Chongqing Zhifei Biological Products Co., Ltd.

2021

Full Year Business Performance

Chongqing Zhifei Biological Products Co., Ltd.

Board of Directors

April 2022

Important Notes

The main content and data of this report are from the 2021 annual report of Chongqing Zhifei Biological Products Co., Ltd. In case of any discrepancy between interpretations of the text, the Chinese version shall prevail.

I. Overview of Principal Business

(I) Company profile

Safeguarding life and delivering healthy outcomes. As an important global vaccine developer and supplier with mission and responsibility, Zhifei has committed to build a global immune barrier. For two decades, the Company adheres to its business principle "prioritizing social benefits over corporate profits" . It focuses on infectious disease prevention and control, innovative research and development, to serve the public, and to continuously contribute to a healthy China. With the development model featuring “technology + market” drivers and the coordinated development of diagnosis, prevention and treatment. The company has now developed into an international, full-industry chain high-tech bio-pharmaceutical enterprise integrating R&D, production, sales, distribution, import and export of vaccines and biological products.

In 2021, there was no material change in the principal business of the Company. Beijing Zhifei Lvzhu Biopharmaceutical Co., Ltd. ("Zhifei Lvzhu") and Anhui Zhifei Longcom Biopharmaceutical Co., Ltd. ("Zhifei Longcom") renewed their efforts to introduce new products against bacteria, viruses and tuberculosis. The parent company, Zhifei, as the main promoter, dedicated to diversifying vaccine products and providing more convenient and considerate services. Taking Zhifei Airport as the import and export channel, the Company also provided warehousing, customs clearance record, and batch release services for imported vaccines. In addition, the Company incubated and cultivated promising biotechnology and products through the Zhirui investment platform by equity investment, and ensured the layout of the mRNA technology platform through INNORNA by subscribing for equity interests.

(II) Major products and indication

As of the disclosure date of this report, a total of eleven products had been launched, of which one product got conditional approval. The Company offers a diverse range of products, including vaccine products for preventing infectious diseases such as influenza, COVID-19, cervical cancer, pneumonia, rotavirus and drugs for the diagnosis, prevention and treatment of tuberculosis, to the

public including groups of infants, teenagers and adults. It effectively provides product support for the prevention and control of infectious diseases, and provides the nation with diversified options for disease protection. Details are as follows:

No.	Common Name	Trade Name	Function and Use / Indication
1	Group $ACYW_{135}$ Meningococcal Polysaccharide Vaccine	Menwayc®	Used to prevent the meningococcal meningitis caused by $ACYW_{135}$ meningococcal polysaccharide.
2	Meningococcal Group A and C Conjugate Vaccine	Mening A Con	Used to prevent infectious diseases caused by meningococcal Group A and C, such as cerebrospinal meningitis and pneumonia.
3	Haemophilus Influenzae Type b Conjugate Vaccine	Xifeibei ®	Used to prevent invasive infections caused by Haemophilus influenzae Type b (including meningitis, pneumonia, septicemia, cellulitis, arthritis, epiglottitis, etc.).
4	Recombinant COVID-19 Vaccine (CHO Cell)	Zifivax®	Used to prevent COVID-19 caused by SARS-CoV-2 .
5	Recombinant Mycobacterium Tuberculosis Fusion Protein (EC)	C-TST ™	Used to diagnose mycobacterium tuberculosis infection, and the results of the subcutaneous test are not affected by the BCG vaccine and can be used for clinical diagnosis of tuberculosis.
6	Mycobacterium Vaccae for Injection	Vaccae®	Used to prevent tuberculosis in the latent groups of infected people with mycobacterium tuberculosis; also used as a drug combination for the adjuvant tuberculosis chemotherapy.
7	Human Papillomavirus Quadrivalent (types 6, 11, 16, 18) Recombinant Vaccine	Gardasil®	Used to prevent the following diseases caused by high-risk HPV16/18: cervical cancer, grade 2 and grade 3 cervical intraepithelial neoplasis (CIN2/3) and adenocarcinoma in situ, and grade 1 cervical intraepithelial neoplasis (CIN1).
8	Human Papillomavirus 9-valent Vaccine, Recombinant	Gardasil 9	Used to prevent the following diseases caused by HPV type contained in this product: cervical cancer caused by type HPV16, 18, 31, 33, 45, 52 and 58; precancerous lesions caused by HPV6, 11, 16, 18, 31, 33, 45, 52 and 58: cervical intraepithelial neoplasis (CIN2/3), cervical adenocarcinoma in situ (AIS), and cervical intraepithelial neoplasis (CIN1); persistent infections caused by type HPV6, 11, 16, 18, 31, 33, 45, 52 and 58.
9	Reassortant Rotavirus Vaccine, Live, Oral, Pentavalent (Vero Cell)	Rotateq®	Used to prevent the rotavirus gastroenteritis in infants caused by serum-type G1, G2, G3, G4 and G9.

