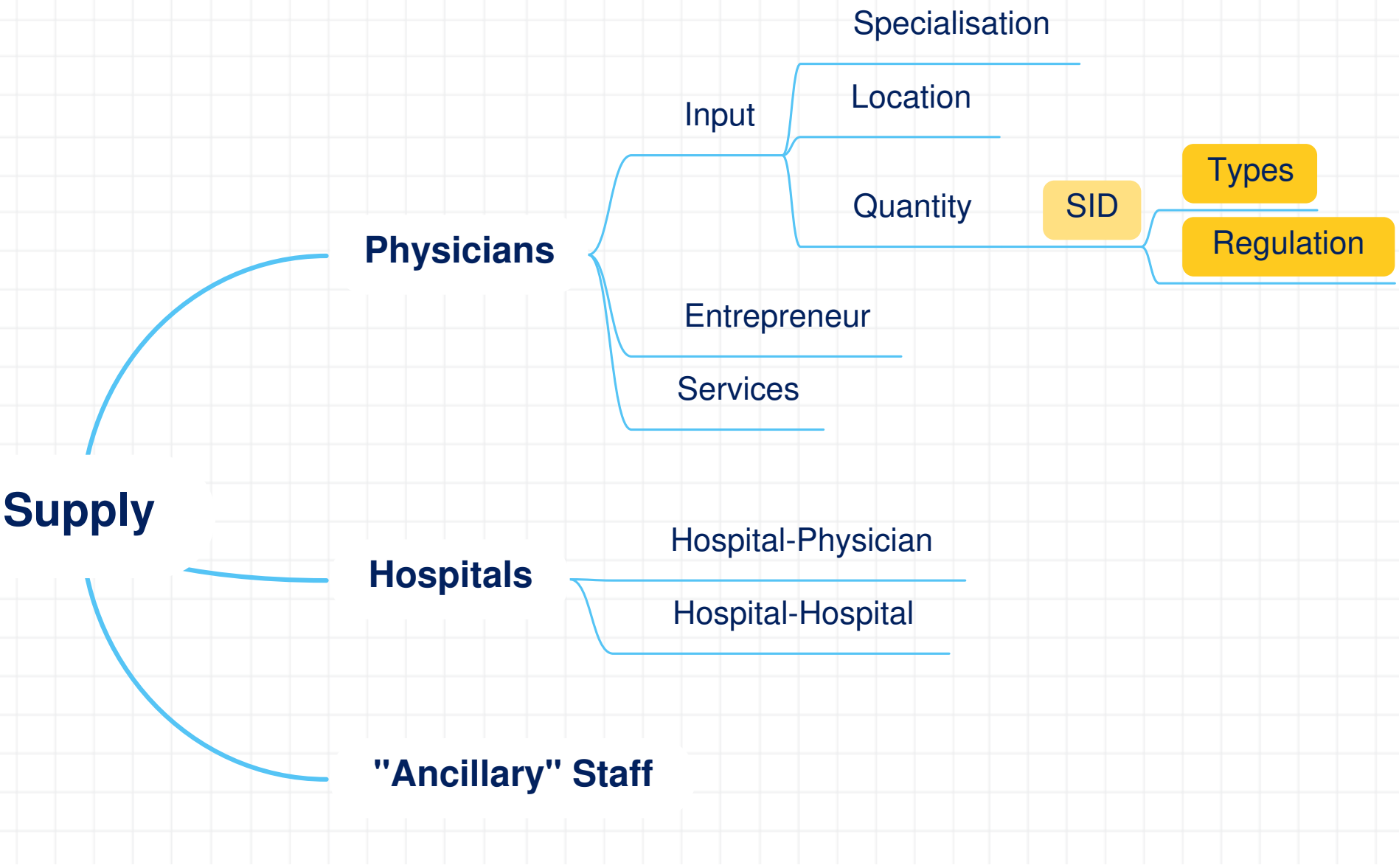
Health Economics
Supply of Health-*care*

Plan


Supply
Physicians
Input
Specialisation
Location
Quantity
SID
Types
Regulation
Entrepreneur
Services
Hospitals
Hospital-Physician
Hospital-Hospital
"Ancillary" Staff

Role of Physicians

Three roles of Physician as an economic agent:

1. Physician as **inputs** into production process;
   - 1.1 Physician as provider of care; and
   - 1.2 Physician as provider of specific type of care.

2. Physician as **manager** to organise production process;
   - 2.1 Decide **location**, staffing, vertical integration, pricing etc.

3. Physician as **organisation of physician services** i.e. combined with other services and delivered as final product to patients;
   - 3.1 Physician-**firms** as profit-maximising entities that combine input
   - 3.2 Quantity of services: Supplier-induced demand
   - 3.3 Quality of services.

Physician as Input: Two Decisions

1. As provider of care: Decision to become physician;
2. As provider of specific type of care: Decision to specialize

Physician as Input - Decision 1: To be or not to be

1. Utility from **non-monetary attributes**: desire to help others, prestige, intellectual content, interaction, work-life balance ?

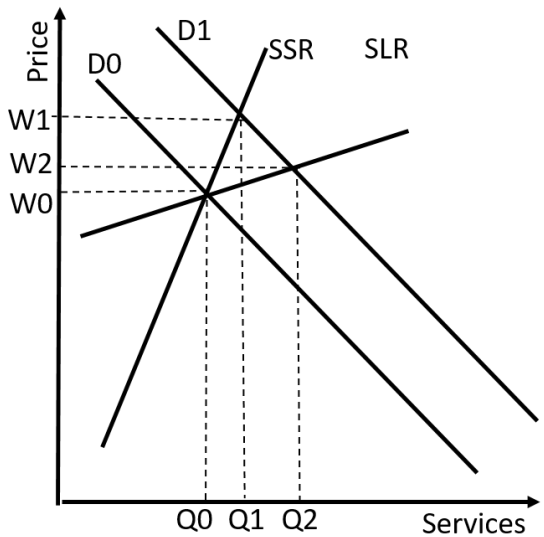
Monetary Attributes?

