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Commentary

Overcoming the COVID-19 Pandemic in Indonesia: A Science, technology, and innovation (STI) policy perspective

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ABSTRACT

Scientific abstract: R&D serves as one of the imperative aspects in handling the COVID-19 pandemic. Since the Indonesian government has declared the COVID-19 pandemic as a national disaster, a number of accelerated regulations were stipulated, engaging research and innovation acknowledged as Science, technology, and innovation (STI) Policy. The results of the regulation mapping in Indonesia during 2020-2021 include the 9 regulations (categorized as STI Policy and dominated by institutional settings of 44.4%, operational mechanisms of 33.3%, and legal devices of 22.3%) as an attempt to address the COVID-19 pandemic. Hence, it is expected that the implementation of STI Policy plays a role in generating the 50 innovation products through the COVID-19 research and innovation consortium.

Public interest abstract: The COVID-19 pandemic has been declared as a national disaster in Indonesia. There are nine regulations in the field of Science, technology, and innovation (STI) Policy set by the Indonesian government until July 2021, which regulate institutions, by institutionalizing the implementation of research and innovation in the health sector. The institution is acknowledged as the COVID-19 Research Consortium, consisting of government R&D institutions, universities, industrial R&D institutions, professional associations, regulators, industry, and 50 research and innovation products which have been launched by this consortium.

Introduction

As of 8 August 2021, Indonesia had experienced 3,666,031 confirmed cases of COVID-19 since March 2020, with 474,233 (12.9%) regarded as active cases, 107,096 (2.9%) of deaths, and 3,084,702 (84.1%) of recovered cases [1]. Globally, as of 6 August 2021, the 200,840,180 confirmed cases were reported, including 4,265,903 deaths [2]. The daily trend of cases indicates that the management of COVID-19 cases both globally and nationally in Indonesia has experienced insignificant improvements. Since the World Health Organization declared a ‘public health emergency of international concern over the global outbreak of novel Coronavirus’ on January 30, 2020 [3], global citizen everyday life has since changed. A number of research results reported that the COVID-19 pandemic (in terms of social impact) has generated inequalities affecting the urban environment [4]. Another study indicated the possibility of a long-term impact along with a fundamental change in the way people interact with others, with unfortunately many losing faith in their ability to emotionally relate to others [5]. On the other

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hand, the COVID-19 pandemic has presented a negative impact on people’s lives; thereby challenging the national leadership in each country to navigate the required strategic steps in addressing the uncertain and challenging situation. However, research results from India have reported that the COVID-19 pandemic has resulted in the acceleration and emergence of technological innovations in the fields of health sector, leading to innovation ecosystem which was previously hard to develop [6].

Thus far, each country (through its government authorities) has endeavoured a number of efforts to control and deal with the pandemic, stipulated in the form of policy and health management [7], including in Indonesia. Similarly, the Indonesia government experienced problems concerning health services, case finding, state financial capacity, and declining economic activity [8,9]. In addition, the pandemic has presented a new problem arising from the labour market to a decline in people’s purchasing power, changes in consumption patterns, and massive layoffs [10]. Since the announcement of the COVID-19 pandemic situation, the Indonesia government responded through the Decision of the Ministry of Health No: HK.01.07/MENKES/104/2020 dated on February 4, 2020 regarding the 2019-nCoV Novel Declaration as a Disease generating outbreaks and measures to overcome the pandemic. Further, the government response was progressed by BNPB (National disaster management agency) dated on February 28, 2020, stipulating the Decision of Head of BNPB 9A/2020 regarding the Declaration of Special Emergency Situation of COVID-19 Epidemic Disaster in Indonesia [11]. Additionally, President Joko Widodo constituted the Presidential Decree of the Republic of Indonesia Number 12 of 2020 on April 13, 2020, concerning the determination of non-natural disaster, due to the proliferation of the corona virus disease 2019 (COVID-19) as a national disaster.

The Indonesia government has since attempted to handle the COVID-19 pandemic by initiating the required measures such as tightening the community activities and increasing the allocation to accommodate health sector and social protection for the affected citizens. The Indonesia government implemented the PEN Program (National Economic Recovery Program) as the main instrument, in the context of handling health and economic recovery as a result of the pandemic in 2020 and 2021. The total budget allocation for the PEN Program in the 2021 State Budget amounted to IDR 699.43 trillion, indicating an increase compared to 2020 reaching IDR. 695.2 trillion. In its development, the PEN Program for 2021 was elevated to IDR.744.75 trillion to provide additional support to accommodate health sector and social protection amid the increase in COVID-19 pandemic cases [12].

