

**Annual International Scientific Conference on Economic Development
and the Legacy of Simon Kuznets**

Roundtable on Global Transformations and Sustainable Development:
Cooperation, Science, Education, Technologies

Discussion Area: Economic Development in the Face of Multidimensional
Uncertainty

Organiser: Simon Kuznets Kharkiv National University of Economics
25 April 2024

**Shortages, Priorities and Rationing in the UK
National Health System Before and During the
COVID-19 Epidemic: Influences on Analysis of
Richard Stone, Simon Kuznets, and Janos Kornai**

Preliminary Draft Prepared on 14 April 2024

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Emeritus Member of the Department of Economics and Wolfson College, Oxford

Coincidences Related to the April 2024 Conference at the Simon Kuznets Kharkiv National University of Economics

- The 50th Anniversary is approaching (September 2024) of my only physical visit to Kharkiv during my first trip to the USSR for a tour of Soviet medical facilities.
- There are similarities between the research of my Ph.D. Supervisor at Cambridge University Prof. Sir Richard Stone (Nobel Prize 1984) and Prof. Simon Kuznets (Nobel Prize 1971).
- I am participating in an academic event with the Keynote Speaker Howard Shatz of RAND for the 4th Time since we met on an economics panel in in September 2022: Budapest, Washington DC, Oxford, Kharkiv.

Structure of Presentation

1. Comparison of the Research and Contributions of Simon Kuznets and Richard Stone
2. Concepts Used in Analysis
 - Definition of Health Sector and Health Production Process Based on Stone's Work
 - Shortages in a National Health System (Kornai)
 - Priorities and Rationing in Health Systems
 - Systems Analysis: Shocks to Health Systems and Resilience
3. UK National Health System in 2000-2019: Readiness for Covid-19 Epidemic
4. Comparison of UK SBF HS and Russia CI HS in 2020-2021: Resilience During for Covid-19

Similarities in the Research of Simon Kuznets and Richard Stone: 1

- Born 1901. Nobel Prize in 1971 (Age: 70).
- Quantitative Analyst and Statistician.
- Pioneer National Income Accounts from 1930s (GNP USA).
- Involved in managing the WW II USA war economy through quantitative analysis of supply and demand for the *War Production Board*.
- Born 1913. Nobel Prize in 1984 (Age: 71).
- Quantitative Analyst and Statistician.
- Pioneer National Income Accounts from 1940s (resulting in 1968 UN SNA).
- Involved in managing the WW II UK war economy under Keynes through quantitative analysis of national income and expenditure.

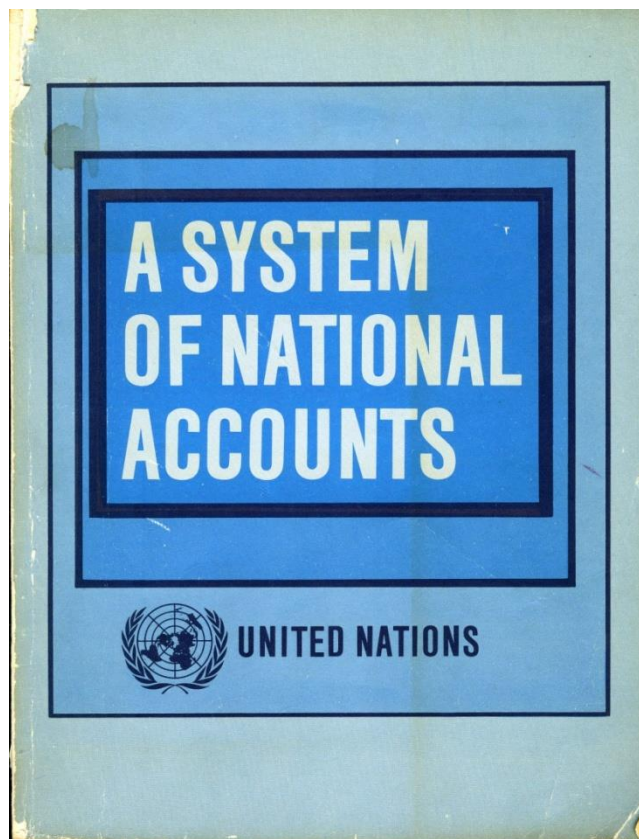
Similarities in the Research of Simon Kuznets and Richard Stone: 2

- Visited India in 1950 with Richard Stone to advise National Income Committee.
- Expert on Growth (1966 book on *Modern Economic Growth*)
- Analyst of links between economy and demography (1973 book on *Population, Capital and Growth*)
- Visited India in 1950 with Simon Kuznets to advise National Income Committee.
- Expert on Growth (1962 book on *A Computable Model of Economic Growth*).
- Analyst of links between economy and demography (1976 UN report *Toward a System of Social and Demographic Statistics*).

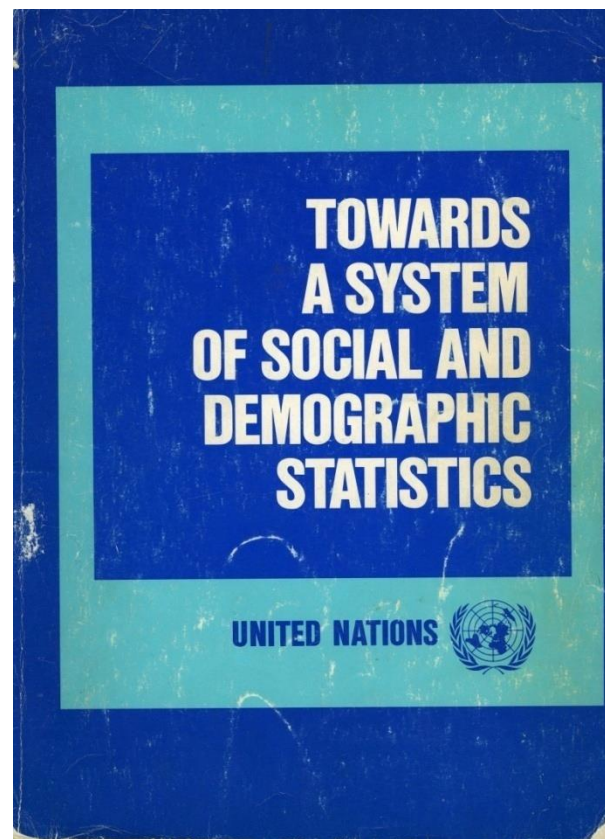
My Early Background in Quantitative Analysis

- 1965-69: Studied Applied Mathematics at Harvard on a US Navy scholarship.
- 1969-73: Served as an officer in the US Navy. First tour: Destroyer. Second tour: Operations Analyst in the Analysis Division of a Navy Staff. Obtained an M.Sc. with a dissertation on cybernetics in the USSR.
- 1973-78: Post-graduate student in Economics at Cambridge University. Ph.D. dissertation on *The Economics of Health in the USSR* (1980). Ph.D. Supervisor was Prof. Sir Richard Stone.

Stone: National Accounting Methods to Compare Economies and Socio-Demographic Sectors



