Social concerns in the Pharmaceutical Supply Chain during a pandemic

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Abstract

Sustainability has taken a central role in the 21st century, shaping governments' decisions, companies' management strategies and civil society's choices. While economic and environmental goals are vastly tackled in optimization models, there is still a gap when it comes to social aspects, which undertake especial importance in some industry sectors such as the pharmaceutical, from which people's health is dependent. This dissertation analyses the social indicators that optimization models account for and the social performance of six leading pharma companies in 2019.

Disruptions like the COVID-19 pandemic highlighted the vulnerabilities of supply chains. Thus, a review is performed on the challenges it posed to the pharma SC, showing that several actions must be taken to turn them more resilient. The identified social challenges lead to the selection of key priority aspects, systematized by the GRI Standards, to be included in the SC stakeholder's annual sustainability reports. Four new reporting disclosures are suggested, including quantitative indicators, to help decision-making tools on SC social performance improvement. Social resilience is, then, defined with four pillars - Access, Stability, Support and Quality - considered necessary to guarantee the social pillar of sustainability. Recommendations are, finally, compiled into a framework to allow pharma companies improve their SC social performance, in times of crisis.

Keywords: sustainability, social resilience, pharmaceutical supply chain, COVID-19, pandemic, GRI standards, framework, indicators

1. Introduction

Five years ago, in 2015, the United Nations established 17 goals to improve the sustainability of our societies, aimed to be achieved by 2030 – the Sustainable Development Goals of the 2030 Agenda for Sustainable Development (UN, 2015). Goal 3 aims to "ensure healthy lives and promote well-being for all at all ages" and Goal 8 pretends to "promote inclusive and sustainable economic growth, full and productive employment and decent work for all" which set the starting point for this work.

Supply chains (SC) ensure that all we need comes to us, being responsible for putting the world "running", as popularly said. Therefore, the way in which SCs operate has strong impact in our economies, the environment and societies. In 1987, the UN Commission on Environment and Development published the first international statement that world economies development should be sustainable, presenting the concept of sustainability development as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). Three pillars have been set to support the sustainability concept: the economic, the environmental and the social. While the first two have undoubtedly been tackled in political or management daily decisions, the social one is still dependent on the political ambience of each country or the importance companies give to it. In what concerns SC management, social aspects are still addressed by only a few authors, thus, still being a research gap (Barbosa-Póvoa *et al.*, 2018).

Crisis situations cause disruptions in the sustainability agenda, leading governments and SC players to prioritize their actions, risking to leave several sustainability aspects to a secondary plan. The COVID-19 pandemic is certainly one of them having had unprecedent impacts due to its consequent lockdowns and movement restrictions. Being a health crisis, the pharmaceutical SC plays a

decisive role in the response of this pandemic, trying to provide suitable treatments to the new disease and above all, a means to immunization – vaccines – while it is also affected.

As such, this work seeks to study the performance of this sector in this new context, focusing on the social problematics of its SC and alert for a set of concerns that should be tackled by its stakeholders in future crisis situations like this pandemic.

Overall, this dissertation tries to answer these questions:

- How do global SCs account for the social aspects in their optimization strategies?
- What are the new social challenges COVID-19 brought to the pharmaceutical SC?
- How can the global SCs, especially the pharmaceutical one, become more resilient from the social point of view?

2. Methodology

This work research methodology was the following:

1. Review of the social indicators used in SC quantitative decision-making tools, namely optimization models aiming to evaluate how these models quantify the social dimension in SC management. Forty papers were analysed and the social indicators were grouped in four areas: employment, labour conditions, health and safety, and community development.

2. To understand how the pharmaceutical industry is organized and which challenges are faced by its SC, a brief characterization of the sector is done, followed by the analysis of the social performance of the six top ranked companies according to the *Dow Jones Sustainability Index*, based on their annual sustainability reports. The identified social indicators were grouped by the same four areas of the previous review and associated to the Global Reporting Initiative (GRI) standards disclosures, a set of norms to help companies better report on their activity.