The health sector and social protection are required to handle the pandemic through the research and development aspect. Globally, from 11 to 12 February 2020, WHO collaborated with the worldwide researchers to navigate the required solutions, through constructing an ‘R&D Blueprint strategy’ aiming to accelerate the research addressing and contributing to COVID-19 pandemic globally. The nine aspects of research and development serve as the focus, comprising:

“1) viruses: natural history, transmission and diagnostics; 2) animal and environmental research on the virus origin, and management measures at the human-animal interface; 3) epidemiological studies; 4) clinical characterization and management; 5) infection prevention and control, including health care workers’ protection; 6) candidate therapeutics for R&D; 7) candidate vaccines for R&D; 8) ethical considerations for R&D and; 9) integration of social sciences in the outbreak response.” [13]

The question however remains on how the COVID-19 pandemic in Indonesia is tackled through the application of research and innovation. Thus, this article presents the efforts through research and innovation policy or particularly acknowledged as science, technology and innovation (STI) policy. STI refers to a strategic component of the post-pandemic agenda in the field of public health, aiming to prepare the community in responding the future emergencies efficiently [14]. In the COVID-19 pandemic situation, the Brazilian government has funded the 789 scientific proposals, intended to overcome the COVID-19 problem [15]. In addition, the Brazilian government has also established a comprehensive health academic center organization, regulating the integrated health assistance and research in the field of public health [16].

This study employed the narrative analysis [17], based on content analysis along with a framework for the implementation of research and innovation, referring to all national policies, from the decree of the Republic of Indonesia to the ministerial regulations. The period of the regulation issuance was initiated since the early 2020 to present (July 2021). Responding to current pandemic situation, researchers of this article have implemented a strict protocol during the process of data collection and analysis (Table 1).

The three aspects of policy implementation were implemented to provide a complete understanding of the framework for the empirical-based analysis, including: 1) legal devices, concerning the underlying legal aspects; 2) institutional settings, regarding the concerned organizational structures and functions, along with the actors related to the structure, relationships, and interactions between actors; and 3) operational mechanisms, regarding the patterns, methods and procedures as well as implementation processes in practical application [18]. The regulations utilized in this article were sourced from the data base, retrieved at https://www.peraturan.go.id/, https://www.jdih.go.id and https://www.peraturan.bpk.go.id/.

Results

Referring to the observed STI policies, especially those related to the implementation of research and development in efforts to deal with COVID-19 in Indonesia, the 9 regulations related to the pandemic were navigated (Table 2). The nine regulations consist of 1 regulation in the form of a presidential regulation, 1 regulation in the form of a presidential decree, 1 regulation in the form of a presidential instruction and a Minister of Finance Regulation, 1 regulation of government goods/services procurement policy institutions, and 4 Decrees of the Minister of Research and Technology/ Head of the Research and Development Agency and National Innovation of the Republic of Indonesia. If perceived from the year of publication, the 2 regulations were stipulated in 2021, and 7 regulations were stipulated in 2020, indicating the first year of government attempt to address the COVID-19 pandemic in Indonesia by highlighting the policy for research and development.

From 2020 to July 2021, the two important STI policies were stipulated to address the COVID-19 pandemic in Indonesia by establishing the research and innovation consortium to accelerate the handling of COVID-19 under the coordination of the Minister of Research and Technology/ Head of the National Research and Innovation Agency in 2020 [19], and by forming the National Team for COVID-19 Vaccine Development by the President of the Republic of Indonesia in 2020 [20]. The research and innovation consortium was tasked with: a) compiling a work plan and strategic steps, required in the implementation of

| Table 1 | Data collection and analysis protocol |
|---------|-------------------------------------|
| **Data sources:** | 1. https://www.peraturan.go.id/ 2. https://www.jdih.go.id 3. https://www.peraturan.bpk.go.id/  |
| **Data period:** | January 2020 – July 2021  |
| **Type of data:** | regulations from the level of the Act to Ministerial Regulations  |
| **Implementation:** | Implementation of regulatory data collection: 1-10 August 2021  |

The scope of regulation used in the analysis

Implementation of research and innovation related to efforts to overcome the COVID-19 pandemic in Indonesia