Stock-flow models,
transactors and markets,
comparison of economies

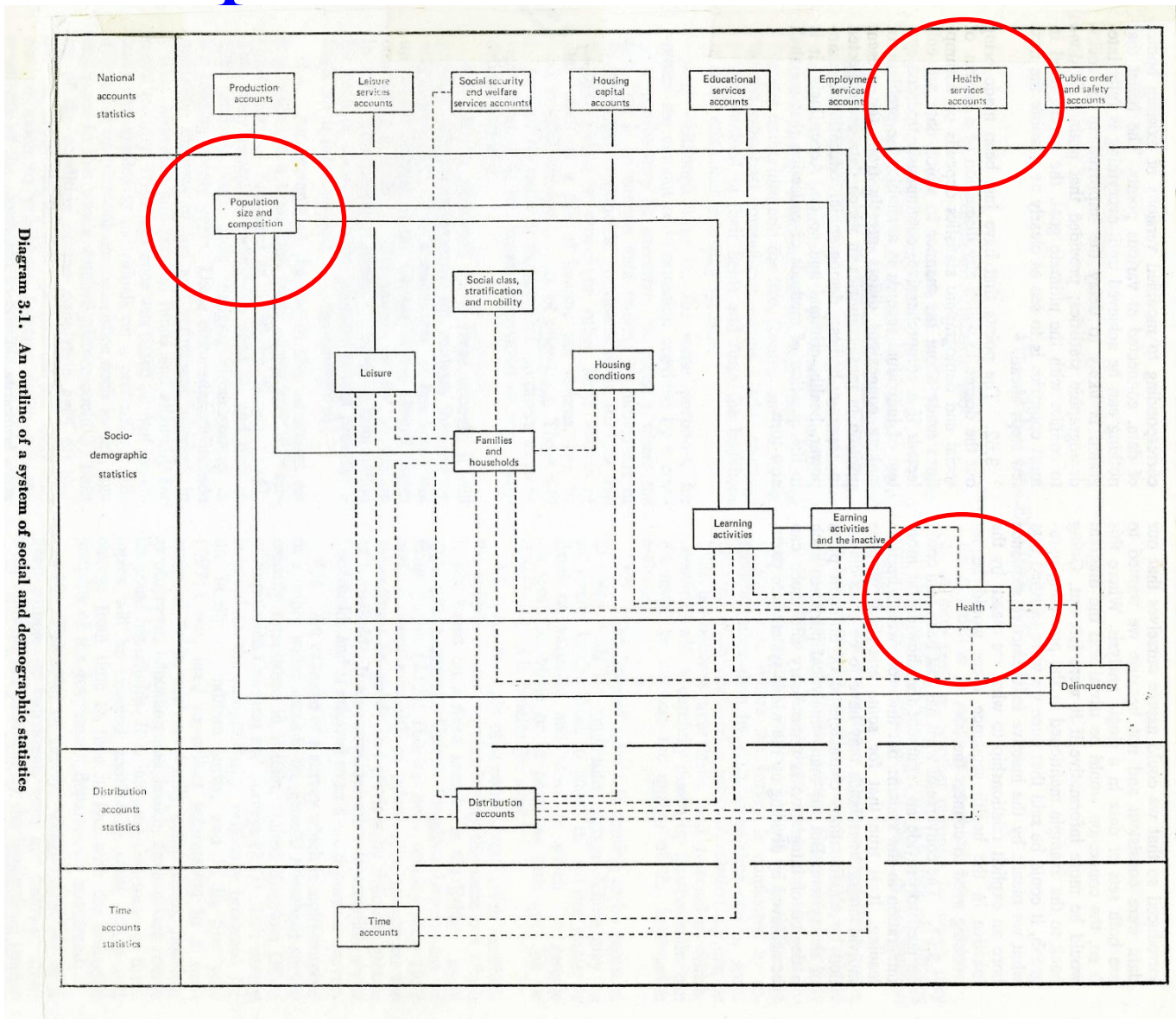


Extend accounts, absorbing
markov chain models,
comparison of social sphere

U.N. SNA and SSDS

- **U.N. System of National Accounts (SNA)**
 - Covers six of the institutions in the health sector engaged in production of and trade in goods and services: medical system; medical supply system; medical industry; biomedical R & D; medical foreign trade; and central health bureaucracy (government) (U.N. 1968). It does not report on health conditions (demographic, consumption, environmental), household health production, illness pattern or health outputs.
- **U.N. System of Social and Demographic Statistics**
 - The U.N. System of Social and Demographic Statistics provides a conceptual basis for the extension of the traditional economic accounts to cover demographic, health and social processes (U.N. 1975). With respect to the HSPP, the SSDS covers health conditions, household health production, illnesses and health output indicators. However, this system has been used on a prototype basis only. No country has fully implemented it.

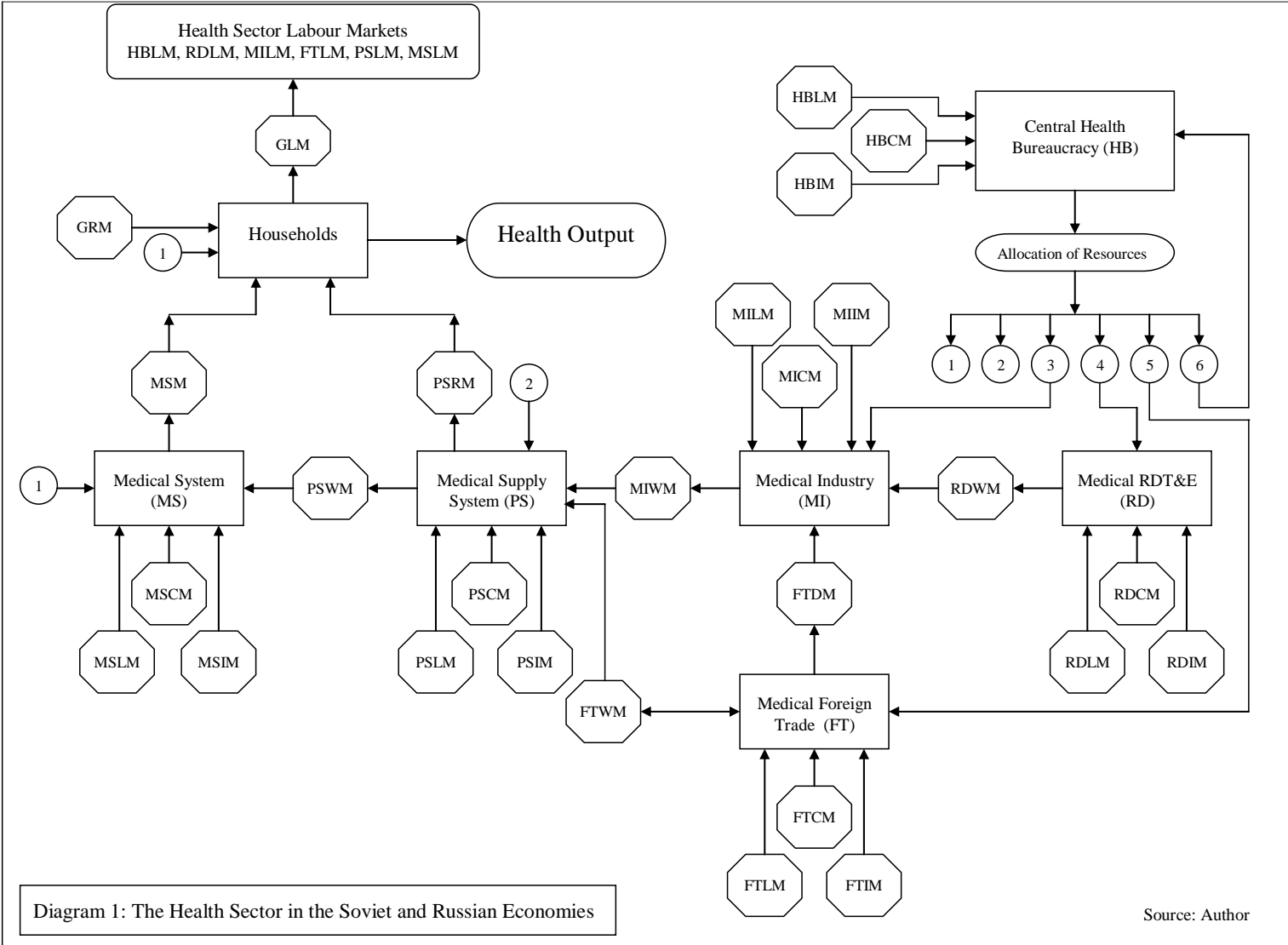
Components of the SSDS



Definitions of Health Sector and Health Production Process

- National Accounting Approach
 - Define economic activity
 - Identify economic institutions(Health Sector: Households, Medical System, Medical Supply, Medical Industry, Biomedical R&D, Medical Foreign Trade, Central Authorities)
- Establish production boundaries and describe production process
- Models of transactions and production in the Health Sector

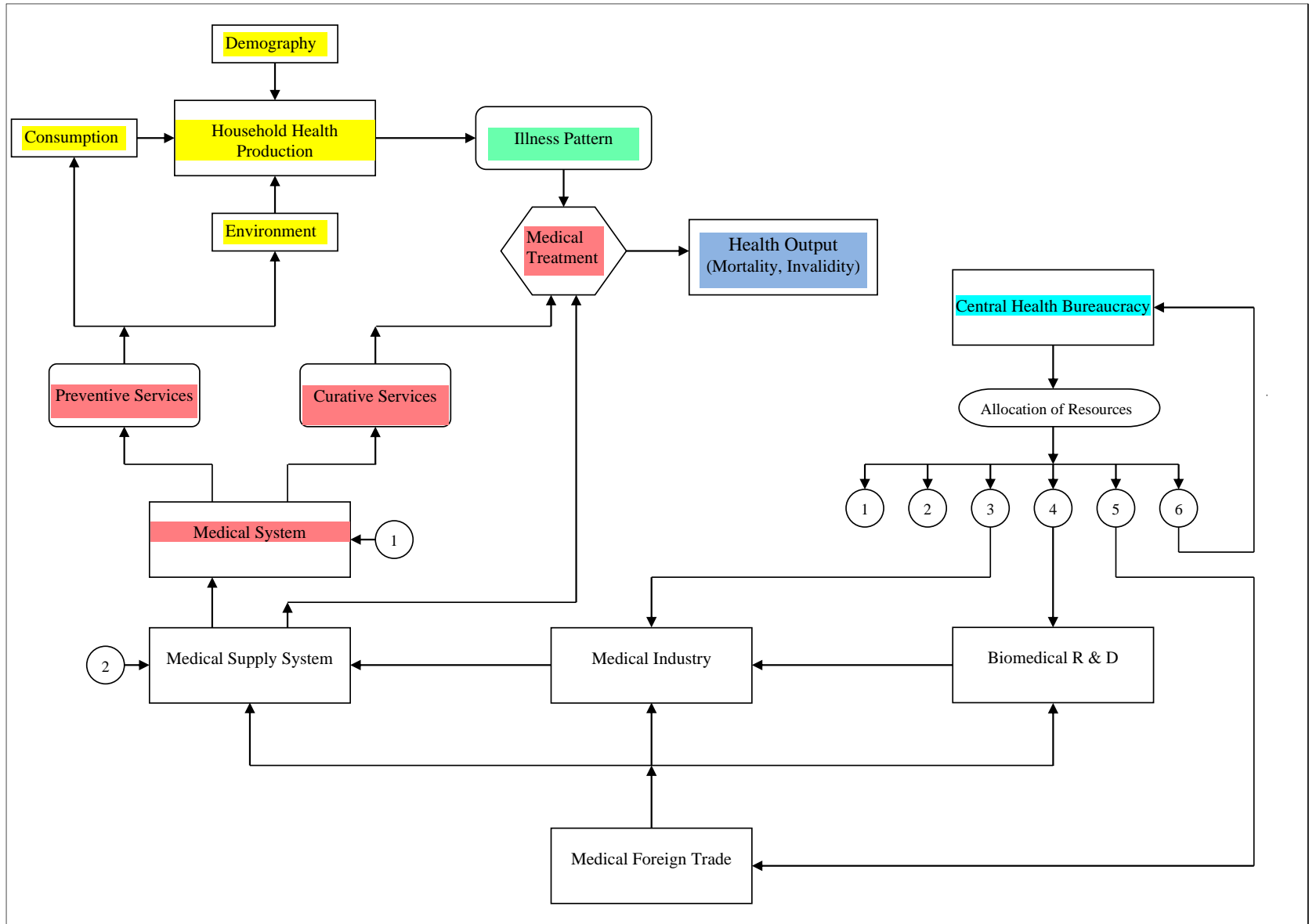
Economic Institutions and Markets in National Health Sector