10	Pneumovax 23 - Pneumococcal Vaccine, Polyvalent	Pneumovax	Used to prevent the pneumococcal disease in the form of the capsulate bacteris contained in this vaccine.
11	Hepatitis A Vaccine (Human Diploid Cell), Inactivated	VAQTA	Used to prevent diseases caused by the hepatitis A virus.

(III) Main business model

The Company has always conducted R&D, production and sales activities in strict accordance with the Law of the People's Republic of China on Vaccine Administration (hereinafter referred to as the "Vaccine Administration Law"), the Law of the People's Republic of China on Drug Administration (hereinafter referred to as the "Drug Administration Law") and other relevant laws and regulations. Adhering to independent R&D innovation principle, the Company has continuously transformed its R&D achievements into production and marketization. It also cooperated on development program with leading R&D institutions and scientific research institutes. Thus the Company built a R&D model mainly based on independent innovation and complemented by industry-university-research cooperation. Innovative R&D, product upgrading and new product launches have continued to inject new vitality into the Company's development, meeting the health needs of the people.

The Company's production model is market-oriented. Applying this principle, the production department schedules production according to the sales plan of the marketing department. It develops production plan based on market needs while maintaining moderate inventory levels. The Company conducts production and inspection activities in accordance with approved production processes and quality control standards and also strictly complies with the Vaccine Administration Law, the Drug Administration Law and other regulations to ensure that the entire production process meets the requirements of the Good Manufacturing Practice of Medical Products. The quality management department strictly supervises and controls product quality, and the Company's complete production quality management system guarantees that the entire product process continues to satisfy legal requirements.

The Company organizes academic promotion meetings and activities by its professional marketing team and adopts the direct sales model to enable its vaccines and anti-tuberculosis products to cover corporate end-users. The Company's vaccines are only available for sale after they are manufactured/imported and have obtained a national batch release and approval certificate. When the vaccines are procured by provinces, autonomous regions, and municipalities directly through the provincial public resource trading platforms, the Company will distribute vaccines to disease prevention and control institutions or their designated vaccination organizations in accordance with the procurement contracts.

II. Analysis of Principal Business

(I) Key accounting data and financial indicators

During the reporting period, key financial indicators are shown below:

	2021	2020	Increase/decrease of the current year compared to the previous year	2019
Operating income (RMB)	30,652,415,906.61	15,190,366,231.21	101.79%	10,587,318,311.60
Net profit attributable to shareholders of the Company (RMB)	10,208,548,452.56	3,301,326,830.15	209.23%	2,366,438,733.29
Net profit attributable to shareholders of the Company after deducting non-recurring gains and losses (RMB)	10,184,137,871.79	3,322,905,479.75	206.48%	2,388,305,638.15
Net cash flows from operating activities (RMB)	8,507,591,817.35	3,496,688,940.12	143.30%	1,366,993,830.88
Basic earnings per share (RMB/share)	6.3803	2.0633	209.23%	1.4790
Diluted earnings per share (RMB/share)	6.3803	2.0633	209.23%	1.4790
Weighted average return on equity	78.01%	46.29%	31.72%	47.67%
	As at the end of 2021	As at the end of 2020	Increase/decrease of the current year compared to the previous year	As at the end of 2019

Total assets (RMB)	30,047,323,465.36	15,215,241,753.29	97.48%	10,942,422,443.88
Net assets attributable to shareholders of the Company (RMB)	17,657,212,911.83	8,248,664,459.27	114.06%	5,747,337,629.12

(II) Key financial indicators by quarter

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Operating income (RMB)	3,926,600,928.88	9,244,877,569.27	8,657,182,276.39	8,823,755,132.07
Net profit attributable to shareholders of the Company (RMB)	938,179,113.58	4,552,471,015.83	2,912,957,659.88	1,804,940,663.27
Net profit attributable to shareholders of the Company after deducting non-recurring gains and losses (RMB)	942,454,637.12	4,560,408,715.15	2,915,311,598.17	1,765,962,921.35
Net cash flows from operating activities (RMB)	-113,803,717.67	6,644,628,403.12	1,790,582,471.29	186,184,660.61