2. *Opportunity cost* Foregone earnings from some other profession.
3. *Time-preference*: Medical school: Heavy front-end costs, higher earnings in later years.
    1. If relatively strong preference for initial consumption: Other profession
4. *Internal Rate of Return*: Interest rate to make you indifferent between bank and other investment.

	Physicians	Dentists	Lawyers
1960	11.8	12.1	7.0
1970	11.6	12.3	7.1
1980	12.1	-	7.2

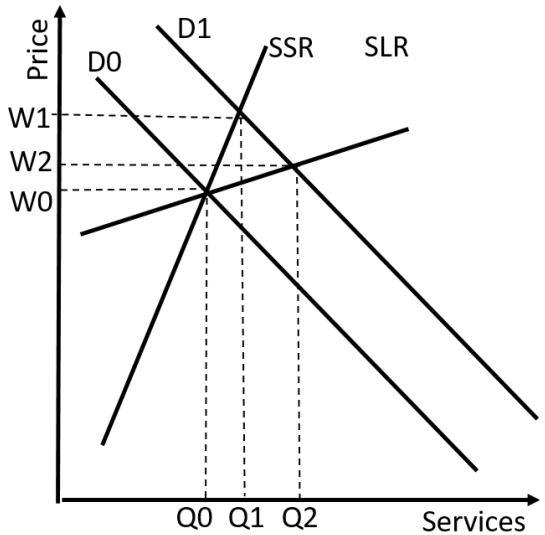
Source: Burstein and Cromwell (1985) for 1970-1980; Sloan (1970) for 1960

Physician as Input - Decision 1: Short Run Supply



1. Short-run supply curve (SSR) steeper than long-run supply curve (SLR)
   1.1 Short run - unable to change physicians due to training, relocation
2. If demand increases due to increase in consumer choices (D0 to D1)
   2.1 Wages and quantity of hours increases in SR to W1 and Q1;
   2.2 More graduates enter the medicine, as $\Delta Y \uparrow$.

Physician as Input - Decision 1: Long Run Supply



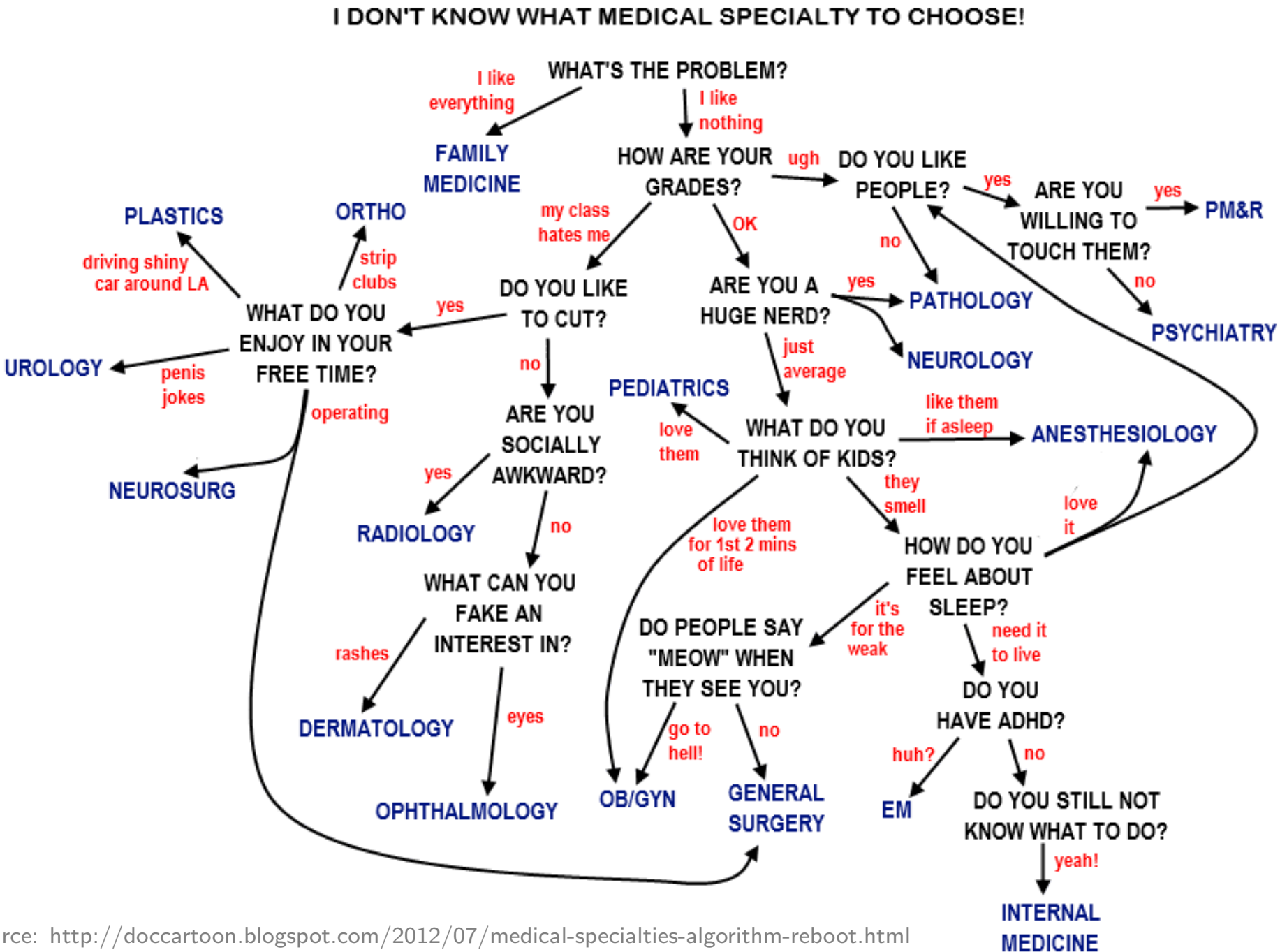
1. Long-Run
   - 1.1 If static wage-expectations, expect wage to stay at W1;
   - 1.2 Then supply increases in LR, surplus of physicians.
   - 1.3 Wage drops to W2 $\rightarrow$ reduce intake of physicians,
   - 1.4 Wage increases $\rightarrow$ cycle of shortage /surplus.
2. But wage-expectations are forward looking:
   - 2.1 Empirical evidence that they correctly expect LR wage to be W2
3. If efficient labor market: self-correct surplus and shortage.