Health Outcomes Generated by Production Processes

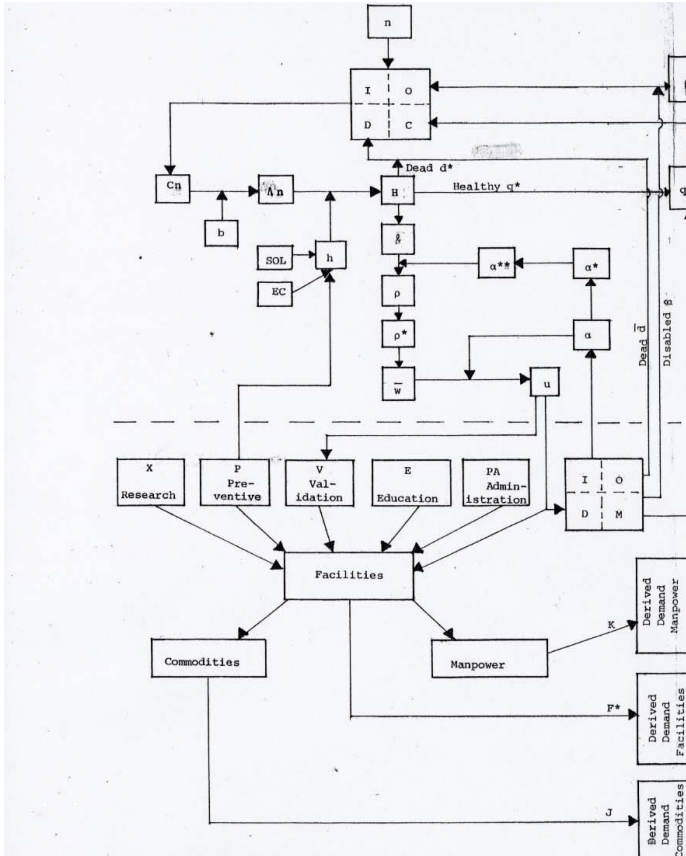
- Demographic, social, consumption and environmental factors generate the needs of the population for medical care.
- Responses of a society to these needs are influenced by its political and economic systems, resource availability, state priorities and the performance of the relevant institutions (e.g. polyclinics, hospitals).

General Health System Production Process



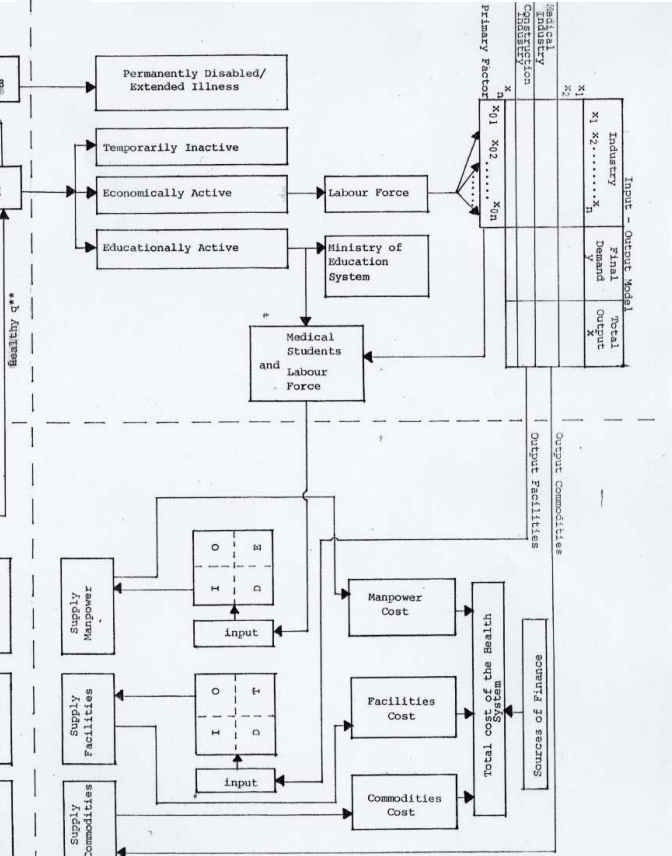
Davis Ph.D. Model Linking Population, Health Systems and Economy

Quadrant I: Population



Quadrant II: Health System

Quadrant IVI: Links to Economy



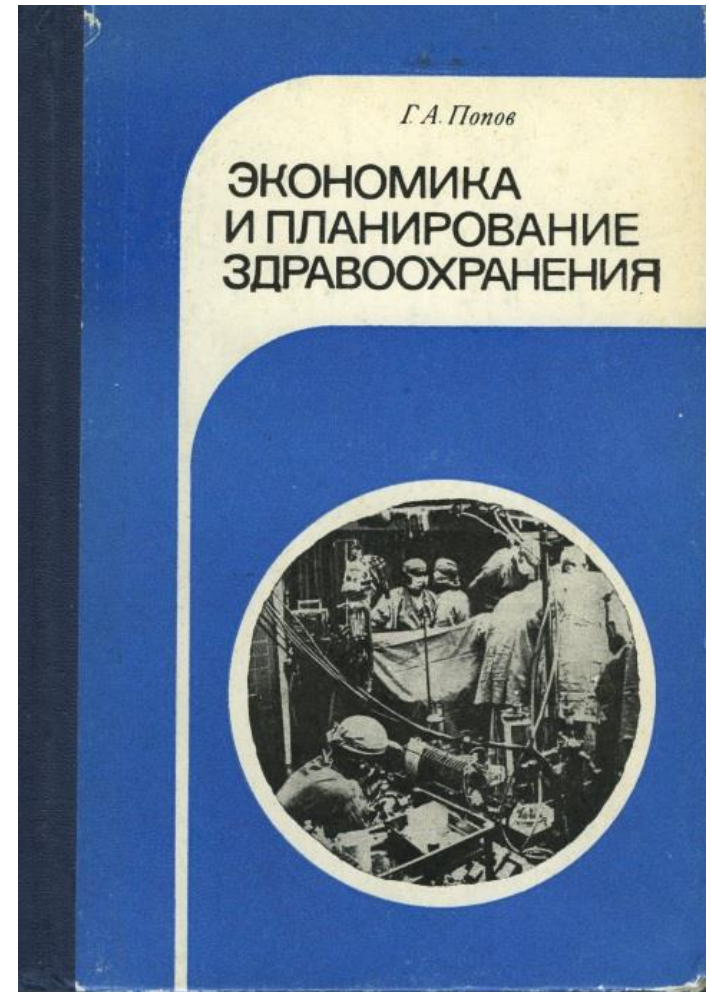
Quadrant III: Inputs to Health System

Measurement of the Health Sector Production Process Using Statistical Systems

- International statistical systems and databases contain information about institutions and activities in the health sector. However, none of these statistical systems provides comprehensive coverage of the production process.
- National Economic Accounts (SNA)
- SSDS: Demographic, health and social processes
- Disease Classification: ICD-10
- WHO Framework for Health System Performance Assessment
- World Bank Comprehensive Development Framework
- U.N. Demographic Yearbook
- UNICEF TransMONEE Database

Background: C. Davis Research on Economics of Health in USSR/Russia

- USA IREX exchange year (1976-77) at Moscow State University, Department of the Economics of the Non-Productive Sphere
- Supervisor G.A. Popov.
- CEMI: 1981 and 1982
- RANEPА and HSE: 2013-2020 (Projects on Health Economics)



My 1976-77 Research in Moscow Using My Model Resulted in My Discovery of Rising Age-Specific Mortality Rates USSR During 1964 - 1976

Age-Specific Mortality Rates¹ (Deaths per 1,000 in the Age Group)

	1964/65	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1975/76 as % of Minimum Since 1964/65
All Ages²	7.1	7.3	7.5	7.7	7.9	8.2	8.2	8.4	8.6	8.7	9.0	9.4	132
0 to 1³	27.2	26.1	26.0	26.4	25.8	24.7	22.9	24.7	26.4	27.9	29.4	31.1	136
0 to 4	7.2	6.9	6.9	7.0	7.0	6.9	6.7	6.8	7.2	7.7	8.2	8.7	130
5 to 9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	100
10 to 14	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	100
15 to 19	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	100
20 to 24	1.6	1.6	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.7	113
25 to 29	2.0	2.0	2.0	2.1	2.2	2.2	2.2	2.1	2.1	2.0	2.1	2.1	105
30 to 34	2.5	2.6	2.6	2.7	2.8	2.8	2.8	2.8	2.8	2.8	3.0	3.0	120
35 to 39	3.1	3.2	3.4	3.5	3.5	3.7	3.8	3.7	3.6	3.6	3.7	3.8	123
40 to 44	3.8	3.9	4.1	4.3	4.6	4.7	4.7	4.8	4.8	4.9	5.2	5.3	140
45 to 49	5.0	5.1	5.3	5.5	5.6	6.0	6.0	6.1	6.2	6.4	6.7	6.9	138
50 to 54	7.8	7.9	7.9	8.0	8.1	8.7	8.7	8.8	8.6	8.8	9.0	9.3	119
55 to 59	10.8	11.1	11.3	11.5	12.1	11.7	11.8	11.9	12.5	12.3	13.0	13.4	124
60 to 64	17.2	17.2	17.4	17.8	18.2	18.0	17.9	18.1	18.0	18.2	18.3	18.9	110
65 to 69	24.4	25.5	25.9	26.3	27.5	27.5	26.9	26.8	27.2	27.0	27.4	28.0	115
70 and Over	64.2	65.8	66.1	66.8	67.3	75.7	74.9	74.8	75.5	73.5	73.3	75.0	117

Notes: (1) ASMR are two-year moving averages; (2) Crude Death Rate: Deaths per 1,000 population; (3) Infant Mortality Rate: Deaths during first year of life per 1,000 live births.

Source: Davis and Feshbach (1980)



Lowest



Highest

Research in Moscow Resulted in One of First Studies of Mortality Problems in the USSR



Rising Infant Mortality in the U.S.S.R. in the 1970's

by
Christopher Davis,
 Centre for Russian
 and East European Studies
 University of Birmingham
 and
Murray Feshbach,
 Foreign Demographic
 Analysis Division.