Data analysis and Policy categorization

1. Legal aspect, 2. Institutional setting, 3. Operational mechanism.
Table 2
Mapping of Handling COVID-19 Regulations in Indonesia: STI Perspective

| Regulation | Appointment Date | Setting Points |
|------------|-----------------|----------------|
| Presidential Regulation (PERPRES) of the Republic of Indonesia Number 14 of 2021 concerning Amendments to Presidential Regulation Number 99 of 2020 concerning Vaccine Procurement and Vaccination Implementation in the Context of Combating the 2019 Corona Virus Disease Pandemic (COVID-19) | 9 February 2021 | Field etiologic studies issued by the Regional Committee for the Assessment and Management of Post-Immunization Adverse Events and causality studies by the National Committee for the Assessment and Management of Post-Immunization Adverse Events. |
| Presidential Decree (KEPPRES) of the Republic of Indonesia Number 18 of 2020 concerning the National Team for Accelerating the Development of the Corona Virus Disease 2019 (COVID-19) Vaccine | 3 September 2020 | a) The establishment of a National Team for the COVID-19 Vaccine Development, under and responsible to the President. b) The team’s working period lasts to December 31, 2021. Upon the task completion of the COVID-19 Vaccine Development Team ends, the activities of the COVID-19 Vaccine Development Team become the responsibility of the National Research and Innovation Agency. |
| Presidential Instruction (INPRES) of the Republic of Indonesia Number 4 of 2020 concerning Relocating of Activities, reallocation of budgets, and procurement of goods and services in the context of accelerating the handling of corona virus disease 2019 (COVID-19) | 20 March 2020 | President of the Republic of Indonesia has instructed the minister of health to accelerate the registration of medical devices and medical devices for handling the COVID-19 that do not have a registration number in accordance with the provisions of the legislation. |
| Regulation of the Minister (PERMEN) of Finance Number 92/PMK.04/2021 concerning the Third Amendment to the Regulation of the Minister of Finance Number 34/PMK.04/2020 concerning the Provision of Customs and/or Excise Facilities and Taxation on Imported Goods for the Purpose of Handling the 2019 Corona Virus Disease Pandemic (COVID-19) | 12 July 2021 | a) Provision of Customs and/or Excise and Taxation Facilities on Imported Goods for the Purpose of Handling the 2019 Corona Virus Disease Pandemic b) The exemption from import duties and/or excise as well as taxation on imported goods for the purpose of handling the Corona Virus Disease 2019 pandemic including a number of goods used for research on handling COVID-19, such as test kits and laboratory reagents, Virus Transfer Media, in vitro laboratory test equipment, etc. |
| Decree of the Minister (KEPMEN) of Research and Technology / Head of the National Research and Innovation Agency of the Republic of Indonesia Number 7 of 2020 regarding changes to government goods/service procurement policy agency regulations number 11 of 2018 concerning electronic catalogue | 07 August 2020 | a) The inclusion of the type of innovation product which is the result of thought, research, development, assessment, and/or application, which contains elements of novelty and has been applied and provides economic and/or social benefits, as one of the criteria for goods/services of sectoral electronic catalogue in the procurement of goods/services. b) The criteria for the type of Innovation product are set by the Minister/Institutional Leader in charge of government affairs in the fields of research, development, study, and application as well as integrated inventions and innovations c) The stages prior to broadcast for the type of Innovation product in the Sectoral Electronic Catalogue are determined by the Minister/Head of Institution in charge of government affairs in the fields of research, development, study and application as well as integrated inventions and innovations |
| Decree of the Minister (KEPMEN) of Research and Technology / Head of the National Research and Innovation Agency of the Republic of Indonesia Number 150/M/KPT/2020 concerning Guidelines for Assessment and Notification of Inclusion of Innovation Products in the Sector Electronic Catalogue of Innovation Products | 7 August 2020 | a) The priority of Product Commodities Innovation on electronic catalogue display for innovation products, including: 1. Food and Agriculture; 2. New and Renewable Energy; 3. Health and Medicine; 4. Transportation; 5. Advanced Materials; 6. Information and Communication Technology; and 7. Maritime b) The inclusion of innovation products in the Sector Electronic Catalogue of Innovation Products takes into account the following aspects: a. aspects of product availability assurance; b. price valuation; c. intellectual property management; d. track record of research, development, assessment, and application of science and technology; e. fixation of product innovation; and f. risk management |
| Decree of the Minister (KEPMEN) of Research and Technology / Head of the National Research and Innovation Agency of the Republic of Indonesia Number 151/M/KPT/2020 concerning the Assessment and Notification Committee on the Inclusion of Innovation Products in the Sector Electronic Catalogue of Innovation Products | 7 August 2020 | a) Recommendation for sandboxing innovations and opportunities; b) Inventory of Procurement of Goods/Services for Innovation Products; c) Assessment for the Certification and Standardization of Innovation Products; d) Determination of the Maturity of Innovation Products; e) Assessment for Product Availability Guarantee; f) Assessment of Price Value. |
| Decree of the Minister (KEPMEN) of Research and Technology / Head of the National Research and Innovation Agency of the Republic of Indonesia Number 118/M/KPT/2020 concerning the Project Management Office (PMO) for the implementation of the Research and Innovation Consortium to accelerate the handling of COVID-19 | 19 June 2020 | a) The COVID-19 PMO is in charge of managing the implementation of the COVID-19 research and innovation consortium b) The 5 research areas, comprising the scope for the management of PMO, include: 1) prevention, 2) screening and diagnostics, 3) medical devices and support tools, 4) social humanities studies, and 5) therapy, medicine and Multy Center Clinical Trial. |
| Decree of the Minister (KEPMEN) of Research and Technology / Head of the National Research and Innovation Agency of the Republic of Indonesia Number 68/M/KPT/2020 concerning the Research and Innovation Consortium to accelerate the handling of COVID-19 | 01 April 2020 | a) Formation of the COVID-19 Research and Innovation Consortium under the coordination of the Minister of Research and Technology / Head of the National Research and Innovation Agency. b) Membership of the consortium consists of government research and development institutions, universities, university hospitals, medical professional associations, local governments, Diaspora, state-owned enterprises, and industrial business actors. |

