Appendix 1: Antibiotics Business Model Initiatives and Programmes

Global

World Health Organization

- Global Action Plan, under the leadership of the Scientific and Technical Advisory Group on AMR
- Technical Consultation on Innovative Models for New Antibiotics Development and Preservation
- Consultative Expert Working Group on Research and Development

Centre for Antibacterial Innovation (CABI)

- Centre of Excellence proposal for collaboration across industry and research bodies
- Global Antibiotic Resistance Partnership (GARP)

EU

Chatham House: Working Group on New Antibiotic Business Models

Innovative Medicines Initiative

- Several workstreams under New Drugs 4 Bad Bugs: COMBACTE, ENABLE
- DRIVE-AB (Reinvestment in R&D and Responsible Antibiotic Use) consortium focusing on the economics of antibiotic drug development

ReACT (Action on Antibiotic Resistance): Global efforts on antibiotic stewardship

UK

Antimicrobial Resistance (AMR) Funders Forum

Nesta (Horizon2020) and Innovate UK: Longitude Antibiotics Diagnostics Prize

Wellcome Trust

(O'Neill) Commission Review on AMR

Antibiotic Action

NHS Chief Medical Officer 5-year Antimicrobial resistance Strategy

US

Civil society

- Infectious Diseases Society of America: Advocacy by infectious diseases physicians
- Alliance for the Prudent Use of Antibiotics: Stewardship and appropriate use
- Brookings Institution: Antibiotic innovation and clinical trials
- Pew Charitable Trusts: Limiting non-human uses and innovation
- AIA: US Antimicrobial Innovation Alliance (companies)

Government bodies

- National Institutes of Health
- The Biomedical Advanced Research and Development Authority
- The Defense Threat Reduction Agency
- The Food and Drug Administration
- US Diagnostics Prize

The White House

- Executive Order September 2014
- Report from the President's Council of Advisors on Science and Technology
- National Strategy for Combating Antibiotic-Resistant Bacteria (CARB)

US Congress

- GAIN (Generating Antibiotics Incentives Now) Act (2012)
- DISARM (Developing an Innovative Strategy for Antimicrobial Resistant Microorganisms) Act (pending)
- ADAPT (Antibiotic Development to Advance Patient Treatment) Act (pending)
- Preservation of Antibiotics for Medical Treatment Act (pending)

APPENDIX 2: Details of Business Models

Industry: Academic publishing
Company: Knowledge Unlatched
Business model: Collaborative monograph publishing

Background

In the traditional journal-publishing model, academics submit drafts and publishers manage the peer review, editorial and publishing process. Journals are then sold to users through either subscriptions or individual issues in order to generate enough income to pay for the publishing process and to provide a profit to the publisher. However, access to research is limited to subscribers. In the past 20 years, the internet has enabled the development of various open-access journals. They are freely available online and their business model is based on charging authors for publication rather than on relying on sales revenues. The two business models coexist; some publishers use both.

Systems and business models are in place to enable open access for journals, but monographs and academic books are more complicated, as authors may expect royalties. It is difficult to predict the size of the market or the number of print and online versions. Publishers still rely on sales to cover their upfront costs and to provide a profit. As a result, book prices are extremely high so that very short print runs can be profitable, and access, in turn, is severely restricted. Notwithstanding these complications, monographs are under considerable pressure to move to open access because it is illogical that short-form content (journal articles) is open while long-form content (monographs) remains closed.

Knowledge Unlatched: The model

A new model was required that would incentivize open access to academic publications. University libraries are the largest market for scholarly books. Publishers take the risk of investing in the upfront costs of bringing them to market, including peer review, editing, typesetting and overheads. This is normally in excess of £8,000 per book. If the book fails to reach a minimum level of sales, the publisher loses money. Although the costs per book are quite small, cumulatively a great deal of money is invested in academic publishing. The total amount spent on monographs per annum is approximately £250 million.

The Knowledge Unlatched model is based on the understanding that university libraries are the primary purchasers and that traditionally publishers have carried the majority of the risk in publishing academic books. Knowledge Unlatched developed a global consortium of libraries that would pay the upfront costs of a book. Academic publishers and university libraries have collaborated and they work through an independent body to collate orders and to pay an agreed specific amount for each book.