3. A few months after the outbreak of the COVID-19 pandemic, global SC's challenges were again assessed and a new characterization of the pharmaceutical sector was made, assessing its resilience problematics, with special attention for its social concerns. The review was based on consultancy companies' studies, papers published during the first semester of 2020 and press articles published in the last months of 2020. The sectors' role in the pandemic was also tackled with emphasis on the vaccine development and supply challenges.

4. Following the new assessment of the pharma SC social challenges, a set of GRI standards disclosures is selected to be prioritized in sustainability annual reports, related to 2020 and future crisis periods. Additional disclosures are suggested to report on what GRI does not yet include, with quantitative indicators that can be included in decision-making tools aimed to improve the SC social performance.

5. The concept of social resilience is proposed according to the performed reviews, leading to the design of a framework that aims to provide guidance to the pharma SC players on how they can improve their social performance and become more resilient.

Finally, the conclusions obtained from every stage of the work are summarised, followed by future research steps.

3. Review

3.1. Social Indicators

GRI describes the social dimension of sustainability as what concerns "an organization's impacts on the social systems within which it operates". These reporting guidelines have been used by some authors to develop measures to evaluate social aspects; and are also the base for the most sustainable pharma companies' annual reports.

SC optimization models

Based on the content analysis of the performed literature review on how social aspects are quantified in SC management, indicators were studied in the following groups: Employment, Labour Conditions, Health and Safety, Community Development (Figure 1).

The most found indicator in SC optimization models was job creation, an indicator which creates income to communities and wealth to regions. GDP, population density and unemployment rates are employment related aspects usually taken into consideration by the analysed models. Safety and health form the second group of indicators evaluated in SC models, with accidents/injuries rate and their impact on the workers performance as the most used. Labour conditions are motivated by human rights concerns, which relate to the quality of the jobs that models aim to create with several different

indicators identified: overtime hours worked, training or distance/travel time home-production site. Industries and their associated SCs can have a big impact in societies, if they are managed towards valorisation of people and maximization of their welfare, contributing to community development, the last studied aspect, that includes indicators such as: donations to NGO's or the investment in social responsibility projects.

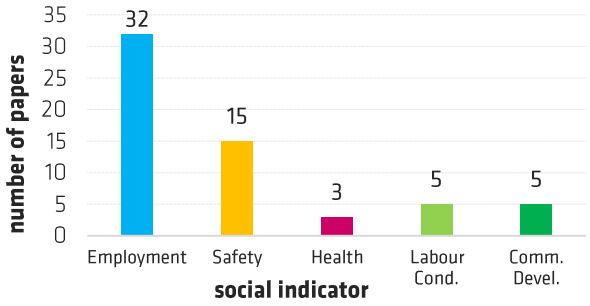

Figure 1 - Social indicator usage frequency in reviewed SCM optimization models.

Most of the models analysed showed only one social criteria in their objective functions, and multi-criteria social functions included always an employment indicator criteria.

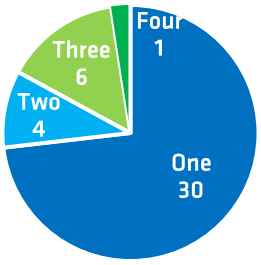

Figure 2 - Number of indicators used per number of papers reviewed.

Pharma leaders' sustainability reports

Societal pressure (also referred as public opinion) triggers sustainable concerns, namely social performance of big pharma companies. As such, an analysis of the six leaders in sustainability according to *Dow Jones Sustainability Index* - AstraZeneca, Daiichi Sankyo, GlaxoSmithKline, Roche, Sanofi and Takeda - was performed to identify best practices and what is being done by these big players in this field. All revealed to be in line with the UN Agenda of Sustainability Development Goals for 2030, focusing their contribution on the improvement of healthcare access and affordability. For this, they work on several projects and partnerships with local governments and NGO's to take medicines and education to the most undeveloped areas of the world, as well as training of healthcare professionals. In addition, they present concern with the quality of their working environment, tackling several social aspects also assessed by some supply-chain optimization models. The most transversal to the six companies are: gender balance and inclusion improvement, employee engagement evaluation, accidents/injuries prevention and reduction, mental health/stress assistance and, surprisingly, driving collision reduction efforts (work and non-work related). It is already possible to notice some identical metrics and an effort to follow GRI, but there is still much work to do in the uniformization of these indicators' assessment.