Series P-95, No. 74
 Issued September 1980

1980



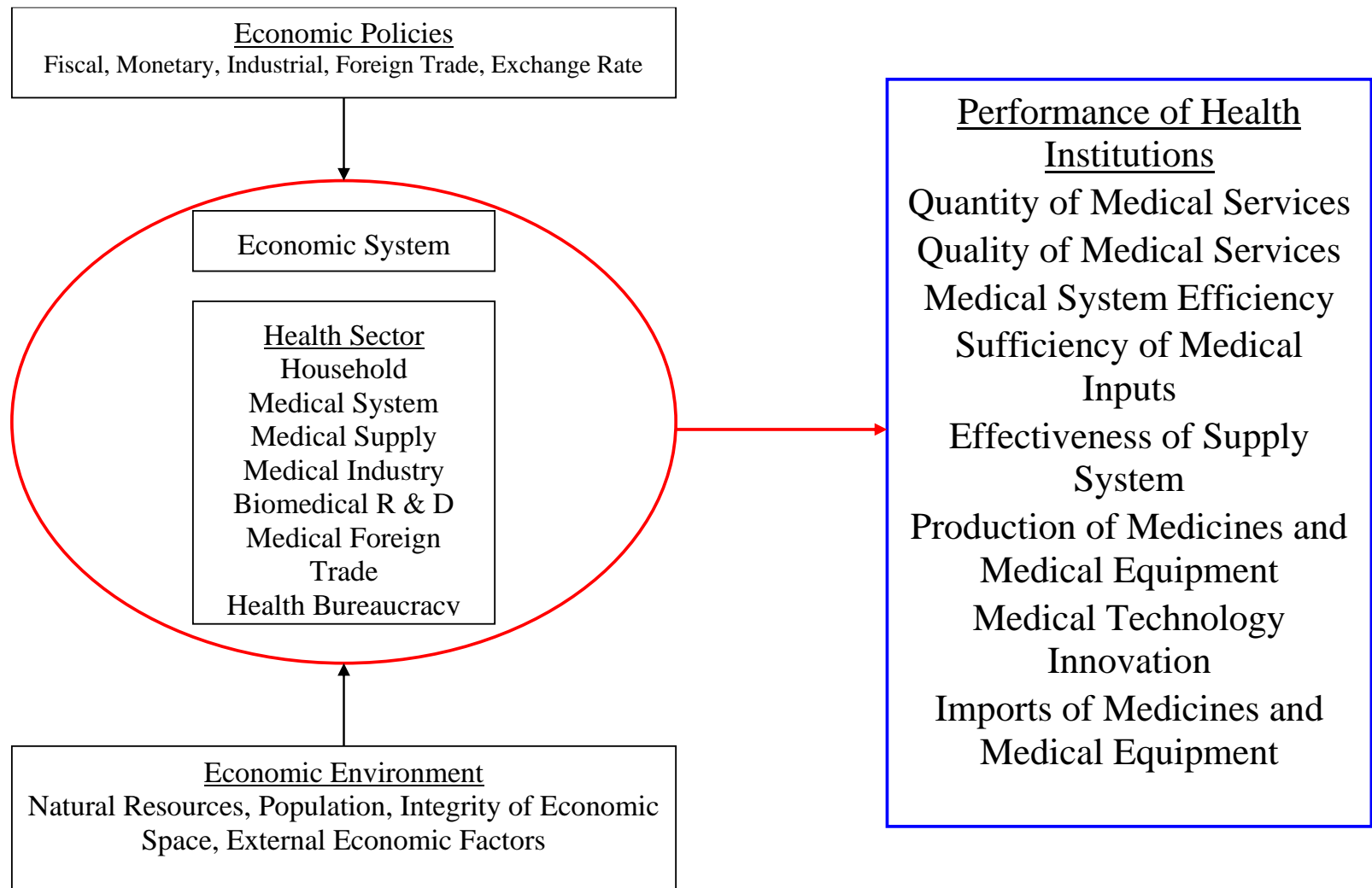
U.S. Department of Commerce
 Philip M. Klutznick, Secretary
 Luther H. Hodges, Jr.,
 Deputy Secretary
 Courtney M. Slater,
 Chief Economist

BUREAU OF THE CENSUS
 Vincent P. Barabba, Director

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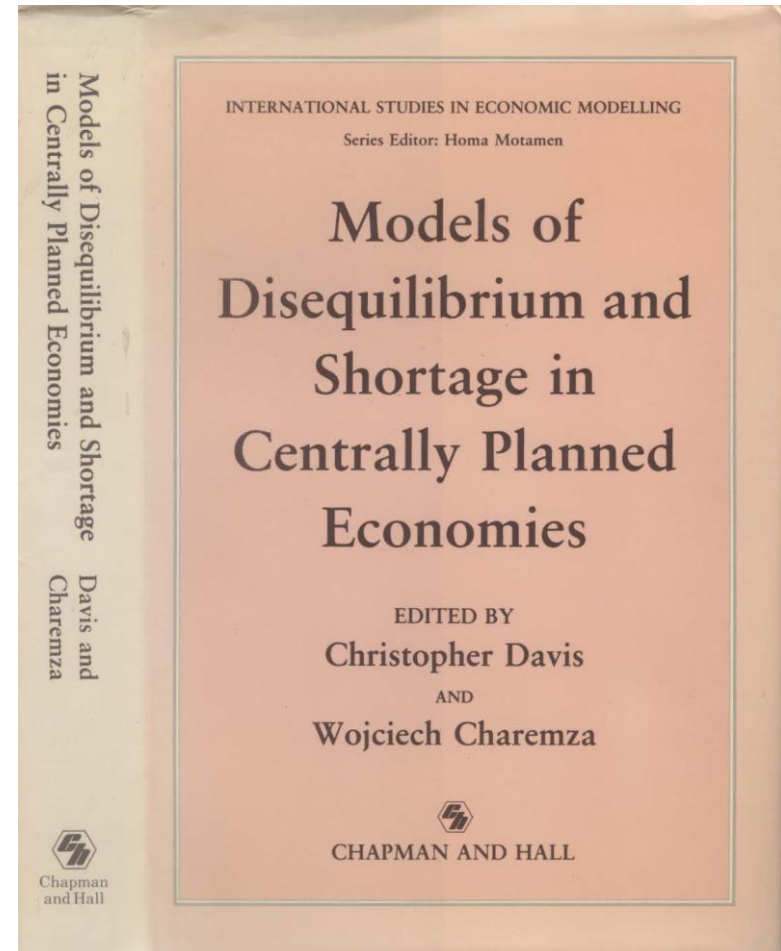
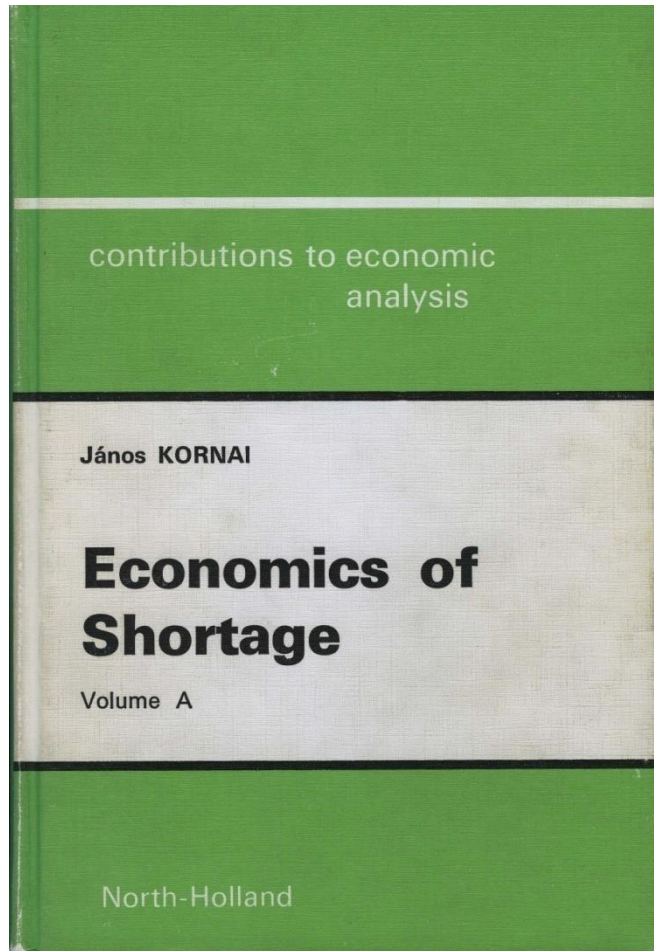
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Health Sector in an Economic System



Davis 2013

Shortages in Health Systems are Related to Shortages in Economies



Davis, C. (1989) *Priority and the Shortage Model: The Medical System in the Socialist Economy*

Categories of Shortages in the Health Systems Before and During Covid-19

Row	Category of Shortage
A	Doctors: National shortages
B	Doctors: Shortages in rural areas and deprived regions
C	Doctors: Shortages of specialists
D	Middle Medical Personnel (MMP): National shortages
E	MMP: Shortages in rural areas and deprived regions
F	MMP: Shortages of specialists
G	Shortages of medicines and medical inputs
H	Shortages of medical equipment
I	Shortages of hospital facilities and beds
J	Shortages of outpatient facilities
K	Shortages in emergency care

Consequences of Shortages in National Health System and Policy Responses

Row	Description of Consequences of Shortages
A	Deficits of specific inputs cause bottlenecks and inefficiencies in production.
B	Shortage-related problems cause higher stress and lower motivation of medical personnel.
C	Shortages discourage patients from reporting illnesses, which become 'hidden'.
Row	Description of Policy Responses to Shortages
D	Revision of medical priorities.
E	Rationing according to category of patient (sub-systems of medical care).
F	Rationing by physical queuing.
G	Rationing by waiting lists.
H	Exclusion of types of medical services from <i>State Guarantee</i> or restrictions on them.
I	Substitution of inferior and less expensive inputs for the normal ones.

