health facilities are governed by the federal government, which refers to the third tier of the health system. These facilities provide tertiary care, including specialist care. The second tier of the health system includes provincial hospitals and health offices/hospitals managed by the provincial governments. These facilities provide specialized care. The Ministry of Social Development/Health of each province governs the provincial health system. Local governments or municipal governments govern the first tier of health system. Health facilities under the first tier of health systems include community (community health clinics, outreach clinics), and ward-level facilities (health posts), primary health care centers, and hospitals with less than 15 beds [110]. These facilities provide essential primary health care services. A total of 753 municipalities (with 6743 wards) have health sections that govern their ward-level health facilities. Currently, the public health services are delivered through a wider network of 7221 public health facilities (125 hospitals, 205 primary health care centres (PHCCs), 395 Ayurvedic facilities, 3870 health posts (HPs) and 2626 community health centres), which fall under the jurisdiction of any of these three tiers of government [111, 112].

Nepal has adopted a mixed healthcare financing system in line with the healthcare delivery system, whereby goods and services are provided by both the public and private sector. The federal MoHP uses a top-down approach of policy and planning, with most of the health budget retained at the federal level [113, 114]. There are government-funded health programmes for basic health services and other vertical programmes such as tuberculosis, HIV/AIDS, malaria, safe motherhood, insurance-based tertiary services, and private health services through out-of-pocket expenditure (OOP). The basic health service is provided free of cost through public primary health facilities, and specialized services are provided either through insurance, vertical programs or OOP in those facilities [115].

A National Health Insurance Program (NHIP) is being implemented (since 2016) as an alternative health financing arrangement to support UHC. In its early year of implementation, NHIP has suffered from low population coverage and high dropout, concerns with financial sustainability due to higher payments to providers against the contribution amount collected, poor insuree satisfaction with the quality of the services and behaviour of the providers, among others [115]. Nepal's 2015 constitution allowed a shift from a unitary governance system to a federal republic with seven provinces, and local governments (municipalities and rural municipalities) which requires further alignment and harmonization among the structures.

Primary health care

Nepal's primary health care system plays a critical role in providing essential health services to the population. Primary health care facilities such as PHCCs and HPs are the first point of contact for individuals seeking basic health care services at the community level. Health posts provide basic level of primary health care facilities and are usually located in rural areas. They provide essential health services, such as immunizations, family planning, and maternal and child health services, as well as treatment of minor injuries. Conversely, primary health care centres provide more comprehensive health services,

including emergency care, outpatient and inpatient care, basic laboratory services, and some diagnostic services [7].

Nepal's primary health care is organized around a primary health care model, with health facilities managed by local governments. This model aspires to ensure that health services are accessible to the population, particularly in rural areas. Aligning with this objective, it has also allowed greater community participation in health care planning and delivery. At the primary care level, peripheral health institutions: starting from the community health workers (e.g., FCHVs), HPs, and PHCCs effectively provide services for most of the population. Each community health worker served up to ~200 (95% CI 160–240) community members a year and varied between geographic locations [7]. The second tier of a primary health care system includes a network of health outreach units, HPs and PHCCs that serve up to ~20 000 (95% CI 16 000–24 000) patients a year. The third tier of the health care system, including former district and provincial hospitals, served up to ~100 000 [95% CI 80 000–120 000] patients a year. The fourth and highest tier of the health care system, including selected tertiary-level health care hospitals, provided a range of specialized services serving up to ~0.66 (95% CI 0.53–0.80) million patients in a year [7]. These figures have been described in detail in our earlier work [7]. Remarkably, the primary health care level is boosted by the presence of nearly 50 000 FCHVs (167 per 100 000 population) [116].

Further, HPs and PHCCs are served by a mix of auxiliary health workers, auxiliary nurse midwives and health assistants providing year-round services (in major areas including maternal and child health, nutrition, and limited services on non-communicable diseases) [117]. The PHCCs, in addition to HPs, consist of a sanctioned position for a doctor, staff nurse and laboratory technician, although their services in practice are affected by their consistent attendance. Each level of these health facilities is also accountable towards the local health facility management committees, which consists of elected and key members of communities. Two key outreach programs make the primary health care system in Nepal unique. The Expanded Programme on Immunization (EPI) is an outreach programme that offers immunization in local communities without the mothers, newborns, infants, and other eligible consumers having to go to the HPs/PHCCs. This outreach service has generated an excellent result in achieving the national immunization targets [117]. Second, but less functional, are primary health care outreach clinics, which despite their potential, have hardly been utilized or delivered to their full potential. In a nutshell, the current primary health care system in Nepal has potential for increasing service efficiency provided there is a strong focus on human resources and spending.

Discussion

Summary

Nepal's health, disease and demographic landscape has evolved over the past two centuries. Our findings highlight an important shift in Nepal's disease landscape coinciding with demographic and political changes. These shifts have posed significant pressure on the health system, often falling short in ensuring quality and coverage of health services. Growing inequities in health services, including shortages in health care workers, is likely to pose increasing challenges [107]. Advances through innovation are necessary to reduce the cost of health services whilst increasing quality and access.