Physician as Input - Decision 1: Wage Differentials

	Physicians	Dentists	Lawyers	Business
1960	11.8	12.1	7.0	
1970	11.6	12.3	7.1	
1980	12.1	-	7.2	
1990	20.9	20.7	25.4	29.0

Source: Wilke (1994) for 1990; Burstein and Cromwell (1985) for 1970-1980; Sloan (1970) for 1960

Physician as Input - Decision 2: What to specialise in?



Source: http://doccartoon.blogspot.com/2012/07/medical-specialties-algorithm-reboot.html

Physician as Input - Decision 2: Speciality

1. Speciality responds to economic incentives.
   1.1 Internal rate of return for the income flow from specializing in A vs B.
2. Four trends for internal rate of return on speciality training:
   2.1 Rate of return on speciality training is large (Primary care: 15.9% vs Speciality 20.9%);
   2.2 Returns have increased over time;
   2.3 Return on paediatrics - either negative or below borrowing costs.
   2.4 Post1980: Primary care growth in return relatively more than internal medicine (15.9% vs 12.7%).

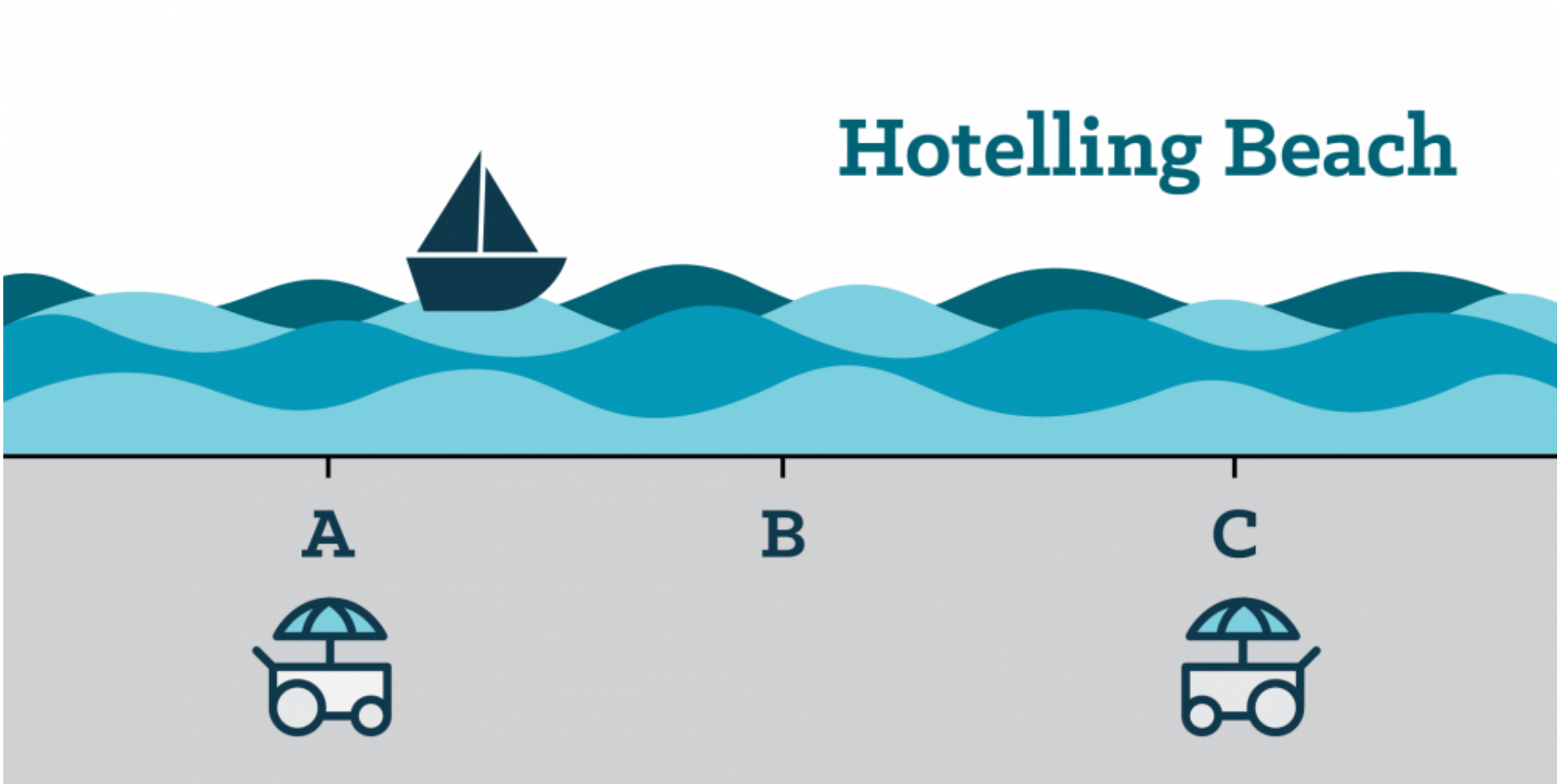
	Internal Medicine	General Surgery	Obs and Gynae	Paediatrics
1965	1.5	5.2	4.8	<0
1975	12.5	11.6	12.1	-
1987	12.7	22.1	25.9	1.5

Source: Marder and Wilke (1991) for 1987; Burstein and Cromwell (1985) for 1975; Sloan (1970) for 1965

Physician as Manager

1. Where to locate?
2. How to organise inputs such as physicians, nurses, allied health?
3. How much to advertise?

Physician as Manager - Decision 1: Location



Source: Image:https://destinationthink.com/sea-of-sameness-destination-branding-paradox/

Physician as Manager - Decision 1: Location

1. **Spatial competition** (Hotelling): Doctors locate in regions with **highest population:doctor ratio**. As supply increases, locate in smaller towns.