3.2. The pharma SC

The pharmaceutical sector comprises several activities related to drugs used for medication (medicines) or vaccines, such as research, development and production. The pharma industry is a very *sui generis* sector because of its unusual characteristics and impact (Taylor, 2016).

Although heavily based on the chemical industry, its products are classified as specialty chemicals (in contrast with bulk or fine chemicals), thus, adding complexity to the pharma industry (Marques et al., 2020). These products can be highly differentiated and are usually purchased based on their function or perceived value, rather than price or chemical composition and tend to be produced in small quantities with very large margins (Smith, 2005).

Focusing on R&D pharmaceutical industry, according to Azzaro-Pantel (2018) the pharma industry goes through two phases: (1) drug development phase and the (2) marketing (production and distribution) of successful drugs.

Figure 3 – Typical pharmaceutical supply chain on a batch operation mode.

A new product development (NPD) phase (1) can last for 15 years and encompasses four activities: discovery, pre-clinical tests, clinical trials on humans and approval and product launch. Then, both product and production process must be approved by regulatory agencies: European Medicines Agency (EMA) in Europe or Food and Drug Administration (FDA) in the USA (Marques *et al.,* 2020).

After market launch, production and distribution phase (2) starts when companies try to capture and establish a market share as large as possible, depending of course on the effectiveness of the therapy compared to other treatments, side effects that may originate and economic factors. The pharmaceutical manufacturing process comprehends two steps: primary production and secondary production. In the first, the API is manufactured through chemical/biological processes characterized by its high product variability, batch operation, multipurpose equipment and long processing times (Sousa *et al.*, 2011). Then, the API is transformed at the secondary production stage into a product suitable for patient administration involving non-ingredients addition as well as further processing and packaging to ensure product stability and integrity. When the product is ready, it is distributed, reaching the healthcare system and finally patients.

A typical pharmaceutical SC (Figure 3), based on a traditional batch production, the operation mode most commonly established, includes (1) suppliers, (2) primary production (also called “drug substance manufacturing”), (3) secondary production (also called “drug product manufacturing”), (4) warehouses and distribution centres, (5) wholesalers, (6) healthcare providers and (7) consumers.

Challenges identified before the COVID-19 outbreak

Before the outbreak, literature pointed to several challenges faced by the pharmaceutical industry such as the slowness, complexity, cost and uncertainty of the new product development process (DiMasi, Grabowski, & Hansen, 2016; Marques et al., 2020; Mckinsey & Company, 2013).

Primary production (API production) and secondary production (product production) are often separated physically and organizationally posing communication/coordination difficulties (Sousa *et al.*, 2011). Batch mode is the commonly used production mode that use low volumes and offer high product variability, presenting several positive aspects, namely facilitated quality control; easy contamination remediation; well defined steps, allowing to know intermediaries; high flexibility; good capital efficiency, due to the utilization of the manufacturing resources across multiple products.

However, batch mode has several features that lead to a poor performance characterization (Marques et al., 2020; Shah, 2004): long production cycle-times; having many unproductive tasks (changeover, Cleaning-in-Place (CIP), Sterilization-in-Place (SIP) necessary between batches, causing long setup times which can reach weeks and high utilization of energy and water); high levels of inventory needed to compensate slow responsiveness to market dynamics; high levels of expired final product due to the excess of inventory, especially in distributors or pharmacies; inefficient materials utilization due to low production yields; low equipment utilization. Continuous production is currently appointed has a solution and an improvement to these limitations, not having yet been implemented massively in the pharma industry.