Comparison with existing literature

Nepal has received accolades for its efforts in improving maternal and child health [7]. However, Nepal still faces significant challenges in other areas. Nearly 5 million Nepalese people live under multidimensional poverty (deprived of affordable housing, clean cooking fuel, schooling, assets and nutrition) – just under 18% of the population in 2021 [118]. The country has high rates of malnutrition, particularly among children, and there are significant disparities in health outcomes between urban and rural areas and across administrative provinces. In addition, Nepal faces significant challenges in addressing NCDs such as hypertension, diabetes, cancer, chronic kidney disease and cardiovascular diseases [8]. It is estimated that NCDs will contribute to nearly two thirds of all deaths by 2030 in Nepal. Providing NCD services will require the government to spend up to nearly 22% of total health care expenditure (US$ 8.76/person), thus strengthening government investment for NCD services will be vital for achieving UHC by 2030 [119, 120].

Nepal can draw key lessons from India and other South Asian countries in streamlining its health system, particularly in leveraging the private sector, technology and primary healthcare reforms. The role of private practitioners in bridging healthcare gaps and achieving UHC [121] highlights how Nepal can integrate private providers to expand service delivery, especially in under-served areas. This integration should be supported by regulatory frameworks, quality assurance mechanisms, and strategic partnerships to ensure accessibility while maintaining affordability and standards of care. The adoption of technology, such as drone-based delivery of medicines and vaccines in remote regions [122], underscores the potential for Nepal to improve healthcare access in its

geographically challenging terrains. India's Health & Wellness Centers initiative [123] demonstrates the value of strengthening primary care infrastructure, while community action models [124] emphasize participatory approaches to health governance. In addition, lessons from Ayushman Bharat [124, 125] underscore the importance of financial protection mechanisms in achieving universal health coverage. These insights, particularly in the context of recent primary healthcare reforms in low- and middle-income countries (LMICs), suggest that Nepal should prioritize strengthening the public health system whilst integrating public and private actors, and incorporating digital innovations and community engagement to enhance accessibility and equity in healthcare. Furthermore, evolving the One Health approach – linking human, animal and environmental health – provides valuable insights for Nepal, where zoonotic diseases and environmental challenges pose significant public health risks. Integrating One Health principles into Nepal's health policies can enhance disease surveillance, improve responses to emerging health threats and foster cross-sector collaboration [126].

Health disparities are present throughout Nepal, as is the case in South Asia and globally [127]. With the increasing digitalization of health systems, these disparities will further deepen among poorer and remote pockets of the country, where the population has no access to even basic digital infrastructure or the means to afford digital tools (e.g. smartphones) [128]. In contrast, countries such as India and Bangladesh have made significant investments in e-health infrastructure through their home-grown mobile devices and have made greater progress in adopting digital health technologies [129]. Echoing such regional developments, Nepal needs a renewed focus to digitalize health infrastructure: tele-consultation and video conferencing (for disease management and supporting emergency services), smartphones (for screening health conditions), image sharing (for decision support), supporting rural health workers, and building referral linkages with specialist in the higher centres. [91, 130]

Digitalizing health infrastructure will be challenged by Nepal's limited capacity and experience in digital innovation. Addressing these challenges will require a continued commitment to investment in healthcare infrastructure and building regional alliances and knowledge transfers. By addressing these challenges, Nepal can continue to improve healthcare outcomes and build a resilient health system for the future.

Way forward

It is difficult to predict the future for the Nepalese health system, but there are some clear signs that the country's health sector will significantly improve in the short and long term provided the current trend continues without significant natural, social, geographical and political disruptions. The country's health and medicine sector are likely to undergo significant changes driven primarily by population growth, changing disease patterns, advancements in technology and medical research, and evolving healthcare policies and systems [2, 7, 104]. We assert that three major areas will always be at the centre: health financing and governance, service expansion (increased digitalization) addressing emerging health priorities such as NCDs, and workforce development and retention. [7]

The health workforce shortags will be a formidable challenge in the forthcoming years, as qualified health workforce drainage to developed countries continues to become an irresistible offer because of the multi-pronged and disproportionate incentives [131]. While health care workers are vital elements of health system, focusing only on production of health care workers (doctors, nurses and paramedics) is not sufficient to strengthen the health system. Mobilizing a massive network of community health workers can alleviate pressure on an already stretched health system. A broader view on increasing opportunities and retention of health care workers including allied health professionals, such as researchers, public health professionals and policy experts, are crucial. Unless prudent measures that offer providence, support and safety to healthcare workers are put in place the drain will likely continue in an increasing trend [41, 132]. Corruption and governance issues could potentially undermine the delivery of quality and essential health services, necessitating the use of bottom-up community-engaged interventions for service expansion [133]. With the relevant policies, investments and partnerships, Nepal has the potential to build a healthcare system that can provide health services for all, whilst addressing gaps and disparities in health care.

Limitations

The study has several limitations. First, inherent in the interpretative analysis and synthesis, findings might have been influenced by the authors' prior epistemic backgrounds, including biases. Second, limiting the inclusion of literature published in English may have omitted details that may have been documented in the Nepali language. Nonetheless, despite Nepali being the lingua franca in Nepal, academic literature are largely limited to the English language. The early academic literature about Nepali health system is largely contributed by foreign expats, supported by funding from international agencies. Thus, the vast majority of academic and grey literature on health systems are reported in the English language. Because of the breadth covered in this

literature review, some of the sections suffered from scarce data and implies the need for further research and development in future. Furthermore, despite our structured approach in literature searches, we may have inadvertently missed relevant studies due to variability in search strategies and inclusion criteria, or literature not being in the public domain for retrieval.