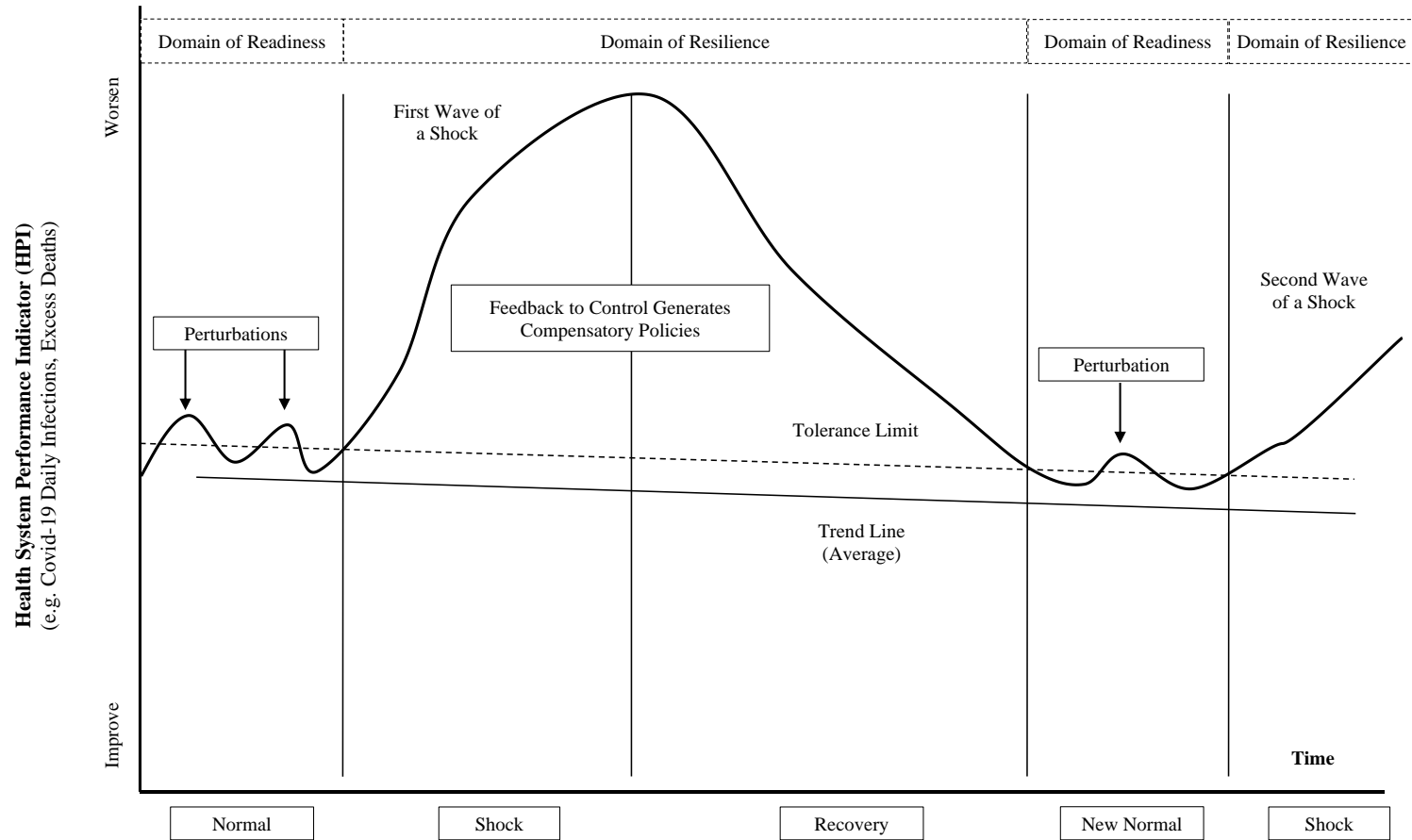
Low and High Priority of National Health Systems

Row	Indicators of Priority Status of NHS	Low Priority	High Priority
		Differing Priority Characteristics of the NHS	
	<i>During Plan/Budget Formulation</i>		
A	Health in Leadership's Objective Function (OF)	Low Weight in OF. Trade-Offs Tolerated between Health and Other Objectives.	High Weight in OF. Minimal Trade-Offs between Health and Other Objectives.
B	Resource Allocation Responsiveness to Problems	Unresponsive	Responsive
C	Wage Rates and Labour Conditions	Relatively low wage rates and poor labour conditons	Relatively high wage rates and bonuses and good labour conditons
D	Adequacy of Financial Norms in Budgets	Stingy	Generous
<i>During Plan/Budget Implementation</i>			
E	Outputs	Modest targets. Minimal help provided to ensure fulfilment.	Ambitious targets and strong commitment to their fulfilment.
F	Budget Constraints	Relatively Hard	Soft
G	Supply Plans	Tolerance of Disruptions	Strong commitment to fulfilment of supply plans
H	Siphoning of Supplies	Scarce Inputs Siphoned Away from Low Priority NHS by Higher Priority Organisations	High Priority Protects NHS from External Siphoning, But It Occurs Internally According to Priorities
I	Investment Plans	Low targets and tolerance of underfulfilment	Ambitious plans and strong commitment to fulfilment
J	Inventories of Inputs	Low Input Inventories	Generous input inventories
K	Reserve Production Capacity	Minimal	Significant relative to normal outputs
L	Shortage Intensity	High	Low

Systems Theory (Cybernetics) Applied to Health System Crises

- My 1974 M.Sc. Thesis was on ‘The Influence of Cybernetics in the USSR on Soviet Economic Management’
- Janos Kornai used Systems Theory in His Early Works (e.g. Anti-Equilibrium)
- The OECD explored Economic Modelling based on Systems Theory after the GFC in 2008
- I used Concepts from Systems Theory in my 2021 article about the UK NHS during Covid-19

Readiness and Resilience of Health Systems Experiencing Shocks (Covid-19)



Phases of Complex Health System Development in Periods of Shocks

© Christopher Davis 2020. Prepared by author with inspirations from Kornai (1980, Figure 3.1) about tolerance limits and Linkov et al. (2019, Figure 3) about stages of resilience.

UK National Health System in in 2000-2019: Readiness for Covid- 19 Epidemics

Summary of Developments in UK Health System During 2000-2019: 1

- **Demography**: Ageing of population
- **Epidemiology**: Rapid growth of non-communicable diseases (NCD)
- **Demand for Medical Care**: Substantial growth for treatment of NCD
- **Priority** of health lowered after GFC in 2008-09 and **Health Spending** growth slows

Health Production in the UK: 2000-2018 (1)

Indicator	Source	Units	2000	2005	2010	2015	2018
<i>Factors Influencing Demand for Medical Care</i>							
Population (mid-year)		Millions	58.9	60.4	62.8	65.1	66.3
Elderly Share of Population		% 60 years and older	18.5	17.3	17.5	19.1	19.7
Malignant Neoplasms Incidence	OECD	New Cases per 100,000	461.6	482.2	523.4	557.5	
<i>Factors Influencing the Availability of Resources to Support the National Health Service</i>							
GDP Index	OECD	2000 = 100	100.0	115.0	117.8	130.2	137.1
Public HE Per Capita	UK	£ Current	841.8	1,372.7	1,863.0	2,058.8	2,217.8
Public Health Exp Share GDP	OECD	%	4.7	5.9	7.0	7.7	7.5

Changing Priority of UK NHS: 2000-2007 versus 2008-2019

		2000-2007	2008-2019
Indicators of Priority Status of NHS		Economic System	
		Decentralised Capitalist	Decentralised Capitalist
		High Priority	Medium-Low Priority
		Summary of Evidence Concerning Priority Indicators	
<i>During Plan/Budget Formulation</i>			
A	Health in Leadership's Objective Function	High Weight in OF	Low Weight in OF
B	Resource Allocation Responsiveness to Problems	Usually Responsive	Slow and Lagged Responses
<i>During Plan/Budget Implementation</i>			
F	Budget Constraints	Relatively Soft	Relatively Hard
J	Inventories of Inputs	Adequate input inventories	Low Input Inventories
L	Shortage Intensity	Low	Rising to High.

Summary of Developments in UK National Health System During 2000-2019: 2

- **Medical Technology**: Advances, but uneven. UK behind Germany. Need to consider facilities, machinery, medicines, medical inputs
- **Shortages** intensify concerning medical labour, technology, facilities, medicines
- **Consequences of Shortages**: Increases in unreported illness and late diagnoses, pressure on staff, disruption of treatment
- **Responses to Shortages**: Treatment priorities, queuing, waiting lists, substitutions of inputs

Health Production in the UK: 2000-2018 (2)

Indicator	Units	2000	2005	2010	2015	2018
<i>Resources and Performance of the National Health Service</i>						
Doctors	Per 1,000	2.0	2.4	2.7	2.8	2.9
Nurses and Midwives	Per 1,000	8.6	9.0	8.9	8.4	8.3
GP Visits Per Year Per Capita	Visits	4.0	4.0	4.6	4.7	4.6
Hospital Beds	Per 1,000	4.1	3.7	2.9	2.6	
Wait Time for Treatment after Specialist Assessment	% more than three months			23.2	28.4	
Computerised Tomography Scanners	Per million population	5.4	7.5	7.9	9.5	9.8
Magnetic Resonance Imagers	Per million population	5.6	5.4	6.6	7.2	8.0
<i>Health Outcomes: Mortality-Related</i>						
Crude Death Rate	Deaths per 1,000	10.3	9.7	8.9	9.3	9.3
Maternal Mortality	Deaths per 100,000 Births	7.0	5.7	5.0	4.5	
Infant Mortality	Deaths per 1,000 Births	5.5	5.1	4.2	3.9	3.9
Population Life Expectancy at Birth	Years	77.9	79.2	80.6	81.0	
Male Life Expectancy at Birth	Years	75.5	76.9	78.6	79.2	

Ratings of Readiness of the UK National Health System: First and Second Waves of Covid-19