Lack of agility is identified one of the major challenges of the pharma SC. Replenishment when shortage occurs, for example, is essential for the well-functioning of healthcare services and crucial when life dependent drugs are at stake. Shortages are critical because they create opportunities for counterfeiters and gray-market vendors, threatening patient safety and cutting into the revenues of legitimate companies. Segmenting SCs according to the characteristics of products and the requirements of the customers, developing forecasting, production and distribution strategies for each, reduces inefficiencies, high inventories and the use of expensive air transport when one product suffers shortage, in opposition to a “one-size-fits-all supply-chains” modus operandi. Agility allows acting fast in emergencies, for which analysing patterns in demand, improving communication and transparency between all supply-chain stakeholders, can help program manufacturing processes and distribution networks. Standardization in metrics used across countries and plants is also fundamental to improve models and cooperation (Mckinsey & Company, 2013).

The price of medicines is also a factor with great impact in end-users such as governments which pay a part of some medicines to the general public (with medical prescription), in developed countries. In developing countries, governments and non-governmental organizations work on the affordability

and access to their very low-income populations. Moreover, generic drugs are often chosen by medical prescriptions, when available owing to their lower price, which is not convenient for R&D based pharma companies (IQVIA, 2019).

Challenges identified after the COVID-19 outbreak

Restrictions on movement and muted demand, due to COVID-19, created uncertainty throughout the global economy bringing new challenges to the SC management. Lockdown policies prevented people from working in order to ensure social distancing, thus interfering with manufacturing operations and transit routes (PwC, 2020). Consequently, disruption on production lines caused supply shocks in some sectors and goods. Moreover, the centralization of global SCs in China (the first country to be affected by the disease), especially in terms of parts and components manufacturing, compromised the SC downstream making retailers, who relied on inputs from these factories, not being able to acquire enough products to sell, and second manufacturers, not being able to acquire their raw materials (Zhu *et al.*, 2020). Then, panic buying fearing food and essential goods shortages during this period caused an increased demand variability and in some case shocks. Variability is particularly difficult to handle by small business, since they have weaker structures and less versatility to maintain an acceptable level of product supply during demand shocks (Parsons 2020). Alongside supply and demand shocks, the pandemic also contributed to an increasing of the bullwhip effect on SCs. The variation of a demand signal is distorted from the consumer until the chain upstream, increasing like a whip trajectory. As explained by Steifert & Markoff (2020), downstream players artificially inflate their supply requirements demanding a larger amount of a scare resource when they preview a supply shortage, calling it “shortage gaming”. This can lead to stockpiling, the accumulation of exaggerated quantities of inventory and ultimately, waste. Cost increasing is also an effect, especially on transportation since commercial flight connections have been severely reduced, resulting in higher air freight costs. Alternative travel modes had to be found to transport air cargo borne by these flights, facing transit restrictions and closed borders. In cases where borders remain opened, safety measures such as custom procedures and approvals cause delays and costs for the suppliers (Shira, 2020). With the reopening of commerce after the March-June lockdown, extra safety and health measures were introduced such as reduced people density in establishments, available disinfectant dispensers, higher cleaning frequency, protective masks and gloves and single-use equipment introduction, increasing costs for all SC stakeholders, also supported by the consumers.

Following the mentioned impacts several recommendations are made by different experts to improve the SC preparedness, response and recovery, that are then compiled in the framework.

3.3. SC pandemic social challenges

From a pharmaceutical organization/supply chain internal angle, literature highlights social concerns related to the workforce such as remote working, unemployment and layoff, training and support, as well as management practices. Additionally, but from an external point of view, aspects such as healthcare system (costumers) interaction with manufacturers/wholesalers, consumers interaction with healthcare system and, particularly concerning the vaccine, confidence and public perception are discussed. Equity in access to pharmaceuticals is an essential aspect to which governmental influence can be the main contributor.