The consortium invests enough money to pay the costs from manuscript to the first digital file. In return, the publisher places the digital file in open access upon publication. The

collective action of academic publishers and university libraries ensures that the required volume of orders and funding can be generated to pay for academic monographs, that publishers' costs are covered and that libraries can afford the monographs. The publisher can generate additional income through the sale of print versions, tablet versions and versions in other formats. In some cases, these paid versions may have enhanced features or functionality. The upfront payment from the consortium of libraries covers publishers' investment costs, removing or reducing their financial risk.

The pilot project was enthusiastically embraced in 24 countries, despite a shoestring marketing budget. The response after the project has been an overwhelming endorsement of the model.

Figure A2.1: The Knowledge Unlatched model: A global consortium

Relevance to the antibiotics R&D scenario

This model provides a way to cover and share upfront costs, thereby reducing the risk to each publisher (in our case, each developer). Sharing the risk and ensuring that costs are covered increases the return on investment and thereby increases the number of publishers that will stay in the sector, a consideration relevant to antibiotics. Additionally, it is a self-sustaining model for customers and producers and it can be used to deliver multiple products. This is of importance in the antibiotics R&D scenario.

How it is delinked from the 'price–volume' model

As the consortium of libraries in this model each pay upfront a pre-agreed amount, an adequate amount of funds is generated to cover upfront costs and other expenses. For this reason, there is no requirement for specific volumes of monographs to be sold to libraries in order to get back revenue to cover the amounts paid to release and publish the monographs.

Time frame to bring about business model change

Knowledge Unlatched's changing of its business model will be small-scale in comparison to a change in the antibiotics sector. But even so, it took 18 months for the company to convince stakeholders before a pilot project could be designed and run. The time from concept to completion of the pilot project was about four years. Once the pilot project began, there was significant momentum.

Industry: Defence

Company: BAE Systems

Business model: 'Service-availability' contracts ('contracting for availability' and 'gain share')

Background

The defence industry has undergone much change in the past 20 years and has had to adopt new ways of working in order to remain innovative and competitive. It has a number of unique characteristics that drive behaviours, relationships and business models; many of them are similar to those of the antibiotics sector. They include:

- Long development timescales. The development process from concept design to active service can take approximately 40 years for submarines and 20 years for military jets.
- Long service lifespan. Equipment has a long service lifetime. For instance, the Tornado aircraft was conceived in the late 1960s and has been in service for more than 30 years.
- Heavy regulation. The defence market is highly regulated. For example, export controls limit potential markets and certification requires safety testing. As advanced weapons are complex products, even incremental changes can take significant time and cost.
- Limited and specific characteristics. A combat aircraft designed for a particular range of environments and threats may require high capability for its aerodynamic performance, radar and sensing. The cost of developing this capability will price equipment out of environments in which the threat is less compelling. Thus a product developed for one market is not readily adaptable to another.
- Low product volumes. Some products have limited runs. For example, there are only six Type 45 destroyers, two Queen Elizabeth Class aircraft carriers and seven Astute submarines.
- Controlled profit margins. In the majority of markets, the government sets the profit margin.
- High R&D costs. Defence products traditionally have very high R&D costs.

All these factors have necessitated consolidation in the defence industry, collaboration and the adoption of innovative business models.

Collaboration

Partnering, collaboration and joint ventures are common practices in the defence sector. This is driven by the factors above, particularly technological complexity and high research and development costs. If the R&D costs can be shared and the market for the finished product can be broadened beyond national boundaries, development will be more cost-effective.

'Contracting for availability'

In the defence sector, the aim for both the military and industry is to provide reliable kit in a cost-effective manner. Therefore it has been necessary to evolve business models the better to share these goals and incentives.

Historically the defence industry would sell military equipment and spares to the military, who would operate, maintain and repair equipment. This arrangement placed much operational and financial risk on the military customer and was identified as an area where change was required.

As a result, the UK Ministry of Defence (MoD) has entered into a number of contractor-logistics-support contracts with the military equipment industry. In the US, performance-based logistics contracts are the equivalent version. They have been primarily labelled as 'contracting for availability.[1] A contractor is remunerated on the basis of service performance in meeting the user's needs rather than on selling a product.