Conclusions

Nepal's health care landscape has continuously evolved over the past centuries, coinciding with key demographic and political changes. To improve the health and wellbeing of the population, better functioning of health systems through monitoring and accountability structure, investments in infrastructure and human resources, as well as a sustainable and locally tailored health financing are necessary for ensuring quality health services for all. Special measures are needed to address the increasing exodus of health professionals from Nepal, which echoes the wider *fuite des cerveaux* (brain drain) observed across multiple sectors in the country. While the road ahead is a tough one, embracing innovation through digital technology, fostering strong partnerships and employing evidence-based interventions can achieve our vision of health for all.

Abbreviations

AMS	Acute mountain sickness
BCC	Behavioural change communication
NHSS	Nepal Health Sector Strategy
GON	Government of Nepal
COPD	Chronic obstructive pulmonary disease
CTEVT	Council for Technical Education and Vocational Training
GLOF	Glacial lake outburst flood
OOP	Out-of-pocket expenditure
MDG	Millennium Development Goals
MoHP	Ministry of Health and Population
mhGAP	Mental Health Gap Action Programme
NCDs	Non-communicable diseases
NHIP	National health insurance program
NGOs	Non-governmental organizations
PoSHAN	Policy and science of health, agriculture and nutrition
PAHAL	Promoting agriculture, health, and alternative livelihoods
PTSD	Post-traumatic stress disorders
SABAL	Sustainable action for resilience and food security
SUN	Scaling Up Nutrition
COBIN	Community-based management of non-communicable diseases
STEPS	STEPwise approach to surveillance
WHO	World Health Organization
TPO	Transcultural psychosocial organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12961-025-01321-z.

Additional file 1: Figure 1. Flow diagram of the review process. Table 1. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist. Table 2. Search terms used for the review. Table 3. Historical milestones of maternal health service delivery in Nepal. Table 4. Nutrition related policies in Nepal from the 1960s to 2020s. Table 5. Health policy with focus on MNH policy reform trajectory in the last three decades (1990–2019) in Nepal [110]

Additional file 2.

Acknowledgements

Authors would like to thank Dr Shreedhar Paudel for providing comments and feedback on the draft of the paper as well as helping with the fact checking.

Author contributions

All authors contributed to the study conceptualization. S.R.M. and B.A. conducted the literature synthesis with inputs from K.G., V.K., D.A., B.S., P.K., S.Y., V.S., D.S. and R.K. B.J., R.K. and V.K. performed the additional literature searches, which were later expanded by all authors for drafting their individual literature sections. All other authors contributed to drafting and editing the final version of the manuscript.

Funding

The authors declare that there was no specific funding for the study. BA is affiliated with the Mahidol-Oxford Tropical Medicine Research Unit (MORU), which is funded by the Wellcome Trust (220211/Z/20/Z). For the purpose of Open Access, the author has applied a CC BY public copyright license to any Author-Accepted Manuscript version arising from this submission. The funder had no role in the writing or preparation of the manuscript.

Data availability

The literature synthesized in this study is freely available through PubMed/Medline and Google Scholar.

Declarations

Competing interests

The authors declare no competing interests.

Author details

[1]Nepal Development Society, Bharatpur-6, Chitwan, Nepal. [2]School of Medicine, Western Sydney University, Sydney, Australia. [3]Bloomberg School of Public Health, Johns Hopkins University, Baltimore, USA. [4]Menzies School of Health Research, Charles Darwin University, Alice Springs, NT, Australia. [5]Nepal Intensive Care Research Foundation, Kathmandu, Nepal. [6]Center for Research on Education Health and Social Science, Kathmandu, Nepal. [7]Bergen Centre for Ethics and Priority Setting in Health (BCEPS), Department of Global Public Health and Primary Care, University of Bergen, Bergen, Norway. [8]Department of Psychiatry and Behavioural Health, Penn State University, Pennsylvania, USA. [9]Richard M. Fairbanks School of Public Health, Indiana University Indianapolis, Indianapolis, USA. [10]School of Public Health, University of Queensland, Brisbane, Australia. [11]Health Social Science and Development Research Institute, Kathmandu, Nepal. [12]Division of Global Health Equity, Department of Medicine, Brigham and Women's Hospital, Boston, MA, USA. [13]Management Sciences for Health, Arlington, Virginia, USA. [14]Mahidol-Oxford Tropical Medicine Research Unit, Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand. [15]Centre for Tropical Medicine and Global Health, Nuffield Department of Clinical Medicine, Oxford, UK. [16]NHMRC Clinical Trials Center, Westmead Applied Research Center, Faculty of Medicine and Public Health, University of Sydney, Sydney, Australia.