An adaptable and flexible management culture, in which hierarchies are less rigid, enables the launch of new temporary cross-functional teams fit to tackle complex situations and propose new solutions (Mckinsey & Company, 2020a). Also, new leaders are able to emerge when a new and unknown situation occurs, which are team members not appointed or elected, who step up as leaders over time due to their group interactions (Gerpott *et al*., 2019). According to Obrenovic *et al*. (2020), emergent leaders are the perfect individuals to cope with a disruptive situation such as pandemic. Reducing two to four layers of hierarchy is advised to easier communication within the organization, while authorization and approval chain of command gets also simplified, fastening decision making (Mckinsey & Company, 2020a). Having a well-prepared workforce requires investment in training and educational programmes, which empower workers to assume positions they don’t usually have in disruption situations. Furthermore, demand labour is shifting, new skills are needed especially related to new digital and technological knowledge (Mckinsey & Company, 2020a; Obrenovic

et al., 2020). Social distancing and lockdowns pushed a significant part of companies' workforces' home, implementing remote work routines. Although, remote work grants the ability to have a flexible schedule, workplace and avoiding commuting, it is already realized that a completely remote work regime may not to be a long-term solution (Buffer (2020), Mckinsey & Company, 2020)). Some processes are not designed for virtual modes such as recruiting, welcoming new employees and the office/company own culture gets faded. Informal and organic interactions, that promote teambuilding and empathy are much more difficult, since non-verbal and emotional cues are harder to read when virtual. Consequently, managers find difficult to know what their teams are doing or feeling in a virtual basis, although they may be successful leaders in person. Buffer's (2020) study shows struggles faced by remote workers stating that, besides the communication challenges, psychological well-being can be affected, mentioning loneliness, inability to unplug and motivation issues.

Changes in design and operating models can result in a redistribution of talent as well as reskilling, with the adoption of digital and analytics tools and automation. Pharmaceutical operations may need workers that can programme, operate, and interpret data (Mckinsey & Company, 2020b). Laboratory positions, related to research and development, are the most difficult ones to transition to remote work, so it is expected to continue in person work, while human resources, finance, marketing and supporting staff shall continue with home working periods.

Contact restrictions posed challenges to the interactions between the upstream of the supply chain (manufacturers and wholesalers), the customers (hospitals, health care practitioners and pharmacies) and, ultimately, the consumers (patients). When a new medicine is launched, companies need to address health practitioners in order to provide information on the innovative aspects or effects of their new products, as well as advantages over existing therapies. This pandemic delayed several non-urgent treatments and redirected a significant number of health practitioners to COVID-19 patients care, causing an accumulation of work. Physicians have scarce spare time and are, thus, less receptive to new products launch, conference attending and face-to-face engagement. Patients had also less contact with healthcare providers as a result of appointment postponements during lockdowns. Tele-health surges to counteract the inability to have medical appointments, however it does not solve every problem, since it doesn't allow physicians to examine patients and is critical with less digital users, such as elder people. Pharmacies can play an important role since they can be the local support for these patients, particularly in rural areas, ensuring some assistance (McKesson, 2020). Aside from physicians, changes in pharmacists practises due to the pandemic have been identified, to guarantee and support patients care, especially in vulnerable populations, such as patient counselling, as well as becoming a hub of information on COVID-19 and other conditions (Hayden & Parkin, 2020). Online communication tools and monitoring technology are once more crucial to improve tele-health appointments and follow-up, as well as remote delivery when it comes to pharmacy ordinary orderings, contributing to unnecessary physical interactions' reduction.

Equity is, perhaps, one of the most complex social challenges faced, since companies are not the only players that influence the equitable access of products, particularly medicines. Political decisions have great impact in this issue, especially in times of emergency and crisis, as witnessed during COVID-19. When it comes to medicine shortages, different attitudes can be seen as Sheffi (2020) points: favouring order shipping according to the importance of each customer, treat everyone equally or taking care of the vulnerable. Treating everyone equally is an option that can be honourable but easily gambled, since customers might inflate orders. Thus, some companies have allocated products based on pre-disruption historical order volumes, as well as fixed-volume orderings (commonly seen in the end of supply chain, limiting shoppers in supermarkets to maximum fixed amount of some products per bill). Helping the most vulnerable is considered especially when quantities required to ensure a customer survival are not large and there is great dependence from that customer on a supplier/manufacturer. During COVID-19, some retailers devised special ways to help vulnerable customers, for example, creating early morning shopping hours for elderly people to get to restocked shelves first (Sheffi, 2020).