This level of performance is measured through a set of agreed key-performance indicators. A simple example of a KPI would be the number of aircraft in a fleet that are ready for active service at any one time. But KPIs can be tailored for many forms of availability. BAE Systems now generates almost half its revenue from service-based contracts. Consequently there is a drive to better understand the balance of risk and reward that these output-based service contracts create.

'Gain share'

'Gain share' is a contracting mechanism to reward the service supplier when it exceeds the level of service targets agreed in a contract. A service supplier may be able to provide a level of service against a set of KPIs for a lower cost than the target cost, or the service provided makes greater savings than expected. Any additional reduced cost, or savings made, is then shared with the service supplier rather than just taken by the customer. On the down side, any cost overrun may be borne by the service supplier at no cost to the customer.

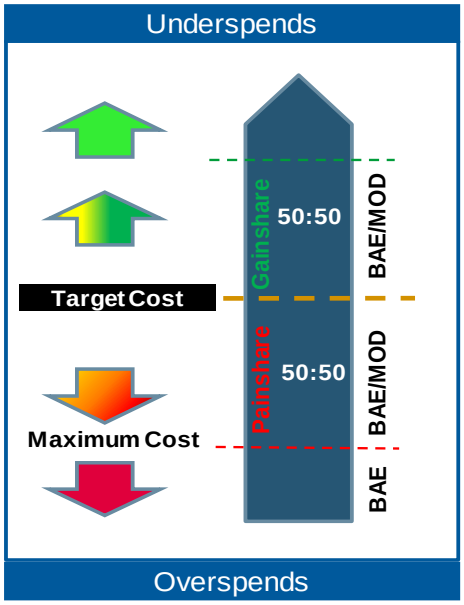
[1] 'Contracting for availability' (CfA) is an output-focused commercial arrangement that incentivizes improvement in asset availability rather than the traditional sale of products and spares and providing repairs.

'Contracting for Availability' and 'Gain share'

Since 2002, BAE Systems has led the Warship Support Modernization Initiative (WSMI) at Portsmouth naval base. The scope of this 'gain-share' contract with the UK's MoD covers a number of service offerings, including fleet-time engineering, waterfront support, estates management and logistics.

In parallel, the Surface-Ship Support Alliance (SSSA) was established between the MoD, BAE Systems and Babcock Marine to transform ship support for in-service warships. The primary objective is to drive down enterprise costs and to maximize ship availability within the agreed budget.

Figure A2.2: Schematic of a 'gain-share' arrangement



A new arrangement, the Maritime Support Delivery Framework (MSDF), has been in negotiation between the three SSSA partners. It aims to put all the WSMI and SSSA services into a single contract with each industrial partner, thereby creating an even more complex service network. This type of service agreement requires a robust set of KPIs to drive the right behaviours and outcomes. From a delivery perspective, it is imperative to understand the relationship between cost, performance and risk for each KPI so as to ensure that they can be successfully delivered. A process has been devised with Cambridge University's Institute for Manufacturing to design a set of KPIs that will best capture the needs of the customer, factoring in realism in delivering desired outcomes. Ideally this process is conducted in collaboration with all parties, to ensure their interests are best represented, and clearly this relies on a high level of trust. Possible KPIs for the MSDF in using this approach might cover the following areas:

- Driving efficiency
- Support to base: estate condition and safe, harmonious living
- Support to sailors: focus on morale
- Material state, including ships and capabilities

- Partner integration
- Behaviours and culture

This would be an evolution from previous contracts in which KPIs were mandated by the customer organization with no acknowledgment of the costs or the risk premiums involved.

Relevance to antibiotics R&D scenario

This type of 'service-availability' agreement could be used as a new way of contracting with key customers, i.e. governments and insurance companies, for how an approved antibiotic will be made available. The annual payment would be based on the delivery of a pre-agreed service. Clear KPIs and aspects of this service would be agreed as part of the contracting process. The annual payment agreed would thus need to cover the costs of the services that the organization would be asked to deliver and to include a profit margin that factors in some return on investment.

How it is delinked from the 'price–volume' model

As this agreement provides annual revenue and is not linked to volume delivered but quality of service delivered, return on investment is delinked from a volume and 'price-per-unit' model.