(III) Breakdown of recurring profit or loss items and amounts

Item	Amount in 2021	Amount in 2020	Amount in 2019
Profit or loss on disposal of non-current assets (including the write-off portion of the provision for asset impairment)	-1,643,198.23	-4,568.29	-731,265.03
Government subsidies included in current profit or loss (excluding those closely related to the Company's normal business operations, which are granted continuously in fixed amounts or quantities in accordance with certain standards and in compliance with national policies)	101,045,331.47	27,189,563.57	23,566,276.53
Profit or loss on debt restructuring	-852,169.20	-783,943.30	-1,516,196.44
Profit or loss from changes in the fair value of financial assets and liabilities held for trading, and investment income from the disposal of financial assets and liabilities for trading and available-for-sale financial assets, except for effective hedging activities related to the Company's normal business operations	-5,625,856.85	-12,574,514.90	-1,073,505.55
Other non-operating income and expenses other than those mentioned above	-66,383,696.92	-40,230,227.90	-45,982,079.05
Other profit or loss items that meet the definition of non-recurring profit or loss	2,025,026.70	935,922.13	0.00
Less: Amount affected by income tax	4,154,856.20	-3,889,119.09	-3,869,864.68
Total	24,410,580.77	-21,578,649.60	-21,866,904.86

III. Overview of the Company's Operations

In 2021, the whole company responded quickly and persistently to various COVID-related challenges. In line with our business principle of "prioritizing social benefits over corporate profits", all Zhifei staff worked hard under the leadership of the board of directors and the management to ensure the R&D progress, production, and supply of COVID-19 vaccines and other products. Applying “technology+market” driven business model, the Company achieved continuous growth in main business by increasing R&D investment, developing innovations into production and marketization.

(I) Conducting independent R&D, and adhering to innovation

Facing the severe challenges in complex and ever-changing pandemic situation, as a pharmaceutical company, the Company keeps doing its part to take social responsibility. At the beginning of the pandemic outbreak in 2020, the management promptly signed a cooperative R&D agreement with the Institute of Microbiology, Chinese Academy of Sciences to initiate the development of COVID-19 vaccines. Clinical trials of Recombinant COVID-19 vaccine (CHO cell) (Zifivax) were initiated in June 2020. The R&D team has worked hard day and night to overcome difficulties, and the Company has vigorously pushed forward the R&D progress to accelerate development process. In 2021, Zifivax received approval for emergency use in March to support the implementation of the national mass immunization program, building an immunological barrier for the people. As of the disclosure date of this report, Zifivax was approved as heterologous booster and received Conditional Marketing Approval in 2022 and has provided protection on over 100 million people, contributing to the recovery of economic activity and life.

"Life First, Action by All, Global Health, End of Tuberculosis." The Company developed a product matrix and proactively took corporate responsibility for prevention and treatment of tuberculosis. On June 16, 2021, the Company announced that its proprietary product, Mycobacterium Vaccae for Injection (Vaccae), was approved for a new indication to prevent tuberculosis in the LTBI (latent tuberculosis infection) population. Vaccae, and Recombinant Mycobacterium Tuberculosis Fusion Protein (EC) (C-TST) together formed a tuberculosis diagnosis, prevention and treatment system. As of the disclosure date of this report, Vaccae has won bids and been listed by 25 provinces and municipalities including Beijing, Shanghai, Henan, Shandong, Guangdong, Hunan, Sichuan,

Zhejiang, etc. The bidding and promotion activities are actively ongoing in many other regions.

Technology and innovation have always been intrinsic drivers of the Company's development. In 2021, the Company continued to expand and advance the pipeline to further strengthen its foundation, and enhance its technology. Progress details of development candidates are as follows:

Recombinant COVID-19 Vaccine (CHO Cell) (Zifivax) was approved for emergency use in multiple countries;

Mycobacterium Vaccae for Injection (Vaccae) was approved for a new indication to prevent tuberculosis in the LTBI population;

Three projects in pipeline, namely Lyophilized Rabies Vaccine for Human Use (Vero Cell), S. flexneri and S. sonnei Bivalent Shigella Conjugate Vaccine, and $ACYW_{135}$ Meningococcal Conjugate Vaccine entered Phase III clinical trial stage ;

Two projects in pipeline, namely DPT Vaccine (Component) and Inactivated Rotavirus Vaccine, entered Phase I clinical trial stage .

In FY2021, the Company continued to increase its R&D investment, which reached RMB 814 million, an increase of 69.38% over last year. By the end of 2021, the Company had a total of 29 independent R&D projects, of which 16 projects were in clinical trial stage or applications for registration, as follows.