City	Population	No. Doctors (1/10,000)	No. Doctors (1/5,000)
A	100,000	10	20
B	20,000	2	4
C	5,000	0	1

   1.1 If doctor:population $<$ 1:10,000 (12 doctors) $\rightarrow$ doctors in A,B, none in C.
   1.2 If total doctors increases to 23. A, B have doctors. None in C
   1.3 If total doctors increases to 24. Ratio drops to 1:5,000.

2. Select most desirable place for practice and **induce demand**.
3. Empirical evidence: Supports spatial competition: 11,000 people per paediatrician; 65,000 people per neurosurgeon, cities with 10,000-20,000 attract paediatrician and 50,000-200,000 attract neurosurgeon.

Physician as Organisation: Hospital Structure 1/2

Hospitals comprises of (a) Physicians; and (b) Administrative staff

Three traditional models of Physician-Hospital:

1. "Physician work-bench": Physicians have visitation rights at hospitals.
   - 1.1 Ancillary services provided by hospital.
   - 1.2 Physicians request for increase in technology adoption. No incentive to control cost.
   - 1.3 Administrators incentive to control cost. Lack knowledge to judge value of innovations.
   - 1.4 Costly bargaining between physicians and administrators.
   - 1.5 Adoption of cost-ineffective technologies. Increase in cost for patients.
   - 1.6 Prevalent in the USA, Singapore private hospitals.

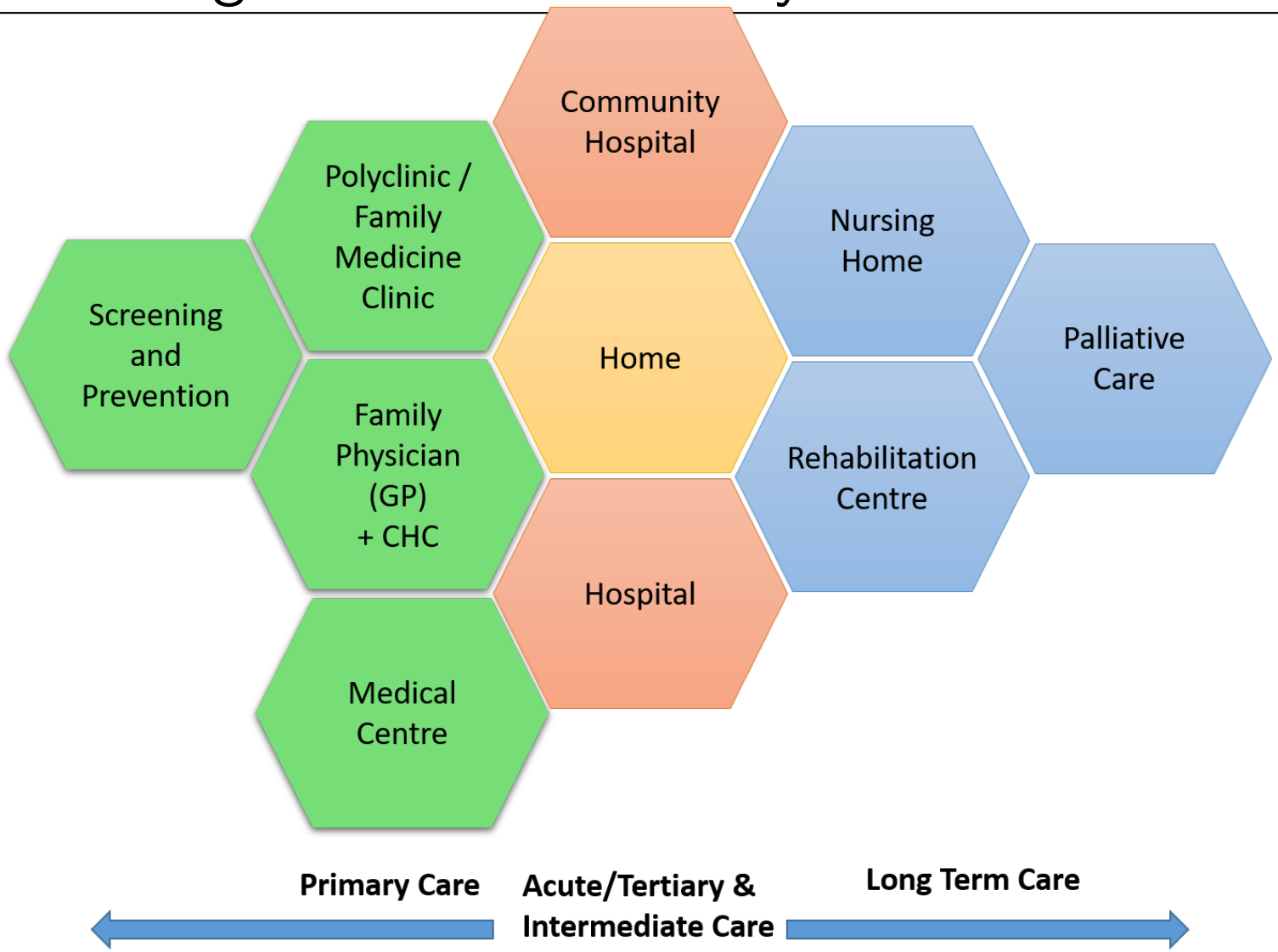
Physician as Organisation: Hospital Structure 2/2

Three traditional models of Physician-Hospital:

2 Physicians as employees: Physicians owned and paid by hospitals.
- 0.1 Physicians have some incentive to control cost.
- 0.2 Salaried doctors - lower incentive to provide care.
- 0.3 Profit sharing doctors - incentives to provide quality care.
- 0.4 Prevalent in the UK, Singapore public hospitals.