Industry: Energy

Company: EDF Energy

Business model: Energy efficiency – incentivizing customers to use less product

Background

The challenges faced by the energy industry are unusual. It is at the forefront of delivering on three major, related challenges to combating climate change while meeting the UK's energy needs. There is an expectation of it to help deliver a reduction in carbon emissions of 80 per cent by 2050 (relative to 1990 levels), to maintain security of supply through multi-billion-pound capital investment in new generation and energy infrastructure and to keep energy affordable for customers.

The customer relationship

The relationship between energy suppliers and customers is prominent in the media. The crisis of trust in the industry is in many respects driven by rising bills as well as indifferent service. Over the past decade, dual-fuel bills have increased by around 40 per cent, partly as a result of the rising costs of implementing various government-mandated policies.

Today approximately 20 per cent of the costs of customer bills is controlled by suppliers. The rest consists of wholesale-market energy costs, regulated-network costs and policy-implementation costs (directed at delivering low carbon investment, energy efficiency and protecting the vulnerable). The challenge lies in managing the relationship with customers through helping them to understand what the key cost drivers are in their bills and getting

them to use their energy more efficiently, i.e. incentivizing them to use less while balancing their needs with the needs of the industry.

Energy efficiency

EDF Energy's position is that it needs to actively engage its customers and help them to manage their energy affordably if it is to succeed in building positive customer relationships that will endure for the long term.

Like the challenge with antibiotics, getting customers to use less product is not simple. The industry spends upwards of £1 billion annually through the Energy Company Obligation programme, which involves rolling out measures to improve the thermal efficiency of UK housing stock by installing loft, cavity and solid-wall insulation and replacing old, non-condensing boilers with newer, more efficient condensing boilers. Much of the target audience for this programme is local communities and other partners that have helped with delivery to people's homes. As a result, take-up of measures under ECO has been steady, but the UK government still expects that a large-scale national programme will need to be in place until 2022 (and almost certainly beyond). There has been less success when consumers have been expected to take the lead.

The government's Green Deal scheme, administered by the energy industry, provides loans that are paid back through gains in energy efficiency. But 18 months after its introduction, only 1,600 customers had taken out loans of approximately £12 million, a far cry from the 400,000 annual Green Deals forecast in the original impact assessment and a direct contributor to higher than expected ECO programme costs.

The industry is also now preparing for a £12 billion national introduction of smart metering. It is yet to be seen how successful smart metering will be in getting customers to use less energy. But the investment case will balance (and customer bills will fall over time) only if £6 billion of annual consumption savings can be made over the lifetime of the new assets and if customers are prepared to allow new meters to be installed in their home.

The logic behind the model

It is necessary to improve the heating efficiency of the UK housing stock, and that requires large investments. If the customer is unable or unwilling to self-fund, it will be impossible for EDF Energy to provide free or near-free efficiency measures on the scale required. In a competitive market, any money that EDF Energy spends on energy-efficiency measures must ultimately be recovered from the customer.

If EDF Energy were alone in raising tariffs to fund a non-mandated energy-efficiency programme, it would lose customers to competitors. To raise sufficient capital, it has therefore been necessary for the government to coordinate energy-efficiency measures through centralized, mandated energy-efficiency programmes, ensuring a common approach across the energy industry.

Examples of barriers to success

Although the energy industry has a clear motivation to help customers manage their energy affordably and customers have a clear financial motivation to use less energy, there is still insufficient uptake of needed measures. There must be understanding and cooperation from customers in order to improve energy efficiency. Regardless of approach, some customers are simply not interested. In several cases, customers have shown a reluctance to instal low-cost measures such as loft insulation even when the payback period is only one or two years. In some cases, it has even been necessary to pay customers to take free loft insulation in order to meet compliance targets.