4. Social recommendations

The review on the challenges it faced pointed to the need of ensuring resilience so it can respond to the

needs of its end-stakeholders: patients, thus, everyone that needs healthcare. Healthcare services and medicines are not optional to those who need them, so this is a sector in which the social pillar of sustainability plays a rare central role.

4.1. GRI Standards

Based on the social challenges identified the following selection of ten GRI disclosures is done to help pharma SC stakeholders report on their social activity during periods of crisis:

- **401-1** ("New employee hires and employee turnover");
- **404-1** ("Average hours of training per year per employee") and **404-2** ("Programs for upgrading employee skills and transition assistance");
- **402-1** ("Minimum notice periods regarding operational changes");
- **103-3** ("Evaluation of the management approach.
- **403-2** ("Hazard evaluation, risk assessment and incident investigation");
- **403-6** ("Promotion of worker health");
- **403-8** ("Workers covered by an occupational health and safety management system");
- **413-1** ("Operations with local community engagement, impact assessments and development programs;
- **417-1** ("Requirements for product and service information and labelling").

Four new disclosures are proposed to report on the non-assessed aspects by the GRI standards, with the following quantitative indicators suggested.

- **Disclosure: New work practices assessment**
  - number of employees in the new working regime (ex: remote work) and respective percentage within the total workforce
  - number of hours of remote work vs number of hours worked in person, by employee (average or detailed by department/team)
  - percentage of workers that claim to be satisfied with the new working practices.
- **Disclosure: Product access equity**:
  - number of products considered to be unique, *i.e.*, with no equivalent on the market (ex: vaccines)
  - percentage of satisfied ordering demand, by region/country (to assess this, demand points can be created based on the population (most vulnerable, elderly or the whole population), presenting data on the supply performance of those points – satisfied or not satisfied demand. An similar approach is based on the (Cardoso *et al.*, 2016) approach of equitable long-care network optimization, considering geographical and socioeconomic equity).
- **Collaboration with public institutions**
  - number of employees allocated to collaborative taskforces,
  - number of committees/taskforce teams the organization participated,
  - number of governmental decisions (laws, regulations, guidance documents) for which the organization contributed,
  - number of educational protocols and/or number of projects (with universities),
  - number of university's students/researchers working on the organizations' projects
  - donations/financial help (patronage/sponsorship) for educational/research projects/institutions.
- **Product/services portfolio adjustments to community's needs**
  - number of new products/services provided apart from the organization's usual portfolio,
  - investment mobilized to the organization's adaptation to provide those products/services,
  - demand evolution for those products/services and the achieved capacity (%) to satisfy it.

4.2. Social resilience definition

Based on the UN Sustainability Development Goals and the social issues reviewed, before and after the pandemic outbreak, it was commonly identified that the principal of Equity is underlined any social concept defined. Four pillars are considered essential to ensure social resilience on the pharma SC (Figure 3):

- **Access**: the possibility to provide access, in an equitable way, to everyone that needs healthcare services, treatments or vaccines, regardless of their location or their socioeconomic condition.
- **Stability**: the ability to ensure continuous and stable production of the needed medicines, with a steady distribution flux, without disruptions for the SC workers (ex: dismissals).
- **Support**: caring for the surrounding communities' development and well-being as well as the SC workforce, providing solidarity initiatives, training, information, and assistance programmes.
- **Quality**: the capacity to ensure that the provided health services and produced medicines meet the

quality and regulatory requirements, ensuring good labour conditions for these services/products providers: the SC workforce.

Figure 4 - Proposed social resilience pillars to assess and improve the pharma SC performance.

4.3. Proposed framework

A set of measures is compiled on the proposed framework (Figure 5) to promote pharma social resilience, each associated to a pillar.

The proposed actions are organized according to the mentioned three identified problems (medicine shortages, inefficiency/lack of value and no treatment available) divided by major players that are responsible for operating them (the pharma SC stakeholders or the governments/regulatory authorities). Moreover, the suggested measures are distributed according to the used stages: (prevention, response and recovery) to increase the SC's resilience before and after an outbreak.