Received: 10 October 2024 Accepted: 30 March 2025
Published online: 20 May 2025

References

1. Adhikari B, Ozaki A, Marahatta SB, Rijal KR, Mishra SR. Earthquake rebuilding and response to COVID-19 in Nepal, a country nestled in multiple crises. J Global Health. 2020. https://doi.org/10.7189/jogh.10.020367.
2. Dixit HJ. Nepal's quest for health (the health services of Nepal). 2014.

3. United Nations. Human Development Index Nepal 1990 to 2019. 2024. https://hdr.undp.org/data-center/specific-country-data#/countries/NPL Accessed 21 April 2024.
4. Gardner H, Miles G, Saleem A, et al. Social determinants of health and the double burden of disease in Nepal: a secondary analysis. BMC Public Health. 2022;22(1):1567.
5. Karkee R, Tumbahanghe KM, Morgan A, et al. Policies and actions to reduce maternal mortality in Nepal: perspectives of key informants. Sexual Reprod Health Matters. 2022;29(2):1907026.
6. Erchick DJ, Lackner JB, Mullany LC, et al. Causes and age of neonatal death and associations with maternal and newborn care characteristics in Nepal: a verbal autopsy study. Archi Public Health. 2022;80:1–10.
7. Adhikari B, Mishra SR, Schwarz R. Transforming Nepal's primary health care delivery system in global health era: addressing historical and current implementation challenges. Globalis Health. 2022;18(1):1–12.
8. Mishra SR, Neupane D, Bhandari PM, Khanal V, Kallestrup PJG. Burgeoning burden of non-communicable diseases in Nepal: a scoping review. Globalis Health. 2015;11(1):1–10.
9. Arksey H, Omalley L. Scoping studies: towards a methodological framework. Int J Soc Res Methodol. 2005;8(1):19–32.
10. Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467–73.
11. Van Olmen J, Criel B, Van Damme W, et al. Analysing health systems to make them stronger. 2010.
12. World Health Organisation. Monitoring the building blocks of health systems. Geneva: World Health Organisation; 2010.
13. Gardner H, Miles G, Saleem A, et al. Social determinants of health and the double burden of disease in Nepal: a secondary analysis. BMC Public Health. 2022;22(1):1–12.
14. Gyawali B, Khanal P, Mishra SR, van Teijlingen E, Wolf MD. Building strong primary health care to tackle the growing burden of non-communicable diseases in Nepal. Glob Health Action. 2020;13(1):1788262.
15. Vos T, Lim SS, Abbafati C, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. 2020;396(10258):1204–22.
16. Pandey AR, Chalise B, Shrestha N, et al. Mortality and risk factors of disease in Nepal: trend and projections from 1990 to 2040. PLoS ONE. 2020;15(12): e0243055.
17. Theuvenet W, Soares D, Baral J, et al. Mass survey of leprosy in Lalitpur district. Nepal. 1994;62:256.
18. Rai SK. Changing trend of infectious diseases in Nepal. Infectious Diseases and Nanomedicine III: Second International Conference (ICIDN-2015), Dec 15–18, 2015, Kathmandu, Nepal; 2018: Springer; 2018. 19–38.
19. Mirzoev TN, Baral SC, Karki DK, Green AT, Newell JN. Community-based DOTS and family member DOTS for TB control in Nepal: costs and cost-effectiveness. Cost Effect Resource Alloc. 2008;6:1–8.
20. Darukaradhya TB, Krishnamurthy J. Modifying non-communicable disease behaviours through effective health communication and behaviour change: a systematic review. Prevent Med: Res Rev. 2025;2(1):24–39.
21. Takhelchangbam ND, Saxena D, Singh NP, Singh A. Epidemiology of double burden of malnutrition: causes and consequences. Prevent Med: Res Rev. 2024;1(6):305–9.
22. Adhikari B, Pokharel S, Mishra SR. Shrinking urban Greenspace and the rise in non-communicable diseases in South Asia: an urgent need for an advocacy. Front Sustain Cities. 2019;1:5.
23. Mishra SR, Shrestha N, Gyawali B, et al. The changing patterns of non-communicable diseases and injuries in Nepal from 1990–2017: a review of evidence from Global Burden of Disease Study 2017. 2020.
24. Sharma A, Kaplan WA, Satheesh G, et al. Health system capacity and access barriers to diagnosis and treatment of CVD and diabetes in Nepal. Glob Heart. 2021;16(1):38.
25. Shrestha A, Maharjan R, Karmacharya BM, et al. Health system gaps in cardiovascular disease prevention and management in Nepal. BMC Health Serv Res. 2021;21(1):1–13.