Lessons learnt

1. **Trust is essential**. To meet the enormous climate challenges facing the UK in general and the energy industry in particular, energy consumers' trust in the industry is critical.
2. **Having an independent intermediary may alleviate trust problems** but it does not address the issue of low trust of the industry. Only the industry can resolve that. However, the establishment of a centralized, government-backed central delivery body, which would have an essential public communications function for smart meter roll-out, is one example of an independent intermediary that helps to coordinate and meet the challenge.
3. **More transparency is needed**. Being clear about what goes into bills and why is also important. This includes honestly accounting for wholesale energy price changes as well as increasing policy costs. The work so far by the industry to simplify tariffs is commendable but it could go further. Removing standing charges and switching to a single-unit rate would make comparisons between tariffs easier and benefit consumers.
4. **Understanding customer behaviour**. An important aspect of the Competitive Markets Authority energy market investigation focuses on understanding customer behaviour, on why some customers choose to be 'actively inactive'. Learning how to better engage these customers will be important in bringing about the changes needed.
5. **Pragmatism and flexibility** are necessary in such large programmes. A pragmatic and rational approach to the daunting energy challenges facing the UK is also necessary. It has already set itself ambitious goals and targets that the energy industry is working towards. However, when new information becomes available, it is important that it is acted upon to manage the cost of programmes to the UK consumer. One example pertains to the Energy Company Obligation. When its costs turned out to be much higher than expected, the government changed the focus of the programme – now to deliver a similar amount of savings but at a much lower cost.
6. **Long-term planning** is essential, and integrated companies have a major role to play. The large and varied challenges that the energy industry faces, combined with the need to keep energy affordable, requires robust long-term planning. Companies need to take a strategic view of the long-term market and to be able to support their customers over the course of their upgrading for energy conservation. There is some discussion within the industry at the moment about the type of business model that can best deliver for customers. EDF Energy believes that a vibrant marketplace with a diverse range of players is important for competition. It also recognizes the value brought by large, financially strong energy companies focused on the long term. Government relies on larger suppliers to deliver

extensive national programmes, and only those companies are obliged to meet the full costs of energy-efficiency schemes and smart metering.

Conclusion
Improving the UK's energy efficiency is essential to meeting the climate change challenge in an affordable way. To achieve a sustainable future, it is critical to listen to the consumer and to understand the drivers of customer behaviour. Essential customer engagement remains subdued, partially because of a lack of trust in energy suppliers. EDF Energy has recognized this barrier and is working hard to regain customer trust. It actively stands on the side of customers when engaging with government on the design of necessary government programmes such as ECO and smart metering and it keeps a sharp focus on energy affordability and the sustainability of those programmes. EDF Energy has chosen to have both an energy-generation and an energy-supply business.

Industry: Corporate Information
Company: Dun & Bradstreet
Business model: Moving to a 'price-per-service' model

Dun & Bradstreet is a leading provider of business information. Traditionally its pricing model was based on transactions: customers were charged every time they purchased or accessed a D&B report. Approximately seven years ago, D&B replaced the traditional 'price-per-item' (or transaction) model with a 'price-per-service' model. The current model charges for the value of the solution provided. This is an oversimplification because D&B customers in effect pay a 'subscription-style' fee in order to access D&B information and to have the option of additional consulting services.

The model is designed not to induce a reduction in the consumption of information (D&B products) but to delink volume of consumption from price by moving to a 'service-value' model. Two sets of drivers, internal and external, were behind this change.

Internal drivers
The previous model generated an unpredictable revenue stream, as D&B's revenue depended on the number of reports purchased. The new model smoothes out the irregular flow of revenue and reduces seasonality; revenue is more predictable and enables a longer-term investment strategy.

The move to a 'service-value' model also increases the sustainability of D&B's relationship with its customers, as they are better able to control and to predict the cost of their information.

External drivers
In recent times, there has been a commoditization of information at the global level, led by rapid reductions of barriers to entry to the market, both technological and regulatory. The

'service-value' model allows access to a wider range of information for a fixed price so that individual pieces of information are available more cheaply than under the 'price-per-service' model and the cost of an additional piece of information to the customer is zero. Customers can access the appropriate level of information without needing to consider the cost of each additional piece of information. D&B is now focused on providing a service that enables the customer to reduce risk.

Delinking revenue from volume

The current model aims to charge D&B customers for the value of the solution provided. Ideally this would be measured in relation to the value of the information provided. Estimating the value of information to customers is not easy. As they operate in uncertain environments, the value of the information supporting their strategic decisions is difficult to calculate. For example, estimating the value of intangible assets such as reputation can be difficult. And decisions taken by partners or competitors today may have effects in the distant future that cannot be included in current calculations. Finally, there is a degree of asymmetry of information between D&B and the customer that generally raises issues of trust. Notwithstanding these difficulties, D&B attempts to estimate the value that the information supplied represents for the customer.