3 Physicians as owners: Physicians own and operate hospitals
- 0.1 High incentive to control costs.
- 0.2 May avoid necessary treatment to save money.

Physician as Organisation: Health System



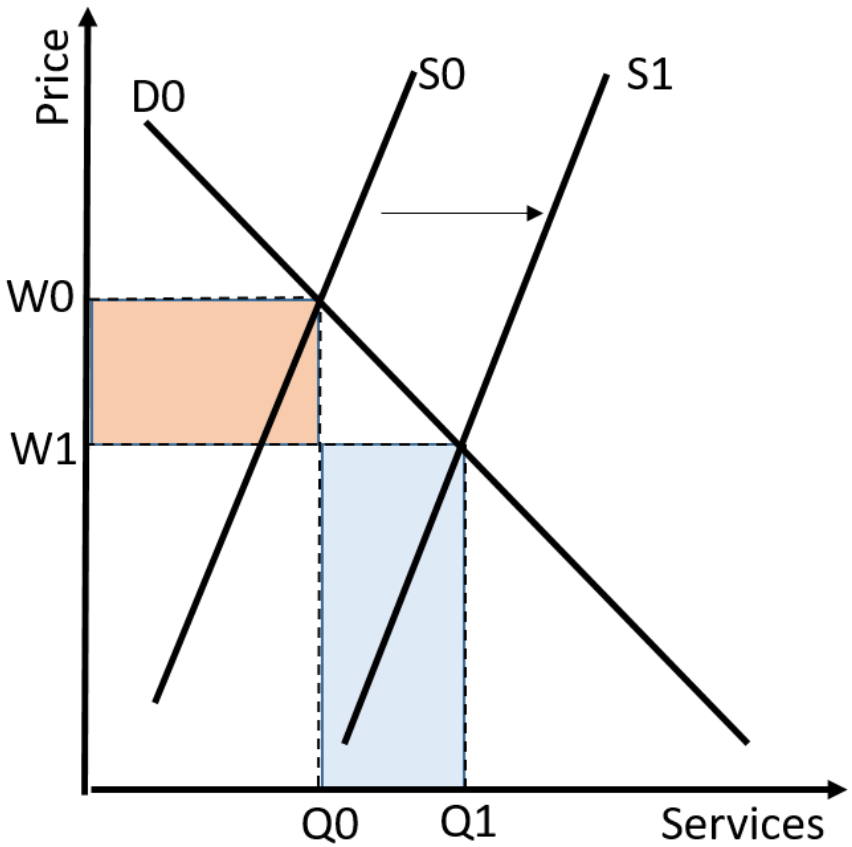
Physician as Organisation: Price

1. Difference from regular market
   - 1.1 Hospital (sometimes) as forbidden to deny care
   - 1.2 High barriers to entry: Cost and approvals
   - 1.3 Price: Insurance, subsidies distort the usual supply and demand.
2. Differentiated product oligopoly
   - 2.1 **High barriers to entry** lead to **few hospitals** $\rightarrow$ oligopoly
   - 2.2 **Products across suppliers are not perfect substitutes**
     - Set of services, and quality differ
     - Patient loyalty to physicians
     - Distance to hospital
3. Oligopoly
   - 3.1 Market-power: $P > MC$. Raise prices without losing customers
   - 3.2 Competition: Cannot raise price infinitely
   - 3.3 Collusion may happen. Forbidden by government.

Physician as Organisation: Quality

1. If cant compete on price, then raise prices and compete on quality
2. Quality
   - 2.1 Physician quality
   - 2.2 Bed/Infrastructure
   - 2.3 Staff
3. Medical Arms Race *Hypothesis*: Hospitals compete on quality to attract patients and physicians. Race to get best technology and may cause over-consumption of medical technology.
   - 3.1 Empirical evidence on arms race is mixed due to payment mechanisms.
   - 3.2 Empirical evidence on effect of arms race on patient outcomes is mixed.
     - More competition $\rightarrow$ lower cost, lower patient mortality, lower waiting time.
     - More competition $\rightarrow$ less patients, less learning by doing, worse patient outcomes.

Interaction of Physicians and Patients



1. What does an increase in supply of physicians do?
2. Outward shift of Supply curve
   - 2.1 (S0 $\rightarrow$S1)
3. Quantity transacted increases
   - 3.1 (Q0 $\rightarrow$Q1)
4. Price drops
   - 4.1 (W0 $\rightarrow$W1)
5. Total expenditure is uncertain
   - 5.1 Depends upon elasticity
6. Real world:
   - 6.1 $\uparrow$ Physician density
   - 6.2 $\Rightarrow$ Medical services $\uparrow$
   - 6.3 $\Rightarrow$ Fees does not drop
   - 6.4 $\Rightarrow$ Medical expenditure $\uparrow$

Supplier Induced Demand 1/15

Medical market $\neq$ Competitive marketplace (Reinhardt, Evans, Fuchs):

1. Lack of Consumer Sovereignty: **Unable to chose provider**.
   - (Traditionally) restricted **advertising** and lack of information; (TV ads)
   - **Technological complexity** makes it difficult to evaluate doctors. (Now websites)