26. Mishra SR, Khanal P, Khanal V. Sustained neglect in mental health during Nepal's crises. Health Prospect. 2018;17(1):4–7.
27. Global IDP Project. Nepal: Up to 200,000 people displaced by fighting remain largely un-assisted. 2004. https://reliefweb.int/report/nepal/nepal-200000-people-displaced-fighting-remain-largely-un-assisted Accessed 12 March 2023.
28. Adhikari B, Mishra SR, Marahatta SB, et al. Earthquakes, fuel crisis, power outages, and health care in Nepal: implications for the future. Dis Med Public Health Preparedess. 2017;11(5):625–32.
29. Singh R, Gupta AK, Singh B, Basnet P, Arafat SY. History of psychiatry in Nepal. BJPsych Int. 2022;19(1):7–9.
30. Rai Y, Gurung D, Gautam K. Insight and challenges: mental health services in Nepal. BJPsych Int. 2021. https://doi.org/10.1192/bji.2020.5810.1192/bji.2020.58.
31. Luitel NP, Jordans MJ, Adhikari A, et al. Mental health care in Nepal: current situation and challenges for development of a district mental health care plan. Confl Heal. 2015;9:1–11.
32. Poudel P, Khatri R, Bhatt L, et al. Baseline Status of Basic Health Service Delivery. 2022 Nepal DHS and 2021 Nepal HFS. 2024.
33. Bentley H. The organisation of health care in Nepal. Int J Nurs Stud. 1995;32(3):260–70.
34. World Health Organization. Maternal mortality: ratios and rates: a tabulation of available information. Geneva: World Health Organization; 1991.
35. World Health Organization. Collaboration in health development in South-East Asia 1948–1988: Fortieth Anniversary Volume (Revised). Geneva: World Health Organizat; 1992.
36. World Health Organisation. Maternal Mortality Ratios and Rates: A Tabulation of Available Information. Geneva: World Health Organisation; 1988.
37. Ministry of Health and Population. National Population and Housing Census 2021: Nepal Maternal Mortality Study 2021. https://mohp.gov.np/uploads/Resources/Final%20Report-26%20March-%202023-UPDATED.pdf.
38. Family Health Division of the Department of Health Services of the Ministry of Health/Nepal. National Reproductive Health Strategy. 1998. https://km.mohp.gov.np/sites/default/files/2018-07/RH_Strategy.pdf Accessed 23 Oct 2024).
39. Dulal KP, Khatri R, Kafle RB, Aryal K, Khanal C, Bietsch K. Factors associated with stagnation in modern contraceptive use, declining fertility, increased use of traditional methods, and induced abortion. 2016–2022 Nepal DHS Surveys. 2024.
40. Khanal V, Khanal P, Lee AH. Sustaining progress in maternal and child health in Nepal. Lancet. 2015;385(9987):2573.
41. Adhikari B, Acharya S, Mishra SR. Protecting health-care workers in Nepal: an urgent call for action. Lancet. 2024;403(10433):1233–4.
42. Karki YB, Krishna R. Factors responsible for the rapid decline of fertility in Nepal, an Interpretation: Further analysis of the 2006 Nepal demographic and health survey: Population Division, Ministry of Health and Population, Government of Nepal; 2008.
43. World Health Organisation. Adolescent Sexual and Reproductive Health Programme to Address Equity, Social Determinants, Gender and Human Rights in Nepal. 2017. https://un.org.np/resource/adolescent-sexual-and-reproductive-health-programme-address-equity-social-determinants (Accessed 23 July 2024).
44. Sharma SP. Politics and corruption mar health care in Nepal. Lancet. 2010;375(9731):2063–4.
45. Elia M. Guidelines for detection and management of malnutrition. *Maidenhead: Malnutrition Advisory Group (MAG), Standing Committee of BAPEN* 2000.
46. Stephenson L, Latham M, Ottesen E. Global malnutrition. Parasitology. 2000;121(S1):S5–22.
47. United Nations Development Program. Indicators for monitoring the millennium development goals: definitions, rationale, concepts and sources: United Nations Publications; 2003.
48. Osborn D, Cutter A, Ullah F. Universal sustainable development goals. Underst Transform Chall Dev Count. 2015;2(1):25.
49. Moock PR, Leslie J. Childhood malnutrition and schooling in the Terai region of Nepal. J Dev Econ. 1986;20(1):33–52.
50. Shrestha N, Mishra SR, Ghimire S, Gyawali B, Pradhan PMS, Schwarz D. Application of single-level and multi-level modeling approach to examine geographic and socioeconomic variation in underweight,