Category of Readiness	First Wave		Second Wave	
	Rating	Points	Rating	Points
A. Control of the health system: Management structure, health priorities and anti-epidemic planning.	<i>Substandard.</i>	2	<i>Average.</i>	3
B. Provision of medical personnel.	<i>Substandard.</i>	2	<i>Average.</i>	3
C. Provision of medical facilities and ICUs.	<i>Average.</i>	3	<i>Average.</i>	3
D. Organisation of the medical supply system.	<i>Substandard.</i>	2	<i>Average.</i>	3
E. Provision of medical capital equipment.	<i>Substandard.</i>	2	<i>Average.</i>	3
F. Provision of medicines and medical supplies.	<i>Substandard.</i>	2	<i>Average.</i>	3
G. Provision of medical personal protective equipment.	<i>Substandard.</i>	2	<i>Average.</i>	3
H. Adequacy of treatment of medical needs of the population (hidden illness in the morbidity iceberg)	<i>Substandard.</i>	2	<i>Average.</i>	3
I. Adequacy of treatment of medical demands (reported illness) of the population (degree of rationing through queuing and waiting lists).	<i>Substandard.</i>	2	<i>Average.</i>	3
J. Domestic industrial capabilities for the production of medicines, medical goods, medical PPE and medical equipment.	<i>Average.</i>	3	<i>Good.</i>	4
K. Domestic biomedical R&D: Development of medicines, testing kits, vaccines and capacity for lab processing of tests.	<i>Average.</i>	3	<i>Good.</i>	4
L. Capacity for carrying out tests for infectious diseases, tracing contacts and quarantining the infected.	<i>Poor.</i>	1	<i>Substandard.</i>	2
M. Medical system performance prior to Covid-19.	<i>Average.</i>	3	<i>Average.</i>	3
N. Health outcomes prior to Covid-19 (Remain Healthy, Illness, Recovery, Mortality)	<i>Average.</i>	3	<i>Average.</i>	3
O. Residential social care for the elderly and its links with the NHS.	<i>Substandard.</i>	2	<i>Average.</i>	3
P. Overall assessment of Readiness of the national health system.	<i>Substandard.</i>	2.3	<i>Average.</i>	3.1

Notes: (1) Scale of Assessments of Readiness: Excellent (*5 points*): At a standard of countries successful in dealing with Covid-19 during the First Wave, such as Germany and South Korea; Good (*4*): Achieves basic objectives. Above average by EU standards.; Average (*3*): Achieves minimal necessary results. Equivalent to middle-ranked EU countries; Substandard (*2*): Failures in some important components of readiness.; Poor (*1*): Failure to achieve basic objectives. (2) Methodology: The preliminary assessments, prepared during the Covid-19 epidemics in 2020 with imperfect information, are based on detailed empirical evaluations of the UK health system over forty years, comparative material published in 2020 about circumstances in the health systems of EU countries (e.g. *European Centre for Disease Prevention and Control* website), as well as past comparative studies of the author (e.g. Davis 2001b, 2020).

©Christopher Davis, 2020. Sources: The design of the table was developed by the author on the basis of research for this article. The ratings are based on analyses presented in Davis (2020) and in the forthcoming book Davis (ca. 2021a), as well as on information provided in Appendix A and new material from the UK published during August-November 2020.

UK National Health System in 2020- 2021: Resilience During Covid-19

UK Health Sector During Covid-19

Table 1: Health Sector Economic Institutions in the Covid-19 Epidemic			
Institution	Inputs	Outputs	Roles During Covid Epidemic
Households	Labour, IG&S, Capital(H)	Individual Health Status (Healthy, Illness, Death)	Households in lockdown. Individuals avoid or contract the virus due to their behaviour. The afflicted either recover at home or are treated in hospitals.
Medical System	Labour, IG&S, Capital(P)	Medical Services (Preventive and Curative)	Prevention: Promote hygiene, social distancing, health education; Curative: Outpatient care, Emergency (Ambulance), Hospitals treatment.
Medical Supply Network	Labour, IG&S, Capital(P)	Wholesale and Retail Sales of Medical Products	Purchase and distribute medicines, medical supplies, PPE, capital equipment (ventilators), tests.
Medical Industry	Labour, IG&S, Capital(P)	Pharmaceuticals and Medical Equipment	Manufacture on an urgent basis PPE, medicines, medical supplies, testing kits, capital equipment (ventilators).
Biomedical R&D	Labour, IG&S, Capital(P)	Medical-Related Scientific Results and Technology	Develop on an urgent basis tests for presence of the virus or antibodies, as well as a Covid-19 vaccine.
Medical Foreign Trade	Labour, IG&S, Capital(P)	Export and Import of Medical Goods	Import on urgent basis PPE, medicines, capital equipment, chemicals; Exports restricted at peak of epidemic.
Social Care System	Labour, IG&S, Capital(P)	Care of elderly and disabled people unable to live at home	Coordinate with NHS (doctors, nurses, hospitals) to care for vulnerable people and to help the NHS by accepting those discharged from hospitals.
Central Health Management	Labour, IG&S, Capital(P)	Administration of the Health Sector	Raise priority of health sector and increase its funding. Develop and implement anti-epidemic strategy (social distancing, lockdown). Increase domestic production and imports of necessary medical goods and improve their distribution. Encourage R&D to develop tests and a vaccine.
Notes: IG&S = Intermediate Goods and Services, Capital(H) = Household Capital Goods, Capital(P) = Production Capital Goods			
Prepared by C. Davis in 2020. Sources: Stone (1971); UN (1976) SSDS; Davis (1979, 1983, 2001)			

National Health Production Process During Covid-19 Epidemics

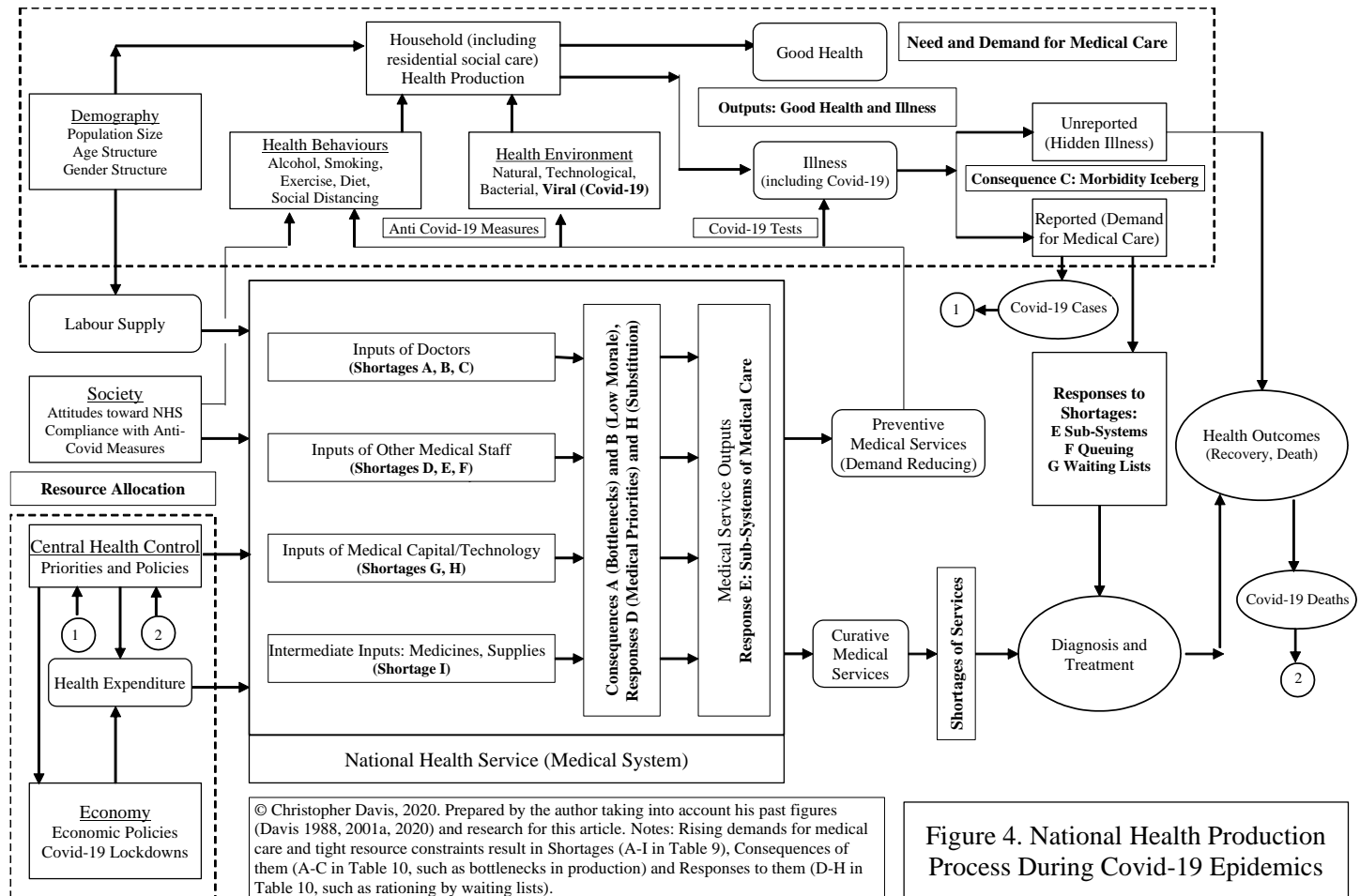


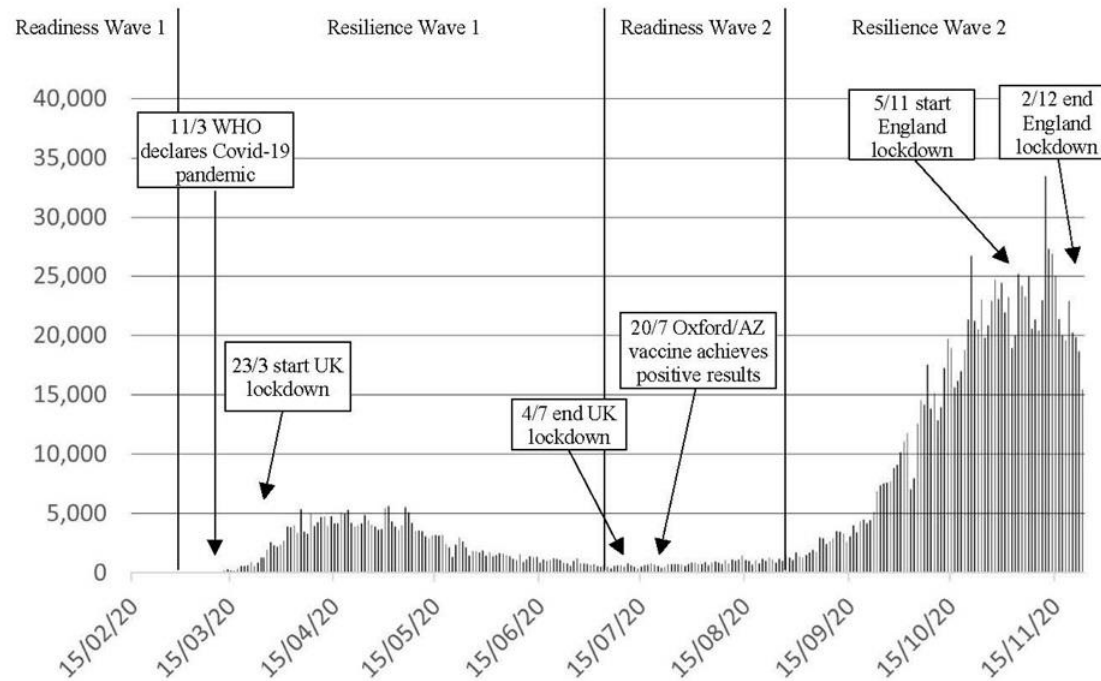
Figure 4. National Health Production Process During Covid-19 Epidemics