5. Conclusion

Sustainability has gained more importance in nowadays political agendas, mainly fostered by the environmental challenges our societies face. However, the absence of the social pillar is still felt in SC decision-making tools such as optimization models, when compared to the other two pillars. Most of the indicators observed in models are related to employment (job creation and dismissals) and then, safety and health of employees (accidents, injuries).

The most common social issues reported by the six pharmaceutical leaders were: employee turnover, gender balance and inclusion improvement, employee engagement evaluation, accidents/injuries prevention and reduction, mental health/stress assistance and driving collision reduction efforts (work and non-work related), revealing special concern for their workforces well-being. Four of these companies use the GRI Standards guidance to elaborate their reports, but there is still much work to do in the uniformization of these indicators' assessment.

The challenges faced by the pharma industry prior to the pandemic already pointed to the need for an improvement in their agility and resilience, which were strongly corroborated by the challenges faced after the COVID-19 outbreak. Suppliers redundancy, safety stock, manufacturing decentralization, regionalization and visibility improvement are the main recommendations to global SCs. In the pharma SC, it is particularly important to reshoring API's production facilities on western regions with a simultaneous regain of knowledge and investment in innovation and research infrastructures. Investment in research is corroborated by the probability of new diseases to emerge and its rapid propagation in our globalized society. Workforce alterations, layoffs, dismissals, an overall change in interactions between the SC players were some of the social challenges posed by the pandemic that confirmed the benefits of adaptable and flexible management strategies with less rigid hierarchies to better respond to crisis situations.

The pharmaceutical sector faced all these challenges while working on the development of treatments and vaccines. The challenges associated to the research process, manufacturing capacity and distribution highlighted the big logistics requirements and the medicine equitable access social concern, reaching the difference still felt between the richest regions of the globe and the poorest. Resilient SCs are the most capable to answer this call so a framework with recommendations is designed to improve the pharmaceutical SC performance, especially from the social pillar point of view. The GRI disclosures selection brings a new focus when to social sustainability. Reporting in employment continues to be an essential issue, with even more relevance after the pandemic outbreak, with special notes on dismissals or layoffs caused by the pandemic. Employee engagement must be intensified to evaluate the impacts of new work regimes. Health assumes a central role, adding the need to reinforce reporting on assistance programmes, injuries/illnesses rate by the pandemic and safety measures implemented.