overweight and obesity in Nepal: findings from NDHS 2016. Sci Rep. 2020;10(1):1–14.
51. Vorster H. The link between poverty and malnutrition: a South African perspective. Health Sa Gesondheid. 2010. https://doi.org/10.4102/hsag.v15i1.435.
52. Siva N. A sprinkle of salt needed for Nepal's hidden hunger. Lancet. 2010;376(9742):673–4.
53. Singh K. Public health and nutritional aspects of endemic goitre in Nepal. Cassava, Toxicity and Thyroid: Research and Public Health Issues: proceedings of a workshop held in Ottawa, Canada, 31 May-2 June 1982; 1983: IDRC, Ottawa, ON, CA; 1983.
54. Pradhan A, Aryal RH, Regmi G, Ban B, Govindasamy P. Nepal Family Health Survey 1996. Kathmandu, Nepal: Ministry of Health/Nepal, New ERA/Nepal, and Macro International, 1997.
55. Ministry of Health. Nepal Micronutrient Status Survey 1998. Kathmandu, Nepal: Child Health Division, Ministry of Health, HMG/N, New ERA, Micronutrient Initiative, UNICEF Nepal, WHO, 1998.
56. Family Health Division of the Department of Health Services of the Ministry of Health/Nepal, New ERA/Nepal, ORC Macro. Nepal Demographic and Health Survey 2001. Calverton, Maryland, USA: Family Health Division Department of Health Services Ministry of Health/Nepal, New ERA, and ORC Macro, 2002.
57. Paudyal N, Chitekwe S, Rijal S, et al. The evolution, progress, and future direction of Nepal's universal salt iodization program. Maternal Child Nutrition. 2022;18: e12945.
58. Ministry of Health NE, ICF. Nepal Demographic and Health Survey 2022. 2023. https://dhsprogram.com/pubs/pdf/FR379/FR379.pdf.
59. Bishwajit G. Nutrition transition in South Asia: the emergence of non-communicable chronic diseases. Research. 2015;4:8.
60. Subedi YP, Marais D, Newlands D. Where is Nepal in the nutrition transition? Asia Pac J Clin Nutr. 2017;26(2):358.
61. Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the double burden of malnutrition and the changing nutrition reality. The Lancet. 2020;395(10217):65–74.
62. Ministry of Health NE, ICF. Nepal demographic and health survey 2016. *Kathmandu, Nepal: Ministry of Health, Nepal* 2017.
63. The DHS Program. Demographic and Health Surveys (Nepal). 2023. https://dhsprogram.com/Countries/Country-Main.cfm?ctry_id=13&c=Nepal&Country=Nepal&cn=&r=4 Accessed 11 June 2023.
64. Karki A, Shrestha A, Subedi N. Prevalence and associated factors of childhood overweight/obesity among primary school children in urban Nepal. BMC Public Health. 2019;19(1):1–12.
65. Neupane D, Rijal A, Henry ME, et al. Mean dietary salt intake in Nepal: a population survey with 24-hour urine collections. J Clin Hypert (Greenwich, Conn). 2020;22(2):273.
66. Dhimal M, Bista B, Bahttarai S, et al. Report of Non Communicable Disease Risk Factors: STEPS Survey Nepal 2019. Kathmandu, Nepal: Nepal Health Research Council, 2020.
67. World Health Organization. Noncommunicable diseases country profiles 2018. Geneva, Switzerland: World Health Organization; 2018.
68. Bhandari G, Zomer P, Atreya K, Mol HG, Yang X, Geissen V. Pesticide residues in Nepalese vegetables and potential health risks. Environ Res. 2019;172:511–21.
69. Pokhrel S, Sauerborn R. Household decision-making on child health care in developing countries: the case of Nepal. Health Policy Plan. 2004;19(4):218–33.
70. Sommer A, Hussaini G, Tarwotjo I, Susanto D. Increased mortality in children with mild vitamin A deficiency. The Lancet. 1983;322(8350):585–8.
71. Houston R, Acharya B, Poudel D, et al. Early initiation of community-based programmes in Nepal: a historic reflection. 2012.
72. Pandey MR, Sharma PR, Gubhaju BB, et al. Impact of a pilot acute respiratory infection (ARI) control programme in a rural community of the hill region of Nepal. Ann Trop Paediatr. 1989;9(4):212–20.
73. Khanal S, Sharma J, Gc VS, et al. Community health workers can identify and manage possible infections in neonates and young infants: MINI—a model from Nepal. J Health Popul Nutr. 2011;29(3):255.
74. Government of Nepal. Multisectoral Action Plan for the Prevention and Control of Non-communicable diseases (2014–2020) (extended to 2025). Kathmandu Nepal: GoN WHO Country Office for Nepal; 2014.
75. Mishra SR, Dhimal M, Guinto RR, Adhikari B, Chu C. Threats to malaria elimination in the Himalayas. Lancet Global Health. 2016;4(8): e519.