research, development, assessment, and application related to efforts to deal with COVID-19, b) conducting research, development, assessment, and implementation related to efforts to deal with COVID-19, c) exploiting the potential resources owned by consortium members including human resources, facilities and infrastructure needed, d) managing and exchanging data and information, required by consortium members on a regular basis concerning the confidentiality and interests of the unitary state of the Republic of Indonesia, in accordance with the provisions of the legislation, e) implementing the results of development, assessment, and implementation related to efforts to deal
with COVID-19 for the benefit of the community by preventing, detecting, and responding to COVID-19, f) developing and producing research and development results following the capacity for consortium members from industry, and g) socializing, educating and disseminating research and innovation results to the public [19]. The COVID-19 Research and Innovation Consortium was established on March 26, 2020 by the Ministry of Research and Technology/National Research and Innovation Agency with members from government research institutions such as the Indonesian Institute of Sciences (LIPI), the Agency for the Assessment and Application of Technology (BPPT), the National Nuclear Energy Agency (BATAN), and the Eijkman Institute for Molecular Biology (LBM); Health Research and Development Agency (Balitbangkes) Ministry of Health, along with academic bodies, such as universities including the University of Indonesia, Gadjah Mada University, Bandung Institute of Technology, Bogor Agricultural University, Tenth of November Institute of Technology, and Airlangga University, as well as pharmaceutical industry such as PT Biofarma and PT SOHO [21].

Meanwhile, the National Team for the Development of COVID-19 Vaccine focuses on building synergies in research, development, assessment, and application of science and technology, inventions and innovations, production, distribution, and utilization of COVID-19 vaccines between the government and scientific institutions as well as scientific and technological resources for the development of the COVID-19 vaccine [20].

Discussion

Table 2 and 3 demonstrate the 9 policies denoting the response of the Indonesia government in terms of research and innovation in handling the COVID-19 pandemic, further divided into two policy-level categories, comprising: 3 regulations in the form of presidential policies (Presidential Decree No. 14/2021, Presidential Decree No. 18/2020, and Presidential Instruction No. 4/2020). Meanwhile, the second category is occupied by the policies in the form of Ministerial Decrees/Ministerial-level Officials (there are six regulations, including: Permen No. 92/PMK.04/2021, Perlem No. 7/2020, Ministerial Decree No. 150/M/KPT/2020, Ministerial Decree No. 118/M/KPT/2020, and Ministerial Decree 68/M/KPT/2020).