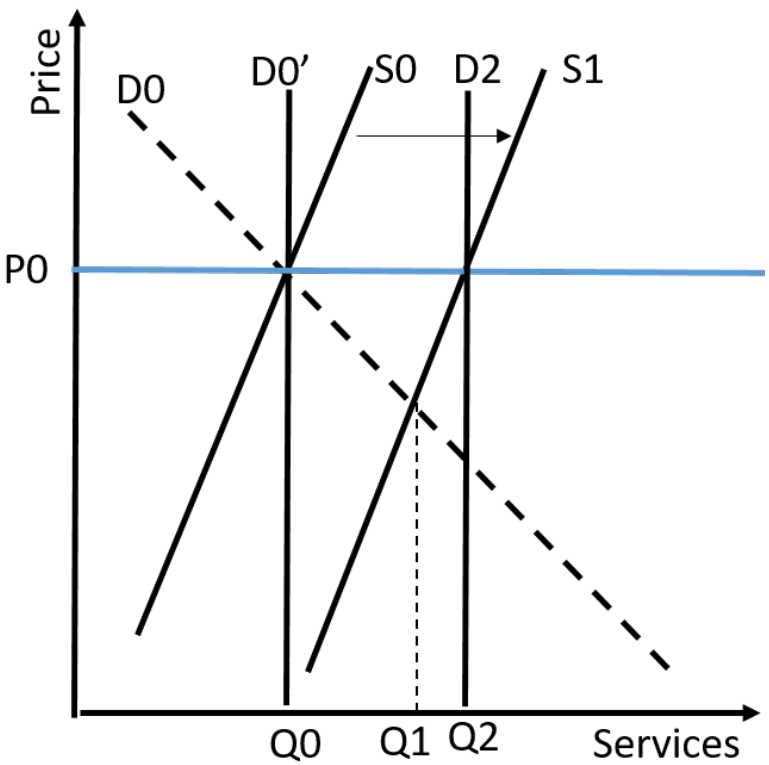
2. Lack of Independence of Demand and Supply:
   - Patient's **incomplete information**. Know need care but not WHAT;
   - Choice to *delegate* treatment to physician;
   - **Physician acts as patient's agent**. Defines needs, recommends treatment;
   - But physician also provides services to meet those needs;
   - Implication: Patient's **Demand** $\sim$ **Supply** from Physicians;
   - Demand for medical care is supplier **determined**

Supplier Induced Demand 1'/15

Principal (Patient) - Agent (Physician) relationship

1. **If** physicians were **perfect** agents for patients: **Chose appropriate care**.
   (Supplied determined demand)
   BUT
2. **If** doctor's decisions **affected** by own **monetary interests**:
3. **Physicians can systematically modify information to alter patient's perception of needs**;
4. Supplier **determined** demand is now supplier **induced** demand (SID).

Supplier Induced Demand 2/15



1. Demand Curve:
   - 1.1 Assume 1: Full insurance coverage:
   - 1.2 Patients dont face the prices,
   - 1.3 Demand independent of price: D0'
2. Equilibrium unit price: p0
   - 2.1 Government fixed to match D0' & S0.
3. Supply of Physicians ↑ to S1
4. Assume 2: If **perfect agents**
   - 4.1 No Δ in demand. D0 = Q0
   - 4.2 Underutilization: Q2-Q0
5. Assume 2' : If **imperfect agents**
   - 5.1 Care about own revenue;
   - 5.2 Advise unnecessary services;
   - 5.3 Demand shifts out to D2, where p0 intersects with S1.

Demand required to match supply is *induced* by physicians. Alt

Supplier Induced Demand 3/15

1. Definition: **'SID' hypothesis: Amount of services transacted is exclusively determined by supply as desired by physicians**.

   Mechanism

2. Physicians have **superior information** as compared to patients;
3. Physicians do **not** act as **perfect** agents ;
4. Physicians act according to **own interests**:
5. **Systematically modify information**;
6. **Boost the demand** at their discretion;

Supplier Induced Demand 3'/15

Definition: **'SID' hypothesis: Amount of services transacted is exclusively determined by supply as desired by physicians**.

Conditions for SID:

1. *Comprehensive health insurance or payment system*: If consumers are fully insured, their **own willingness to pay is no longer relevant**.
   - Only resistance left is time-cost for treatment.

2. *Riskless medical technology*: If physicians have technology, that does provide **minimal benefits but does no harm**, they are likely to use it.

3. Revenue *must* rise sufficiently with the amount of services supplied. (else it is not worth it)

Supplier Induced Demand 4/15 - Theoretical Setup

Demand Side	
Total Population	n
Number of Physicians	a
Physician-density (physicians-population ratio)	$\delta = \frac{a}{n}$
Per-capita demand of healthcare (Fully insured, DD does not depend on P)	M
(1) Demand per physician	$\frac{nM}{a} = \frac{M}{\delta}$
(2) Unit of induced demand per physician	s and $s \geq 0$
Total Demand for each physician (1+2)	$\mathbf{h}(\delta, \mathbf{s}) = \mathbf{M}/\delta + \mathbf{s}$

Supply Side	
Actual working time ($0 \leq t \leq 1$)	$t = min[h(\delta, s), 1]$
Price	p
Physician's disposable income (consumption)	$y = y(pt)$, $y' > 0$, $y'' < 0$

Supplier Induced Demand 5/15 - Theoretical Setup

Recall (from previous slide):	
Actual working time ($0 \leq t \leq 1$)	$t = min[h(\delta, s), 1]$
Unit of induced demand per physician	s and $s \geq 0$
Physician's disposable income (consumption)	$y = y(pt)$

Physician's utility $\rightarrow$	$\mathbf{u} = \mathbf{u}(\mathbf{y}, \mathbf{t}, \mathbf{s})$ with
- Positively on consumption	$u_y > 0, u_{yy} < 0$
- Negatively on time	$u_t < 0, u_{tt} \leq 0$
- Negatively on inducement	$u_s < 0, u_{ss} \leq 0$
- Consumption & Leisure are complements	$u_{yt} \leq 0$
- Professionalism important at higher income	$u_{ys} \leq 0$
- Workload t has no effect on professionalism	$u_{st} = 0$
- Note: $u_y = \frac{\partial u}{\partial y}$	