Below are three pricing situations that D&B is considering. Although it would ideally use the 'price-per-service' (perfect information) model, it is unable to ascertain the savings for its clients thanks to D&B information. Therefore it must use the 'price-per-service' (imperfect information) model.

***Price per item*:** The price to the customer is simply the number of reports multiplied by the cost of each report. This is the traditional model. D&B applies a volume discount (D) if the customer accesses a significant number of reports. For example, the company Furniture Factory accessed 15 reports, which have a price per report of £75. The total price (P) is 15 × £75 = £1,125.

***Price per service (perfect information)*:** D&B charges a percentage (X) of the savings (S) achieved by the customer as a result of using D&B information. For instance, Furniture Factory accessed 15 reports. The information in these reports enabled it to avoid bad debt totalling £30,000. D&B charged a percentage of this saving. The total price was (P) £30,000 × 5% = £1,500.

***Price per service (imperfect information)*:** In the absence of accurate information on potential savings, D&B estimates the different alternatives available to the customer, including the price under the 'price-per-item' model, by using alternative sources of information or by finding alternative ways to address the challenge. For example, Furniture Factory's accessing of 15 reports would have cost £1,125 under the 'price-per-item' model. It could use one of D&B's competitors, which would charge £2,000, or it could take out debtor insurance costing £2,500. The total price could be an average: (P) = (£1,125 + 2,000 + 2,500)/3 = £1,875.

Table A2.1: The logic of pricing: 'price-per-item' model vs 'price-per-service' model

	Price per item	Price per service (perfect information)	Price per service (imperfect information)
Information required to establish price	Number of reports (No:), per report price (RP), volume discount (D)	Potential savings achieved by customer using D&B information (S), percentage share for D&B (X)	Potential savings using D&B information; cost using the 'price-per-item' (PPI) model; D&B competitor (C); substitutes, including insurance (I)
Structure of price	P = (No: * RP) * D	P = S*X	P= function of (PPI, I, C)

D&B has maintained the 'price-per-item' model but has included incentives for customers to transfer to the 'price-per-service' model. It increases the price of reports when the 'price-per-item' model is used. By contrast, the 'price-per-service' model allows customers access to services that they find valuable at a lower cost than the 'price-per-item' model.

For D&B, the 'price-per-service' model has resulted in higher total revenue but a lower price/volume ratio. This means that D&B customers are accessing more information than they would have under the traditional 'price-per-item' model. Contracts with D&B can be terminated by customers if its information fails to achieve certain levels of bad debt reduction. In this way, D&B's ability to retain and increase contract value depends on its ability to prevent bad debt.

The transition from 'price per item' to 'price per service' involved a 12–18-month planning phase followed by an 18–24-month deployment phase. During the planning phase, D&B identified three main risks:

1) Impact on contract length and revenue – concern that the new model could encourage customers to defer contract end dates and therefore payment
2) Transformation of sales approach – making the transition from a basic sales cycle to a professional services-style approach
3) Potential cannibalization of future growth – concern that customers might over-consume information but resist future price increases.

These risks were addressed as D&B implemented the model.

Industry: Finance

Company: Barclays Bank Plc

Business model: Antibiotic corporate bond (ACB) and patent-extension certificate (PEC)

Barclays Bank proposed a model designed specifically for the challenge of antibiotics R&D. The proposed antibiotic corporate bond and patent-extension certificate solution uses two main ways to motivate greater investment in R&D for new antibiotics. The ACB will generate greater private-sector investment in the discovery of antibiotics and the PEC will provide a mechanism for paying back investors with a bond.

The antibiotic corporate bond (ACB)

An ACB would be issued to raise funds for injecting private capital into antibiotics R&D. The research funding would be financed by raising a government-guaranteed bond that would be sold to third-party investors. The ACB would be identical to typical government bonds that are issued daily in capital markets. Barclays believes the bond should be backed by government credit support, as this would give investors in the bond confidence that it is a debt rather than an equity risk.

There are precedents for the provision of government guarantees when a private-sector solution is unavailable or too expensive. Previous examples of UK government-guaranteed bonds include London and Continental Railways finance, used to finance the high-speed link to the Channel Tunnel, and Infrastructure UK bonds, for incentivizing investment in infrastructure.