Summary of Developments in UK National Health System During 2020-2021: 1

- **Demography**: High share of elderly in population, who are most vulnerable to Covid-19
- **Epidemiology**: Unexpected rapid growth of infectious disease (Covid-19)
- **Demand for Medical Care**: Substantial growth for treatment of Covid-19, reduced demand for traditional medical services due to fear of infection and restrictions of supply

UK Covid-19 Daily Infections During First and Second Waves

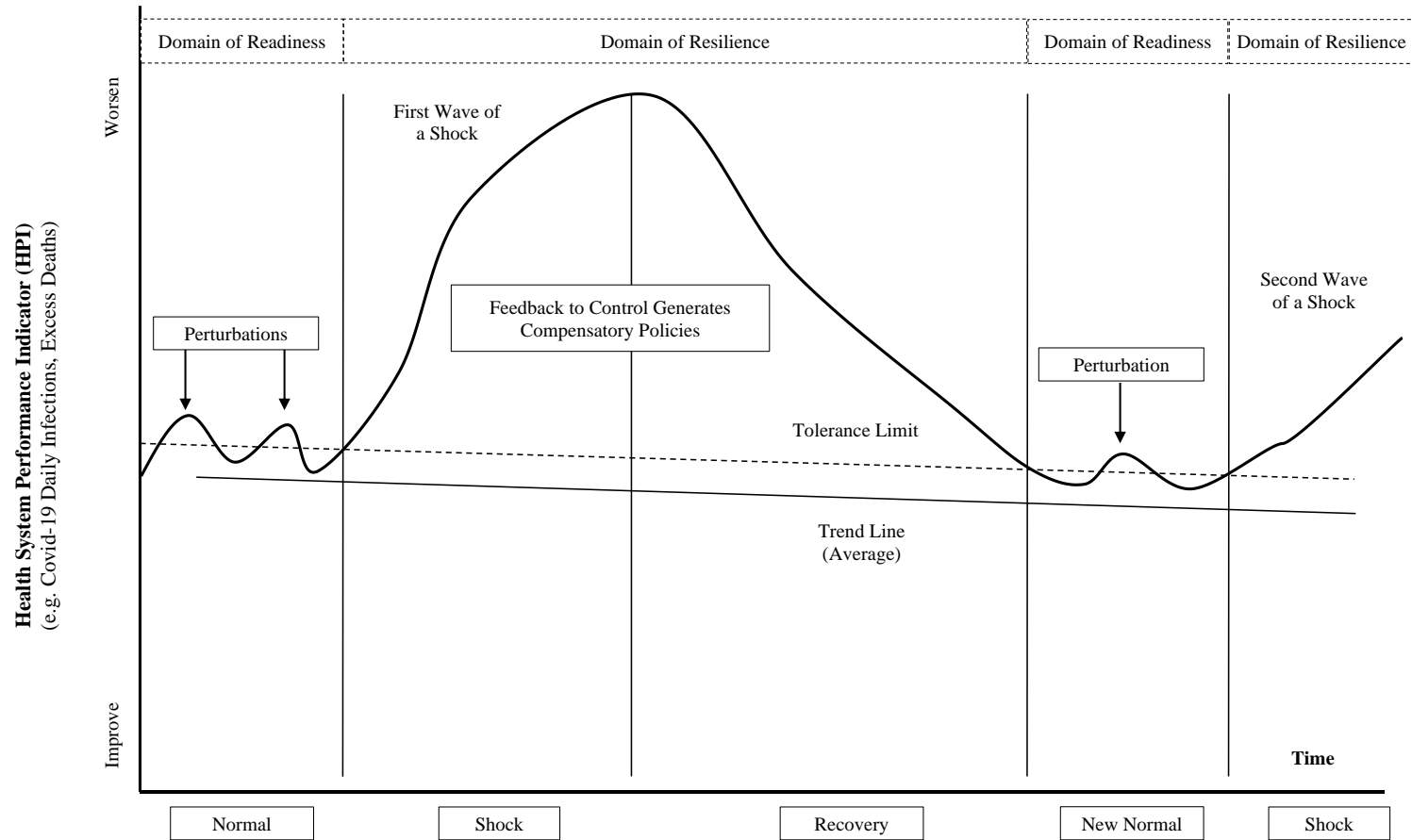
Figure 6: Daily Test-Confirmed Cases of Covid-19 in the UK



Sources: Worldometer 2020 and online information about timing of lockdowns in the UK.

Notes: (1) The figures show number of confirmed cases by day. In both countries testing improved over time, so actual cases in March-April would have been substantially higher than shown. Despite this, it is clear that a Second Wave started at the end of the summer, for well-known reasons. (2) The author obtained the statistics from the 'source code' pages of the relevant Worldometer figures, which contain separate blocks of comma delimited data for 'days' and 'daily cases'. These were disaggregated into cells in rows of Excel tables and then were used to generate the cluster column charts.

Readiness and Resilience of Health Systems Experiencing Shocks (Covid-19)



Phases of Complex Health System Development in Periods of Shocks

© Christopher Davis 2020. Prepared by author with inspirations from Kornai (1980, Figure 3.1) about tolerance limits and Linkov et al. (2019, Figure 3) about stages of resilience.

Summary of Developments in UK National Health System During 2020-2021: 2

- **Priority** of health raised in general, budget constraints are softened and health spending increases (excess demand). But radical shift in priorities related to treatment, with infectious disease highest, NCD lower, and basic services restricted.
- **Medical Technology**: UK health system had deficient technological standards in general and was not prepared for severe and sustained epidemics of infectious disease. This was reflected in deficiencies in facilities, technology (e.g. ventilators), medical inputs (e.g. PPE), medicines, and vaccines. Substantial improvements over time.

Intra-sectoral Priorities in Health Systems During Covid-19 Epidemics

Row	Indicators of Priority Status in Health Systems	High priority: Anti-Covid-19 institutions and programmes and urgent medical care	Low priority: Normal preventive health measures and medical treatments
		Summary of evidence concerning indicators	
During Plan/Budget Formulation			
A	Health in leadership's objective function (OF)	Anti-Covid-19 health programmes have had high national priority. Urgent normal medical care also has been important. However, within some elderly Covid patients have been given lower priority in intensive care treatment.	Leadership accepts needs for trade-offs in health system between anti-Covid/urgent and less acute medical challenges. Low priority given to the usual non-communicable diseases, routine medical needs, and non-Covid preventive care.
B	Resource allocation responsiveness to problems	Government and NHS leaders react quickly to Covid-related problems and allocate resources to solve them.	Slow responses to usual health problems and limited resource allocations.
During Plan/Budget Implementation			
E	Output plans	Strong commitment to ensure fulfilment of plans for outputs related to anti-Covid fight: medical services, medicines, PPE, medical equipment, test kits, vaccines.	Minimal efforts made to protect outputs related to usual medical activities.
F	Budget constraints	Soft budget constraints for activities engaged in anti-Covid fight (medical care, ICUs and ventilators, supplies, tests).	Budgets are reduced and constraints become harder (more binding).
H	Siphoning of supplies	Covid-19 programmes protected against external siphoning and benefit from siphoning from less important programmes within NHS.	Resources (personnel, equipment, PPE, medicines) siphoned away from usual medical activities to support Covid-19 fight.
J	Inventories of inputs	Government and NHS leaders support the build-up of inventories needed for fight against Covid-19 (First and Second Wave).	Limited replacement of items used or siphoned away during First Wave.
L	Shortage intensity	High intensity of shortages of anti-Covid products in March-April, but reduced in May-June due to better supplies. Staff shortages remain intense.	Higher intensity of shortages throughout First Wave and few actions to reduce them.