Supplier Induced Demand 6/15 - Solution

1. Physician's utility $\rightarrow u = u(y, t, s)$
2. Recall that $y = y(pt)$; $t = min[h(\delta, s), 1]$
3. Utility could be re-written as function of induced demand s only, by replacing y and t as functions of s:
4. Physician's utility $\rightarrow u = u\Big(y\big(p(\frac{M}{\delta} + s)\big), (\frac{M}{\delta} + s), s\Big)$ or

4b Physician's utility $\rightarrow u = u\Big(y\big(p(y(s)\big), \quad t(s), \quad s\Big)$

5. Form the Lagrangean: $\mathcal{L}(s, \lambda) = u\Big[y\big(p(y(s)\big), t(s), s\Big] + \lambda[1 - \frac{M}{\delta} - s]$

Supplier Induced Demand 7/15 - Solution

1. Form the Lagrangean:

$$\mathcal{L}(s,\lambda) = u\Big[y\big(p(y(s)),t(s),s\Big] + \lambda[1 - \frac{M}{\delta} - s]$$

Kuhn-Tucker conditions:

2. $\dfrac{\partial \mathcal{L}}{\partial s} = py'u_y + u_t + u_s - \lambda = 0$

   2.1 $py'u_y$: marginal benefit of additional consumption;
   2.2 u_t: marginal utility lost from working extra hours;
   2.3 u_s: the bad conscience from demand inducement;

3. $\dfrac{\partial \mathcal{L}}{\partial \lambda} = 1 - \dfrac{M}{\delta} - s \geq 0$

Supplier Induced Demand 8/15 - Optimal Cases $\star$

1. Boundary optimum: s=0 and t = 1
2. Optimum: s=0 and t<1
3. Interior optimum: s>0 and t<1
4. Optimum: s>0 and t=1

Supplier Induced Demand 9/15 - Optimum Case 1

Boundary optimum: s=0 and t = 1

1. Occurs when **Physician density (δ) very low**.
   1.1 s.t. demand exceeds capacity $M/\delta \geq 1$ i.e. **Unmet** demand
2. Physicians **work full-time t = 1**
3. As t = 1, **no capacity/need for induced demand. (s = 0)**
   3.1 Total amount of services supplied = No. of physicians X time = a * t
   3.2 Per patient amount of services supplied = $q = \frac{a * t}{n} = \frac{a}{n}$ (as t = 1)
   3.3 But $\frac{a}{n} = \delta$, so $q = \delta$ and $\frac{dq}{d\delta} = 1$
4. **Billing per patient is proportional to physician density.**
5. **Increase in physician density** will likely **increase billings** per patient and expenditure as long as all physicians work at full capacity (t=1).

Supplier Induced Demand 10/15 - Optimum Case 2

Optimum: s=0 and t $<$ 1

1. Occurs when **Strong professionalism, leisure preference is high**:
   - 1.1 Strong professionalism $\rightarrow$ No inducement (s=0);
   - 1.2 Leisure preference is high $\rightarrow$ Do not work full-time (t<1).
2. Physicians work **just enough** to meet primary demand: $\frac{M}{\delta} < 1$
   - 2.1 Amount of services: $q = M$
   - 2.2 $\frac{dq}{d\delta} = 0$
3. **Billing per patient do not depend on physician density.**
4. **Increase in physician density** will **not increase expenditure** for a small range of physician-density (δ).

Supplier Induced Demand 11/15 - Optimum Case 3

Interior optimum: s>0 and t<1

1. **Physician density very high** s.t. even with optimum inducement (s>0), not fully occupied (t<1).
2. Recall from FOC: $\frac{\partial \mathcal{L}}{\partial s} = py'u_y + u_t + u_s - \lambda = 0$
3. **Induce demand** to the point where marginal benefit of additional consumption ($py'u_y$) is equal to the marginal utility lost from working extra hours (u_t) and the bad conscience from demand inducement (u_s).
4. Increase in physician density:
   - 4.1 If s=0, then revenue (pt), and consumption (y) fall $\rightarrow$ u_t should fall too.
   - 4.2 If large physician density and physician incomes decline, then marginal benefit from additional consumption exceeds marginal utility loss from additional work and demand inducement and **billings per patient increase**.

Supplier Induced Demand 12/15 - Optimum Case 4

Optimum: s>0 but t=1

1. Occurs when **income motive** is very strong.
2. Such that induce a lot of demand (s>>0) until full-capacity (t=1)
3. **Inducement**: $\mathbf{s = 1 - \frac{M}{\delta}}$
   - 3.1 Total amount of services supplied = No. of physicians X time = a * t
   - 3.2 1 Per patient amount of services supplied = $q = \frac{a * t}{n} = \frac{a}{n}$ (as t = 1)
   - 3.3 But $\frac{a}{n} = \delta$, so $q = \delta$ and $\frac{dq}{d\delta} = 1$
4. **Billing per patient is proportional to physician density.**
5. **Increase in physician density** will likely **increase billings** per patient and expenditure until they reach full capacity (t=1).

Supplier Induced Demand 13/15 - Increase in Physician Density ⋆

1. Low physician density:
   - 1.1 Rationing of demand (Unmet demand);
   - 1.2 Billing per patient is **proportional** to physician density.
2. Intermediate physician density:
   - 2.1 Demand inducement *may* not occur
   - 2.2 Billing per patient *may* not change with physician density.
3. Large physician density:
   - 3.1 Physician incomes decline:
     - If **Strong ethical**, professional, **leisure preferences**: **No change in billings**
     - Else, marginal benefit from additional consumption exceeds marginal utility loss from additional work and demand inducement and billings per patient increase.

Supplier Induced Demand 14/15 - Alternative Theories

1. **Permanent Excess Demand**: Graph
   - 1.1 If prices are regulated, lead to permanent excess demand.
   - 1.2 Physicians work to full-capacity (t=1). Still unmet demand.
   - 1.3 Increase in physician density $\rightarrow$ increase in quantity of services.