Governance and description

Barclays proposed that an independent agency should be established to govern the issue and administration of a series of new ACBs designed specifically to fund R&D of new antibiotics. An ACB agency would comprise neutral members, who have no connection with potential recipients of R&D funds.

A series of new 10-year ACBs would be created to raise capital investment from institutional investors. Some revenue would be retained to service the coupons over the life of each series of ACBs and the remainder would be administered by the ACB agency as grants. The ACB agency grants would be distributed to entities, potentially biotechnology or pharmaceutical companies, that show a great likelihood of successfully developing new antibiotics in line with public health needs. Recipients may be new or existing pharmaceutical or technology developers.

By way of hypothetical example, the ACB agency sells £1 billion of 10-year bonds with a 3 per cent coupon. The ACB agency holds £300 million in reserve to pay the £30-million coupon payment annually for 10 years. The remaining £700 million is made available as ACB agency grants to support research into new antibiotics. At the end of the 10 years, investors receive their principal investment of £1 billion.

Recipients of ACB agency grants would receive cost-free funds or equity and allocate them exclusively to activity expected to lead to the discovery of new antibiotics. If a grant recipient successfully develops a new antibiotic, this would be considered a ‘trigger event’ that initiates the awarding of a PEC.

Patent-extension certificate

A PEC allows its owners to extend the patent life of another product in their portfolio. It is generated when regulators approve a new antibiotic for marketing. A PEC is saleable and transferable, and may be sold to the highest bidder. This allows the successful bidder to extend a patent on an existing medicinal product in its portfolio. The funds from the sale of a PEC provide a revenue stream disconnected from the sale of the new antibiotic coming to market.

PEC: Process

A PEC is generated as soon as a new antibiotic is approved by the regulator (the European Medicines Agency or the US Food and Drug Administration) for marketing. The PEC is then immediately transferred or awarded to the ACB agency. The PEC, which could extend the patent protection for an existing medicinal product for up to three years, is then sold by the ACB agency on the open market to a pharmaceutical company. What is important, the PEC is awarded to and sold by the ACB agency, not the pharmaceutical company that received the ACB agency grant and developed the new antibiotic.

The proceeds of the sale of the PEC will be split between the grant recipient (the pharmaceutical company or another organization that developed the new antibiotic), the initial investors in the ACB and the ACB agency, which issued the bond and administers the funds.

The ACB agency will apply the proceeds of the sale of the PEC to:

1) repay the initial bond investors (the £1 billion discussed in the example above),
2) replace subsequent bond issuance,
3) provide additional grants or
4) complete other related activities such as reimbursing appropriate sponsors of the healthcare sector for the indirect costs resulting from a PEC.

In this proposal, the PEC would provide market exclusivity to another product for up to three years in the US and the EU, similar to extending the patent. The length of the PEC extension period would reflect the relative value of the new antibiotic in the fight against bacterial infection. The number of PECs to be granted would be limited, for example to 10. Assuming at least one new antibiotic is developed, the system should become self-funding.

Hypothetical example

The ACB agency provides a £200-million ACB charity grant to a biotechnology company called 'Plus Drugs' that goes on to develop a new antibiotic called 'Bug Kill'. Once 'Bug Kill' is ready for use in the community, a PEC is issued and transferred to the ACB charity. The ACB agency sells the PEC on the open market to an intentional pharmaceutical company called 'Big Pharma' for £4 billion (Barclays believes that this is a conservative figure). 'Big Pharma' uses the PEC to extend the patent on one of its other drugs. The ACB agency provides a sum of money, from the sale of the PEC, to 'Plus Drugs' (potentially 25 per cent of the total or, in this case, £1 billion) and holds the remainder of the money to pay back the £1 billion

invested in the bond and to issue additional ACB agency grants.

If the ACB agency grants do not result in new antibiotics breakthroughs, no PECs will be issued and no auction proceeds will be received. In this case, the government, either in the US or the UK, will be responsible for repaying the ACBs, i.e. the £1 billion in the example above.

Industry: Insurance
Company: Allianz Worldwide Care
Business model: Insurance model

Allianz presented an antibiotics insurance scheme and gave details of two insurance models that could be relevant to antibiotics. In the traditional health insurance model, policyholders pay a yearly premium. The total of all the insurance premiums is expected to be greater than what the insurance company pays out in medical expenses based on its assessment of likely healthcare costs for each of its policyholders. From the perspective of the insurance company, the normal payout ratio in healthcare is approximately 75 per cent, meaning that on average, insurance companies pay out 75 pence in medical services for every pound they collect in premiums. The remaining 25 per cent, 25 pence in the pound, covers their administration and broker's commission and gives profit.