76. Shakti P, Pradhananga D, Ma W, Wang P. Energy, Environment. An Overv Glaciers Distrib Nepal Himalaya. 2013;13:20–7.
77. Mishra SR, Adhikari B. Planetary health in Nepal's post-earthquake rebuilding agenda: progress and future directions. Lancet Planetary Health. 2019;3(2):e55–6.
78. Rijal KR, Adhikari B, Ghimire B, et al. Epidemiology of dengue virus infections in Nepal, 2006–2019. Infect Dis Poverty. 2021;10(1):52.
79. Bijukchhe SM, Hill M, Bch BM, Adhikari B, Shrestha A, Shrestha S. Nepal's worst dengue outbreak is a wake-up call for action. J Travel Med. 2023. https://doi.org/10.1093/jtm/taad112.
80. Mishra SR, Bhandari PM, Issa R, Neupane D, Gurung S, Khanal V. Climate change and adverse health events: community perceptions from the Tanahu district of Nepal. Environ Res Lett. 2015;10(3): 034007.
81. Basnyat B. High altitude pilgrimage medicine. High Altitude Med Biol. 2014;15(4):434–9.
82. Basnyat B, Gertsch JH, Johnson EW, et al. Efficacy of low-dose acetazolamide (125 mg BID) for the prophylaxis of acute mountain sickness: a prospective, double-blind, randomized, placebo-controlled trial. High Altitude Med Biol. 2003;4(1):45–52.
83. Biology PS. Diploma in mountain medicine: a perspective of a female doctor from Nepal. High Altitude Med Biol. 2021;22(4):417–9.
84. Mehata S, Shrestha N, Ghimire S, Atkins E, Karki DK, Mishra SR. Association of altitude and urbanization with hypertension and obesity: analysis of the Nepal Demographic and Health Survey 2016. Int Health. 2021;13(2):151–60.
85. Basnet R, Rai N, Tamang R, et al. The matrilineal ancestry of Nepali populations. Human Gen. 2023;142(2):167–80.
86. Arciero E, Kraaijenbrink T, et al. Demographic history and genetic adaptation in the Himalayan region inferred from genome-wide SNP genotypes of 49 populations. Mol Biol Evol. 2018;35(8):1916–33.
87. Wang H-W, Li Y-C, Sun F, et al. Revisiting the role of the Himalayas in peopling Nepal: insights from mitochondrial genomes. J Human Gen. 2012;57(4):228–34.
88. Bastola A, Sah R, Rodriguez-Morales AJ, et al. The first 2019 novel coronavirus case in Nepal. Lancet Infect Dis. 2020;20(3):279–80.
89. Shrestha R, Katuwal N, Adhikari N, Vanaerschot M, Tamrakar D, Dhimal M, Gyanwali P, Bhattarai S, Madhup SK, Devkota B. Whole genome sequence analysis to identify SARS-CoV-2 variant in Nepal. Kathmandu Univ Med J. 2021;19(2):237–42.
90. Subedi M. Indigenous healing practices in the Himalayas: use of medicinal plants and health development in Nepal. Cham: Springer; 2023.
91. Siddiquee NKA, Poudyal A, Pandey A, et al. Telemedicine in resource-limited setting: narrative synthesis of evidence in Nepalese context. Smart Homecare Technol TeleHealth. 2020. https://doi.org/10.2147/SHTT.S227854.
92. Sapkota S, Adhikari P, Sah S, et al. Use of telehealth services among Nepali living overseas during COVID-19 pandemic: the opportunities, limitations, lessons learned and recommendations. J Oral Biol Craniofacial Res. 2022;12(2):299–301.
93. Poudyal BS, Gyawali B, Rondelli DJE. Rapidly established telehealth care for blood cancer patients in Nepal during the COVID-19 pandemic using the free app Viber. Ecancermedicalscience. 2020. https://doi.org/10.3332/ecancer.2020.ed104.
94. Devkota A, Pandey S, Pandey Y, et al. Home hospital care through telehealth during COVID-19 pandemic in Nepal. Europasian J Med Sci. 2022. https://doi.org/10.46405/ejms.v4i1.375.
95. Bhandari B, Narasimhan P, Jayasuriya R, Vaidya A, Schutte AE. Effectiveness and acceptability of a mobile phone text messaging intervention to improve blood pressure control (TEXT4BP) among patients with hypertension in Nepal: a feasibility randomised controlled trial. Glob Heart. 2022;17(1):13.
96. Yilmaz SK, Bohara AK. Mhealth: potentials and risks for addressing mental health and well-being issues among Nepali adolescents. Front Public Health. 2021;9: 563515.
97. Ministry of Health and Population, Government of Nepal. Nepal Health Sector Strategy (2016–2021). Kathmandu, Nepal: Ministry of Health and Population,Government of Nepal, 2017.
98. MInistry of Health and Population Nepal. National eHealth Strategy 2019. https://km.mohp.gov.np/sites/default/files/documents/2019-04/Nepal_e_health_strategy_2017_final.pdf Accessed 11 Aug 2023.