As indicated by the existing policy aspects (Table 3), the Indonesia government response towards the STI Policy during the handling of COVID-19 pandemic focuses more regulation on institutional aspects by forming the National Team for COVID-19 Vaccine Development, the Innovation Product Assessment Committee in the Electronic Catalogue Sector of Innovation Product, and the PMO to implement the COVID-19 research consortium. Institutional formation through the national team to accelerate vaccine development was conducted by the government as an effort to support the acceleration of handling COVID-19 pandemic in Indonesia, by implementing science, technology, and innovation in the domestic vaccine field. The ultimate goal for Indonesia is to have national resilience and national independence in handling COVID-19 pandemic. This national team involves elements such as ministries and business entities in Indonesia, coordinated by the Head of the National Research and Innovation Agency.

The second aspect of concern lies in the operational mechanism, by emphasizing the etiologic study for the co-occurrence of post-COVID-19 vaccine immunization in Indonesia, provision of customs, excise and taxation facilities on a number of imported goods, utilization of research laboratories and the opportunity for research and innovation products from researchers in Indonesia, as included in the electronic catalogue under the procurement of government goods/services, especially related to products for handling the COVID-19. In addition, the government pays attention to legal aspect by instructing the Minister of Health to accelerate the registration of medical devices which do not yet have a registration number, thereby capable of circulating in the market, including products from the research results.

### Table 3

| No. | Regulation Type | Policy Aspect |
|-----|----------------|--------------|
| 1   | Presidential Regulation (Perpres) | ✓  |
| 2   | Presidential Decree (Kepres) | ✓  |
| 3   | Presidential Instruction (Inpres) | ✓  |
| 4   | Ministerial Regulation (Permen) | ✓  |
| 5   | Institutional Regulations (Perlum) | ✓  |
| 6   | Ministerial Decree (Kepmen) | ✓ ✓ ✓ ✓  |

**Notes:**
- LD = legal devices; IS = institutional setting; OM = operational mechanism

At the beginning of the COVID-19 pandemic in Indonesia, researchers immediately responded and assisted in handling the pandemic. Initially, the innovations produced were only limited to the production of disinfectants and sterilization of medical devices. LIPI particularly opened a BSL-3 laboratory in Cibinong for testing samples of the COVID-19 virus. In addition to providing physical facilities, LIPI also trained human resources to test the COVID-19 virus. LIPI through the Chemical Research Centre produced hand sanitizers and disinfectants from its laboratory facilities [22].