The annual premiums paid by consumers, from £400 to £2,000, are relatively small compared to the large sums paid out if intensive treatment is required. For example, a cancer intervention or a triple bypass can cost £150,000, and some claims exceed £1 million. Insurance models function because the value of the payout should things go wrong completely outweighs the cost of the initial payment. People take out health insurance because they value 'peace of mind'.

Catastrophe insurance
Models of catastrophe insurance could be applicable to a pandemic. A scheme is set up in expectation that it will be called on every few years in response to an event of unpredictable size, timing and cost. Owing to the volatility of the situation being covered, companies load up annual premiums by about 30–50 per cent. This is to ensure that the expected payout is about 70 per cent of the premium. The less frequent or predictable the event, the lower the required payout ratio because the risk is higher.

Governments could invest significant funds (on the order of €1–2 billion/year in the EU) as an 'insurance premium' to prevent the catastrophic consequences of a post-antibiotics era. Considering the magnitude of the risk, it would be excellent value. Governments, businesses and individuals understand that insurance is a financial mechanism to prepay for the assumption and distribution of risk. Lessons from catastrophe insurance policies show how

annual premiums can be calculated to ensure that adequate funding is collected in the upfront years in order to subsequently cover the costs of the service that needs to be delivered when the crisis or catastrophe hits.

If insurance-type schemes were put in place, they would need to be set up as soon as possible in order to allow the pharmaceutical industry, and other organizations that will be distributing and delivering antibiotics, to accumulate the annual premiums from the years with no catastrophe. This would enable the companies to inject further funds into developing new antibiotics and to have adequate funds to put manufacturing and distribution in place when a pandemic or regional resistance crisis occurs.

Bacteria pandemic insurance-product proposal

Allianz pointed out that those who are nervous about pandemics may have an incentive to purchase pandemic insurance. They could be governments, healthcare insurance companies, reinsurance companies or wealthy individuals and trust funds. Together they could be interested in pre-funding a potential cure should a pandemic break out. Premiums paid to health insurance companies would be pooled and invested in R&D into new antibiotics.

Allianz estimated the cost of a pandemic for the Workshop (see Table A2.2 below); but as would be expected, there is a great deal of uncertainty and very little data to flesh out these figures.

Table A2.2: Estimated cost and incidence of pandemic

Level of care	Incidence	Estimated cost
Hospitalization	1%	£15,000
Consultation with GP and antibiotic treatment	20%	£150
No formal care	79%	£0

If an antibiotic treatment can be administered that avoids hospitalization, it would have a big impact for potential patients and on the cost to the insurance company.

Provision of premiums to fund R&D

As it is unclear which pharmaceutical company will develop the antibiotic that cures the pandemic, it would be logical for the funding (received through insurance premiums) to be distributed among those companies likeliest to develop new antibiotics. The model from Allianz makes the funding very predictable over time through the well-known mechanism of annual insurance premiums. Making these commitments over many years, perhaps over decades, would smooth out premiums even more. Part of this funding pot could be provided to companies and research organizations to fund development costs.

Proposed antibiotics insurance for individuals

The authors of this report, along with some participants in the Workshop, modified Allianz' proposal for the individual antibiotic insurance product. The details of the proposal are described below.

Other than for pandemics, some individuals may be prepared to pay a small premium, perhaps as part of a larger premium for healthcare insurance, to fund drug-related R&D programmes in return for priority access to pharmaceutical treatment. If these individuals become unwell with an illness that cannot be cured with existing treatments, they would have automatic access to experimental treatments from pharmaceutical companies receiving funding. Such treatments, whether experimental or just on the market, would be provided free of charge.

Currently, pharmaceuticals or other treatments classed as experimental are excluded from insurance policies owing to their high cost. Therefore this insurance could save or much increase the quality of life for those individuals concerned.

Concerns were raised at the Workshop, and by the authors, about the global fairness of this insurance product. The authors and members of the Workshop changed the proposal so that specific insurance premiums would be sourced from governments rather than individuals.