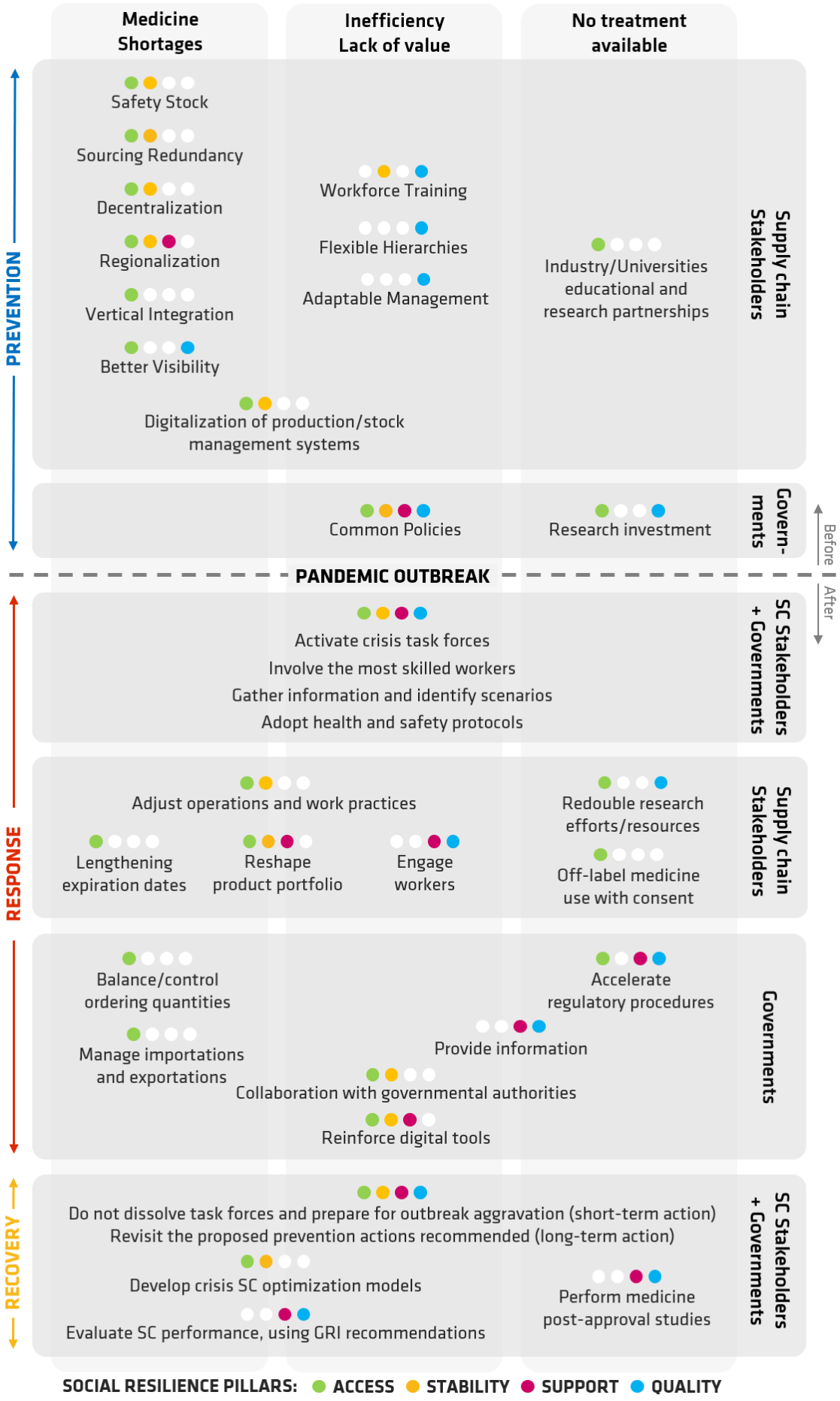

Figure 5 - Proposed framework to prepare the pharma SC to a pandemic crisis like the COVID-19 and improve its social resilience.

Community engagement is not forgotten, as pharma stakeholders can make the difference on governmental action, assistance services, information providing, and satisfy the population's product needs.

This work's limitations are predominantly lack of validation of the reviews on the pharmaceutical characterization since no inquiries were made to pharma companies, namely the six analysed ones. Interviews with management teams and surveys to these (and other) companies' workforces would help supporting the perceived challenges and respective recommendations proposed. It would also bring to this work what are the current recovery plans on the short and long terms. Likewise, surveys to both pharmacies, healthcare practitioners and patients would provide more information on the interaction changes and obstacles their daily activities faced. Direct contact with governmental institutions (e.g.: the national Health Ministry or the EU Commission) to better understand the response strategies, what worked and what did not was so successful, would provide more information to include in the framework regarding the governments' actions.

The analysis performed in this dissertation leaves space for further investigation on the recovery process that is expected to take place in the next years, that will allow to add new measures to the framework. An analysis to the 2020 reports of the same companies would allow a comparison on how the new social aspects were reported. As indicated in the framework, developing quantitative decision-making tools to improve resilience in crisis situations, accurately and with more use of social indicators is a path that should be followed. In addition, more quantitative indicators can be developed for the more subjective already existent GRI disclosures, as this work only suggests quantitative indicators for the new proposed disclosures.

Finally, performing this kind of study in other sectors than the pharmaceutical might be useful, as similar social challenges may probably be found. The respective, already tackled, solutions might be transposed from one to another, thus enhancing social resilience in several different SCs, contributing to several UN Sustainable Development Goals achievement, in the next decade.

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