As a result of the government’s response in the field of research and innovation, the researchers and engineers who are members of the COVID-19 Consortium have initiated the solutions in the form of 50 innovations addressing the COVID-19 (Table 4). The solutions are generated in the form of products or instruments to prevent the transmission of the COVID-19, screening and diagnostic instruments, medical and supporting devices, as well as therapies and drugs [23]. The aforementioned products are regarded as a collaboration form of quadruple helix or acknowledged as penta helix (scholars - Business/businessmen - Government - Community - Media) [24,25], by involving the Ministry of Research and Technology/National Research and Innovation Agency, and the Ministry of Finance through the Education Fund Management Agency. In addition, external inventors included R&D institutions and universities such as scholars, and
| No. | Innovation Product | Development Institution |
|-----|--------------------|-------------------------|
| 1.  | Rapid Diagnostic Test Microchip | Agency for the Assessment and Application of Technology (BPPT), Universitas Gadjah Mada (UGM), and Universitas Airlangga |
| 2.  | Rapid Diagnostic Test RI-GHA | Agency for the Assessment and Application of Technology (BPPT), Universitas Gadjah Mada (UGM), Universitas Airlangga, PT Hepatika Mataram, Universitas Mataram, and Ministry of Health Republic of Indonesia. |
| 3.  | Real Time Polymerase Chain Reaction Test Kit BioCov-19 | Agency for the Assessment and Application of Technology (BPPT), Nusantika, IndonesiaPastiBisa, PT Bio Farma, Ministry of Health Republic of Indonesia, and Lab Microbiology Clinic Faculty of Medicine - University of Indonesia. |
| 4.  | Viral Transport Medium | Universitas Gadjah Mada (UGM), and PT Swayasa Prakarsa |
| 5.  | VTM (Viral Transport Medium) | Eijkman Institute of Molecular Biology. |
| 6.  | Plasmid Eijkman Control for COVID-19 (pCoC-19) | Eijkman Institute of Molecular Biology. |
| 7.  | RAISA Robot (Health Nurse) | Universitas Airlangga and Institut Teknologi Sepuluh Nopember (ITS) |
| 8.  | RAISA TIARA Robot | Universitas Airlangga and Institut Teknologi Sepuluh Nopember (ITS) |
| 9.  | RAISA BCL Robot | Universitas Airlangga and Institut Teknologi Sepuluh Nopember (ITS) |
| 10. | Robot Dekontaminasi (Decontamination Robot) | Universitas Airlangga and Institut Teknologi Sepuluh Nopember (ITS) |
| 11. | Smart Syringe Pump | Universitas Telkom and Indonesian Institute of Sciences (LIPI) |
| 12. | Autonomous Autonomous Ultraviolet C (UVC) Mobile Robot | Eijkman Institute of Molecular Biology, Gatot Soebroto Army Central Hospital (RSPAD) and Biofarma |
| 13. | Convalescence Serum | Agency for the Assessment and Application of Technology (BPPT), Institut Teknologi Bandung (ITB), Indonesia Artificial Intelligence Society (IAIS), Asoasi Prakarsa Indonesia Cerdas (APIC), Bogor Agricultural University (IPB), Universitas Islam Bandung, ABI, and Ministry of Health Republic of Indonesia |
| 14. | Mobile Laboratory Biosafety Level-2 (BSL-2) | Agency for the Assessment and Application of Technology (BPPT), Institut Teknologi Bandung (ITB), Indonesia Artificial Intelligence Society (IAIS), Asoasi Prakarsa Indonesia Cerdas (APIC), Bogor Agricultural University (IPB), Universitas Islam Bandung, ABI, and Ministry of Health Republic of Indonesia |
| 15. | Emergency Ventilator | Agency for the Assessment and Application of Technology (BPPT), PT Len Industri (Persero), PT Poly Jaya, and PT Dharma |
| 16. | Powered Air Purifying Respirator | Universitas Al Azhar Indonesia |
| 17. | Ventilator Vent-I | Institut Teknologi Bandung (ITB), Unpad, and Yayasan Pembina Masjidy Salman |
| 18. | Venindo V01 | Universitas Gadjah Mada (UGM), PT ATMI Solo, CV Rajawali 3D, PT Stechoq Robototika Indonesia, Yogya Presisi Tehnikatama Industri, PT Swayasa Prakarsa, GSM and Rumah Sakit Umum Pusat Dr. Sandijito |
| 19. | Venindo R03 | Universitas Gadjah Mada (UGM), PT ATMI Solo, CV Rajawali 3D, PT Stechoq Robototika Indonesia, PT Yogya Presisi Tehnikatama Industri, PT Swayasa Prakarsa, GSM and Rumah Sakit Umum Pusat Dr. Sandijito |
| 20. | Gerlink LPI High Flow Nasal Cannula (GLP-HFNC-01) | Research Center for Biomedical Engineering (RCBE) Fakultas Teknik Universitas Indonesia (FTUI), Dynapack Asia Pte Ltd, PT Chandra Asri Petrochemical Tbk, PT Ingress Malindo Ventures, PT Toyota Motor Manufacturing Indonesia, PT Langgeng Jaya, PT Indachi Prima, and PT Sri Tita Medika |
| 21. | Sterilized Nasopharynx Swab Stick (Flocked Swab) | Indonesian Institute of Sciences (LIPI) and PT Gerlink Utama Mandiri |
| 22. | Sequence Protein S SARS COV 2 | Agency for the Assessment and Application of Technology (BPPT), Institut Teknologi Bandung (ITB), Indonesia Artificial Intelligence Society (IAIS), Asoasi Prakarsa Indonesia Cerdas (APIC), Universitas Katolik Indonesia Atma Jaya, Universitas Negeri Surabaya, Universitas 17 Agustus 1945, Zi.Care, Rumah Sakit Umum Daerah (RSD) Koja, Universitas Syiah Kuala, Ministry of Health Republic of Indonesia, Neurabot and Rumah SakitUmum Pusat Nasional Dr. Cipto Mangunkusumo - Faculty of Medicine - University of Indonesia |
| 23. | AI-based Medical Imaging System | Universitas Gadjah Mada (UGM), Institut Teknologi Bandung (ITB), and Universitas Airlangga |
| 24. | OST D (water soluble vitamin D supplements) | Universitas Gadjah Mada (UGM), PT Swayasa Prakarsa and Lembaga Farmasi Angkatan Laut Republic Indonesia |
| 25. | Minuman Herbal/ Herbal beverage (Teh Java) | Universitas Gadjah Mada (UGM), and PT Swayasa Prakarsa |
| 26. | Minuman Herbal/ Herbal beverage (Teh Sereh) | Universitas Gadjah Mada (UGM), and PT Swayasa Prakarsa |
| 27. | Jamu Herbal (Herbal Beverage) Imonogama | Universitas Gadjah Mada (UGM), and PT Swayasa Prakarsa |
| 28. | Minuman Herbal/ Herbal beverage (Wedang Uwah Celup) | Universitas Gadjah Mada (UGM), and PT Swayasa Prakarsa |
| 29. | Fermented Milk LOWKOL | Universitas Gadjah Mada (UGM), and PT Swayasa Prakarsa |
| 30. | Herbal Hand Sanitizer | Universitas Gadjah Mada (UGM), and PT Swayasa Prakarsa, and Apotek UGM |
| 31. | Imboost Flu Herbal | Universitas Gadjah Mada (UGM), and PT Sobo Global Health |
| 32. | Smart Biosafety Swab Chamber (BCL-UGM) | Universitas Gadjah Mada (UGM), PT Karya Sehati Utama and CV Multiteknologi |
| 33. | GAMA Swab Sampling Chamber | Universitas Gadjah Mada (UGM), and CV Solusi Mitra Teknologi |
| 34. | Insert masker | Universitas Gadjah Mada (UGM), and PT Global Meditech Utama |
| 35. | Air Cleaner | Universitas Gadjah Mada (UGM), and PT Yogyakarta Presisi Tehnikatama Industri |
| 36. | Portable Air Purifier | Universitas Gadjah Mada (UGM) |
| 37. | COV-Watch (a health monitoring tool for COVID-19 patients which includes a smart-band, thermometer, and is integrated with an application to be installed on the patient’s smartphone) | Universitas Gadjah Mada (UGM), and Klinik Pratama Firdaus |
| 38. | Touchless Mobile Handwash | Universitas Gadjah Mada (UGM) |
| 39. | Digital Platform (Cared+) | Universitas Gadjah Mada (UGM), and PT Gamatechno Indonesia |
| 40. | Digital X-Ray Radiography | Universitas Gadjah Mada (UGM), PT Madeena Karya Indonesia, CV Prestige Furniture and PT Seger Medical National |
| 41. | N95 Mask Sterilization Box | Universitas Gadjah Mada (UGM), CV Ekka Indopekarsa, Rumah Sakit Akademik Universitas Gadjah Mada (UGM), Rumah Sakit Gigi dan Mutul Prof. Soedomo FKG Universitas Gadjah Mada (UGM), and Rumah Sakit Soetarto |