Summary of Developments in UK National Health System During 2020-2021: 3

- **Shortages** abruptly intensify in 2020 concerning medical labour (respiratory doctors, nurses) technology (ventilators), facilities (building unsuitable for treating patients with infectious illnesses, medicines)
- **Consequences of Shortages**: Increases in unreported illness and late diagnoses, severe pressure on staff, disruption of treatment especially in low priority areas
- **Responses to Shortages**: Treatment priorities, queuing, waiting lists, substitutions of inputs
- Substantial increases in **Excess Mortality** and declines in **Life Expectancy**

Shortages in UK NHS During Covid-19 Epidemic

Table 7: Shortages in the UK NHS During Covid-19 Epidemics: January-June 2020

Row	Category of Shortage	UK NHS 2020
A	Doctors: National Shortages	Low provision of doctors by EU standards. Shortages of GPs and hospital doctors compared to positions. Deficits related to Covid-19 covered by re-allocations from low priority branches. Supply reduced by illnesses and self-isolation.
B	Doctors: Shortages in Rural Areas and Deprived Regions	Availability of GPs and hospital doctors remained lower than in large cities. Occasional acute shortages arose in areas with high infection rates.
C	Doctors: Shortages of Specialists	Initial localised shortages of fully-trained specialists in respiratory illnesses, acute care and anaesthetists. Shortages reduced by mobilisation and re-training, but increased by illnesses and self-isolation.
D	Middle Medical Personnel (MMP): National Shortages	Low provision of MMP by EU standards and many vacant positions. Deficits reduced by mobilisation and re-training, but increased by illnesses and exits.
E	MMP: Shortages in Rural Areas and Deprived Regions	Significant shortages of nurses and technical personnel. Problems slightly mitigated by adjusting (lowering) standards (e.g. more patients per nurse) and substitutions.
F	MMP: Shortages of Specialists	Serious shortages of fully-trained nurses in acute care as well as technicians to operate ventilators and other capital equipment. Deficits reduced by training of staff.
G	Shortages of Hospital Facilities and Beds	NHS had low bed and ICU provision by EU standards. NHS discharged 30,000 patients, increased ICU capacity, and built <i>Nightingale</i> hospitals. Only local ICU shortages related to Covid-19 due to rationing, but increased deficits in low priority medical programmes.
H	Shortages of Medicines and Medical Inputs	Rising demands resulted in general and localised shortages of: painkillers, sedatives, blood pressure drugs, anaesthetics and medical supplies. Widespread shortages of PPE in NHS and social care.
I	Shortages of Testing for Covid-19	Supply of Tier 1 and Tier 2 tests rose from negligible in January to 43,109 daily by late June. Demand was controlled by rationing, so limited open evidence of shortages. But severe deficits existed relative to need.
J	Shortages of Medical Equipment	NHS had only 5,000 ventilators in February, but these were re-allocated to treat Covid patients, so shortages did not develop before supply increased to 8,000. UK had low provision of CT scanners and dialysis machines and shortages intensified as Covid demands increased. Shortages in low priority medical programmes intensified.

© Christopher Davis, 2020. Sources: Davis (2020) for starting positions and Davis (ca. 2021) contains more evidence. The list of references of this article contains many UK and Russia sources about shortages.

Consequences of Shortages in UK NHS During Covid-19 Epidemic

Table 8: Consequences of Shortages in the UK NHS and Policy Responses During Covid-19 Epidemics: March-June 2020

Row	Type of Consequence	
A	Shortages Cause Bottlenecks in the Production of Medical Services	Personnel: lack of ICU nurses caused cancelled emergency care admissions; high illness rates & self-isolation of staff disrupted hospital teams. Equipment: lack of dialysis machines impeded treatment. Medicines and supplies: deficits caused disruptions to provision of medical care.
B	Shortages Increase Stress and Lower Motivation of Medical Personnel	Covid hospital treatment was stressful due not only to complexity and lethality of disease and risk to staff of infection/death, but also to shortages of PPE, tests for Covid, medicines, and equipment. Stress was augmented by complaints from patients concerning insufficiency of non-Covid medical services.. Attempts were made to keep up morale of NHS staff: weekly clap by the public in the UK and cash bonuses for front-line workers in Russia.
C	Shortages Cause Citizens to Under-Report Illnesses, Increasing the Hidden Components of Morbidity Icebergs	Patients avoided GPs and A&E departments due to fear of infection and cut-backs in NHS services. GPs discouraged personal meetings, A&E adopted firmer triage rules and hospitals reduced normal treatments. So, more illnesses were not reported and hidden component of morbidity iceberg increased.
	Types of Responses	
D	Adjustments of Medical Priorities and Constraints on Non-Covid Medical Care	See Table 2. Highest priority: Covid-19 patients and emergency cases of other illnesses. Medium priority: cancer and other serious illnesses; Low priority: some frail elderly with Covid, routine illnesses, and elective surgery.
E	Rationing through Sub-Systems of Medical Care	There was no rigid rationing through subsystems, but there was unevenness of capacities to treat Covid-19 across four 'nations', large cities, and counties. Most patients were treated in local facilities. Few hospitalised 70+ elderly Covid patients received intensive care.
F	Rationing by Queuing	Physical queues at GP offices were replaced by triage by telephone to set up personal meetings with a doctor. A&E visits dropped by 27%, but the number of waits beyond 4 hours fell by 50%.
G	Rationing by Waiting List	Most under-60 Covid patients in hospitals were treated fully on an urgent basis, whereas few elderly 70+ received intensive care. Waiting lists and waiting times increased for treatments of non-communicable diseases (cancer, cardiovascular).
H	Temporary Elimination of Medical Services in the NHS	In responses to the rising risk of infections and reallocations of resources to support medical treatment of Covid cases, many standard screening, diagnostic and treatment services were temporarily suspended or severely reduced in outpatient facilities and hospitals. This contributed to the growth of hidden illness and waiting lists.
I	Substitution of Traditional Inputs by Cheaper or Less Effective Ones	During the peak periods of the epidemics, there were many forced substitutions to avoid or cope with shortages. Personnel: fully trained ICU staff members were replaced by re-profiled colleagues. Medicines: less effective drugs replaced recommended ones. Equipment: alternative less capable machines and treatment procedures (e.g. intermittent dialysis) were used. Supplies: recommended PPE was replaced by less effective alternatives.

© Christopher Davis, 2020. Sources: Davis (2020) provides information about starting positions in the UK and Davis (ca. 2021) contains evidence about developments summarised in this table. The list of references of this article contains many UK sources about the consequences of shortages and policy responses to them.

Ratings of Resilience of the UK and Russia Health Systems During Covid-19 Epidemics

Category of Resilience	UK				Russia			
	First Wave		Second Wave		First Wave		Second Wave	
	Rating	Points	Rating	Points	Rating	Points	Rating	Points
A: Control of the health system: Adaptations of health management and priorities.	<i>Substandard.</i>	2	<i>Average.</i>	3	<i>Average.</i>	3	<i>Average.</i>	3
B: Mobilisation and management of medical personnel.	<i>Average.</i>	3	<i>Average.</i>	3	<i>Good.</i>	4	<i>Good.</i>	4
C: Mobilisation of medical facilities, medical equipment and ICUs.	<i>Average.</i>	3	<i>Good.</i>	4	<i>Average.</i>	3	<i>Average.</i>	3
D: Adaptation of the medical supply system and its effectiveness.	<i>Poor.</i>	1	<i>Average.</i>	3	<i>Average.</i>	3	<i>Average.</i>	3
E: Acquisition and distribution of new medical capital equipment.	<i>Average.</i>	3	<i>Average.</i>	3	<i>Average.</i>	3	<i>Average.</i>	3
F: Acquisition and distribution of medicines and medical supplies.	<i>Substandard.</i>	2	<i>Average.</i>	3	<i>Substandard.</i>	2	<i>Average.</i>	3
G: Acquisition and distribution of medical personal protective equipment (PPE).	<i>Poor.</i>	1	<i>Average.</i>	3	<i>Poor.</i>	1	<i>Substandard.</i>	2
H: Adequacy of treatment of medical needs of the population (morbidity iceberg including hidden illness).	<i>Substandard.</i>	2	<i>Substandard.</i>	2	<i>Substandard.</i>	2	<i>Substandard.</i>	2
I: Adequacy of treatment of medical demands (reported illness) of the population (scale of rationing through waiting lists).	<i>Substandard.</i>	2	<i>Substandard.</i>	2	<i>Substandard.</i>	2	<i>Substandard.</i>	2
J: Mobilisation of domestic industry production of medicines, medical goods, medical PPE and medical equipment.	<i>Good.</i>	4	<i>Good.</i>	4	<i>Good.</i>	4	<i>Good.</i>	4
K: Mobilisation of domestic biomedical R&D for the development of Covid-19 tests and vaccines and for laboratory processing of tests.	<i>Good.</i>	4	<i>Good.</i>	4	<i>Good.</i>	4	<i>Good.</i>	4
L: Mobilisation of field testing for Covid-19 and tracing contacts of infected people.	<i>Poor.</i>	1	<i>Substandard.</i>	2	<i>Substandard.</i>	2	<i>Average.</i>	3
M: Medical system performance during the Covid-19 epidemic	<i>Average.</i>	3	<i>Good.</i>	4	<i>Average.</i>	3	<i>Average.</i>	3
N: Health outcomes (Remain Healthy, Illness, Recovery, Mortality).	<i>Substandard.</i>	2	<i>Substandard.</i>	2	<i>Average.</i>	3	<i>Substandard.</i>	2
O: Mobilisation of residential social care homes to protect vulnerable people.	<i>Poor.</i>	1	<i>Average.</i>	3	<i>Average.</i>	3	<i>Average.</i>	3
P: Overall assessment of the resilience of the national health system.	<i>Substandard.</i>	2.3	<i>Average.</i>	3.0	<i>Average.</i>	2.8	<i>Average.</i>	2.9

Lessons Concerning Performances of the UK National Health System Concerning Covid-19 Readiness and Resilience: 1

- During 2000-19 the UK NHS exhibited inadequate growth in HE relative to demand, especially after the GFC in 2008-09. This contributed to deficiencies in Readiness for Covid-19.
- Past failures of forecasting morbidity developments (e.g. focus on NCD) resulted in incorrect investment in medical technologies and capital stock by 2020.
- UK: Shortages and neglect of middle medical personnel (nurses) undermine medical treatment.
- UK: Poor management of elderly patients in hospitals generated bottlenecks in hospitals and increased risks.

Lessons Concerning Performance of UK NHS Concerning Covid-19 Readiness and Resilience: 2

- Inadequacies in medical supply systems. Insufficient inventories of PPE, equipment and medicines in the Covid-19 period. Over-reliance on certain countries, such as China for PPE and India for vaccines.
- Neglect of maintaining national capabilities in science and technological innovation (e.g. vaccines) and production capabilities.
- Analysis of empirical record of UK NHS during 2000-21 suggests that economic system and performance, priorities, and health spending were more important than features of the health financing system.