2. **Decreasing Indirect Cost**, improved quality of treatment:
   - 2.1 Reduction in non-financial costs (e.g. appointment time, transport) due to more physicians.
   - 2.2 More physicians enables each physician to spend more quality time with patient.
   - 2.3 '**Availability effect**' increases demand in response to increase in physician density.

3. **Reverse Causality**:
   - 3.1 When doctors choose where to locate, they choose areas with high demand.
   - 3.2 High demand $\rightarrow$ high density.

Supplier Induced Demand 15/15 - Empirical Evidence

Fuchs (1978)	USA	1 additional surgeon 10% ↑ density	30-40 additional surgeries per year 3% ↑ care utilization
Cromwell & Mitchell (1986)	USA	10% ↑ density 10% ↑ density	0.9% ↑ overall surgery per capita 1.3% ↑ elective surgery
Delattre & Dormont (2003)	France	10% ↑ density	0.5% ↑ expenses
Li et al (2012)	China		50% prescriptions for antibiotics 2X frequency of WHO

1. Currie et al [China]: Experiment for SID:
   - 1.1 Provide gift to doctor [Reciprocation]. Reduce by 13.3 percentage points
   - 1.2 Signal knowledge about antibiotics. Reduce by 20 percentage points
   - 1.3 Remove financial incentives: Reduce by 51.6 percentage points

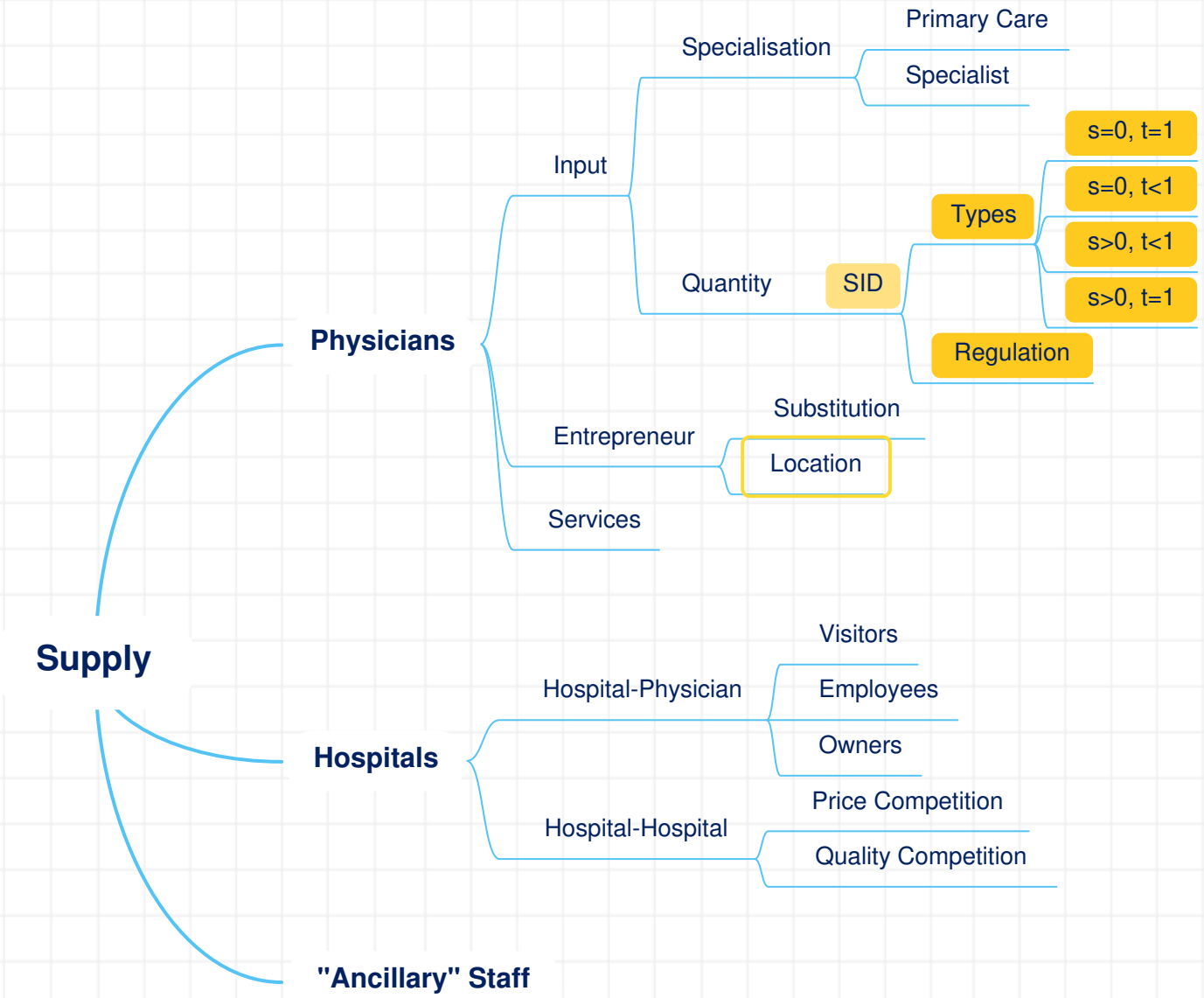
Supply of Physicians - Interventions

Medical markets are not free to operate both in short or long-run.

Number of medical schools and spaces within medical schools is highly restricted.

1. Heavily regulated and restricted medical market to obtain:
   1.1 Optimal **quality**, optimal number, optimal mix, location.
2. Need optimal quality to address the asymmetric information from consumers:
   2.1 Patients are ill/not-informed of their **own** medical conditions;
   2.2 Patients are unable to directly ascertain **doctor's** quality;
3. Some ways to address the quality issue:
   3.1 High quality medical education
   3.2 Licensing and Regulation
   3.3 Quality Disclosure
   3.4 Third-party agents write quality contingent contracts.
   3.5 Malpractice lawsuits

Summary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Owners
Hospital-Hospital
Price Competition
Quality Competition
"Ancillary" Staff