(continued on next page)
industrial partners such as Covix, PT, Labs247, PT. Chroma International, PT. Hepatica Mataram, PT. Bio Farma, and Nusantics, actively conducting the downstream research and innovation products, as well as supporting and participating in the health community sector such as the Executive Board of the Indonesian Doctors Association, the Association of Indonesian Doctors of Clinical Pathology and Laboratory Medicine (PDS), the Association of Doctor Developer for Indonesian Traditional Medicines and Herbal Medicine (PB POTJI), and the Indonesian Pulmonologist Association (PD PI) [23]. This involvement includes the role of print and electronic media in Indonesia by providing information related to the presence of research and innovation products.

Conclusion

Since COVID-19 has become a global pandemic, the Indonesian government has also responded by declaring the COVID-19 pandemic as a national disaster, requiring a special approach. A special approach is evidenced by issuing regulations in the field of research and innovation in handling COVID-19, which is known as the STI Policy in COVID-19. This research shows that institutional arrangements dominate 44.4% of STI Policy regulations. This result indicates that the institutional aspect is prioritized to handle the COVID-19 pandemic in Indonesia from the STI Policy perspective. It is expected that the implementation of existing policies has contributed to the acceleration of research and innovation in the health sector, generated by producing 50 research and innovation products, reflecting the incident of the COVID-19 pandemic in Indonesia by achieving the quadruple helix or Penta helix collaboration. However, this article is limited by not elaborating on the variable (relationship among actors in the quadruple helix in overcoming the COVID-19 pandemic in Indonesia). Therefore, further research is highly recommended to include such variables further.

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Author contribution

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Declarations of Competing Interest

The author declared there is no conflict of interest

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