99. Ministry of Heatlh and Population. National e-Health Strategy 2017. 2017 Accessed 12 Jan 2025).
100. The Rising Nepal. Ministry plans integrated electronic system to avoid duplication of health tests. 2025. https://risingnepaldaily.com/news/56422 Accessed 12 Dec 2025.
101. Marasini BJ. Health system development in Nepal. J Nepal Med Assoc. 2020;58(221):65.
102. ClioInfra. Life Expectancy at Birth. 2022. https://clio-infra.eu/Indicators/MalelifeExpectancyatBirth.html Accessed 15 Aug 2023.
103. Chaturvedi S, Porter J, Pillai GKG, Abraham L, Shankar D, Patwardhan B. India and its pluralistic health system–a new philosophy for Universal Health Coverage. Lancet Regional Health-Southeast Asia. 2023;10:100136.
104. Mishra SR, Khanal P, Dhimal M. Nepal's quest for universal health coverage. J Pharmacy Pract Commun Med. 2016;2(4):104–6.
105. Mishra SR, Joshi B, Poudyal Y, Adhikari B. Epistemic indebtedness: do we owe to epistemic enterprises? J Global Health Econ Policy. 2022;2:2022012.
106. Ministry of Health and Population (MoHP). First Long-Term Health Plan (1975–1995). 1995 Accessed 15 Jan 2025.
107. Adhikari B, Mishra SRJTL. Urgent need for reform in Nepal's medical education. Lancet. 2016;388(10061):2739–40.
108. Wasti SP, Van Teijlingen E, Rushton S, Subedi M, Simkhada P, Balen J. Overcoming the challenges facing Nepal's health system during federalisation: an analysis of health system building blocks. Health Res Policy Syst. 2023;21(1):117.
109. World health Organisation. WHO Country Cooperation Strategy (CCS) 2023–2027. 2023 Accessed 23 Feb 2025.
110. Khatri RB, Durham J, Assefa Y. Investigation of technical quality of antenatal and perinatal services in a nationally representative sample of health facilities in Nepal. Arch Public Health. 2022;80(1):1–14.
111. MOHP [Nepal]. Annual Report 2021: Ministry of Health and Population. Kathmandu, Nepal. Ministry of Health and Population, Department of Health Services. 2021.
112. Ministry of Health and Population. Progress of Health and Population Sector 2023/24 (2080/81). 2023. https://mohp.gov.np/uploads/Reports/Progress%20of%20Health%20and%20Population%20Sector-final.pdf. Accessed 22 Jan 2025.
113. Mishra SR, Khanal P, Karki DK, Kallestrup P, Enemark U. National health insurance policy in Nepal: challenges for implementation. Glob Health Action. 2015;8(1):28763.
114. Khatri RB, Assefa Y, Durham J. Multidomain and multilevel strategies to improve equity in maternal and newborn health services in Nepal: perspectives of health managers and policymakers. Int J Equity Health. 2023;22(1):1–16.
115. Khanal GN, Bharadwaj B, Upadhyay N, et al. Evaluation of the National Health Insurance Program of Nepal: are political promises translated into actions? Health Res Policy Syst. 2023;21(1):7.
116. Khatri RB, Mishra SR, Khanal V. Female community health volunteers in community-based health programs of Nepal: future perspective. Front Public Health. 2017;5:181.
117. Ghimire U, Shrestha N, Adhikari B, Mehata S, Pokharel Y, Mishra SR. Health system's readiness to provide cardiovascular, diabetes and chronic respiratory disease related services in Nepal: analysis using 2015 health facility survey. BMC Public Health. 2020;20(1):1–15.
118. United Nations. Briefing note for countries on the 2023 Multidimensional Poverty Index. 2023. https://hdr.undp.org/sites/default/files/Country-Profiles/MPI/NPL.pdf Accessed 12 April 2024.
119. Koirala B, Adhikari S, Shrestha A, et al. A national equity initiative to address noncommunicable diseases and injuries: findings and recommendation from the Nepal NCDI poverty. Commission. 2022;20(3):376–83.
120. Pandey AR. Health financing reforms in the quest for universal health coverage: challenges and opportunities in the context of Nepal. J Global Health. 2023;13:3021.
121. Khan IA, Priyanka N, Mitra SK, Lahariya AU, Vaz RP, Lahariya C. The role of private practitioners in bridging the healthcare gap and achieving universal health coverage in India. Prevent Med: Res Rev. 2024;1(5):260–3.
122. Aggarwal S, Balaji S, Gupta P, et al. Enhancing healthcare access: drone-based delivery of medicines and vaccines in hard-to-reach terrains of northeastern India. Prevent Med: Res Rev. 2024;1(4):172–8.
123. Lahariya C. Health & wellness centers to strengthen primary health care in India: concept, progress and ways forward. Indian J Pediat. 2020;87(11):916–29.
124. Lahariya C, Roy B, Shukla A, et al. Community action for health in India: evolution, lessons learnt and ways forward to achieve universal health coverage. WHO South-East Asia J Public Health. 2020;9(1):82–91.
125. Lahariya C. 'Ayushman Bharat' program and universal health coverage in India. Indian Pediatr. 2018;55(6):495–506.
126. Mahajan S, Khan Z, Giri PP, et al. Operationalising 'One Health' through primary healthcare approach. Prevent Med: Res Rev. 2024;1(4):199–206.
127. Marmot M, Allen J, Bell R, Goldblatt P. Building of the global movement for health equity: from Santiago to Rio and beyond. Lancet. 2012;379(9811):181–8.
128. Parajuli R, Bohara D, Kc M, Shanmuganathan S, Mistry SK, Yadav UN. Challenges and opportunities for implementing digital health interventions in Nepal: a rapid review. Front Digital Health. 2022;4:861019.
129. USAID. Urban Digtial Health: Insights from India, Bangladesh, and Nepal. 2024. https://static1.squarespace.com/static/59bc3457ccc5c5890fe7cacd/t/650dd33209331f1f49520c5f/1695404852831/Asia+Report-FINAL-NS.pdf Accessed 26 April 2024.
130. Adhikari B, Shrestha L, Bajracharya M, et al. Triage practices for emergency care delivery: a qualitative study among febrile patients and healthcare workers in a tertiary care hospital in Nepal. BMC Health Serv Res. 2024;24(1):180.
131. Dumka N, Gurung A, Hannah E, Goel S, Kotwal A. Understanding key factors for strengthening Nepal's healthcare needs: health systems perspectives. J Global Health Rep. 2024;8: e2024010.
132. Adhikari B, Subedi R, Kumar Thakur R, Shakya P. The wounded healer during COVID-19: unraveling the violence against healthcare workers in Nepal. J Global Health Econ Policy. 2021. https://doi.org/10.52872/001c.26102.
133. Naher N, Hoque R, Hassan MS, Balabanova D, Adams AM, Ahmed SM. The influence of corruption and governance in the delivery of frontline health care services in the public sector: a scoping review of current and future prospects in low and middle-income countries of south and south-east Asia. BMC Public Health. 2020;20:1–16.

Publisher's Note