Projects Entering the Registration Process

No.	Drug Name	Registration Class	Major Functions	Registration Stage	Progress
1	Influenza Virus-split Vaccine	Preventive biologic products class 15	After vaccination, it can stimulate the body to produce anti-influenza virus immunity and is used to prevent influenza caused by the strain of virus.	Clinical trial	Clinical trial completed
2	Pneumovax 23 - Pneumococcal Vaccine, Polyvalent	Preventive biologic products class 9	Used to prevent infectious diseases caused by streptococcus pneumoniae.	Clinical trial	Clinical trial completed
3	Recombinant COVID-19 Vaccine (Zifivax)	Preventive biologic products class 1	Used to prevent diseases caused by the novel coronavirus.	Clinical trial	Phase III clinical trial in progress
4	15-Valent Pneumococcal	Preventive biologic	Used to prevent infectious diseases caused by streptococcus pneumoniae.	Clinical trial	Phase III clinical trial in progress

	Conjugate Vaccine	products class 7			
5	Lyophilized Rabies Vaccine for Human Use (MRC-5 Cell)	Preventive biologic products class 9	After vaccination, it can stimulate the body to produce anti-rabies virus immunity and is used to prevent rabies.	Clinical trial	Phase III clinical trial in progress
6	Lyophilized Rabies Vaccine for Human Use (Vero Cell)	Preventive biologic products class 15	After vaccination, it can stimulate the body to produce anti-rabies virus immunity and is used to prevent rabies.	Clinical trial	Phase III clinical trial in progress
7	Four-valent Influenza Virus-split Vaccine	Preventive biologic products class 15	After vaccination, it can stimulate the body to produce anti-influenza virus immunity and is used to prevent influenza caused by the strain of virus.	Clinical trial	Phase III clinical trial in progress
8	S. flexneri and S. sonnei Bivalent Shigella Conjugate Vaccine	Preventive biologic products class 1	Used to prevent infectious diseases caused by Shigella.	Clinical trial	Phase III clinical trial in progress
9	$ACYW_{135}$ Meningococcal Conjugate Vaccine	Preventive biologic products class 7	Used to prevent infectious diseases caused by meningococcus.	Clinical trial	Phase III clinical trial in progress
10	Intestinal Virus Type 71 Inactivated Vaccine	Preventive biologic products class 1	Used to prevent diseases caused by EV71 infection.	Clinical trial	Phase II clinical trial in progress
11	Lyophilized Recombinant Tuberculosis Vaccine (AEC/BC02)	Preventive biologic products class 1	Used to prevent tuberculosis in the latent groups of infected people with mycobacterium tuberculosis	Clinical trial	Phase II clinical trial in progress
12	Quadrivalent Recombinant Norovirus Vaccine (Pichia Pastoris)	Preventive biologic products class 1	After vaccination, it stimulates the body to produce anti-norovirus immunity, which is used to prevent acute gastroenteritis caused by norovirus infection.	Clinical trial	Phase II clinical trial in progress
13	DPT vaccine (component)	Preventive biologic products class 4	Used to prevent diseases caused by pertussis, diphtheria and clostridium tetani.	Clinical trial	Phase I clinical trial in progress
14	BCG	Preventive biologic products class 15	After vaccination, it enables the body to generate cellular immune responses. Used to prevent tuberculosis.	Clinical trial	Phase I clinical trial in progress

15	BCG-PPD	Therapeutic biologic products class 15	Used for clinical ancillary diagnosis of tuberculosis, epidemiological survey of tuberculosis and monitoring of body immune response after BCG vaccination. In combination with an in vivo diagnostic reagent (Recombinant Mycobacterium Tuberculosis Fusion Protein (EC)) for identification purposes, it can be used to identify the groups not infected with tuberculosis that are not vaccinated or are negative after vaccination by BCG, the groups not infected with tuberculosis that are positive after vaccination by BCG, and the groups infected with tuberculosis.	Clinical trial	Phase I clinical trial in progress
16	Inactivated Rotavirus Vaccine	Preventive biologic products class 1	Used to prevent diarrhea caused by rotavirus.	Clinical trial	Phase I clinical trial in progress

Preclinical Project

No.	Product Name	Progress and Changes in 2021	Expected Progress (2022-2023)	
1	Recombinant Hepatitis B Vaccine (Hansenula Polymorpha)	Preclinical study	Preclinical study	IND
2	Bivalent HFMD Vaccine	Preclinical study	Preclinical study	IND
3	Bivalent Recombinant Rotavirus Vaccine (Pichia Pastoris)	Preclinical study	Preclinical study	IND
4	Recombinant Zoster Vaccine (CHO cell)	Preclinical study	Clinical application	IND
5	Inactivated Japanese Encephalitis Vaccine	Preclinical study	Preclinical study	IND
6	Therapeutic BCG Vaccine	Preclinical study	Preclinical study	IND
7	Inactivated Varicella-zoster Virus Vaccine	Preclinical study	Preclinical study	Preclinical study
8	Respiratory Syncytial Virus (RSV) Vaccine	Preclinical study	Preclinical study	Preclinical study
9	Recombinant Group B Meningococcal Vaccine	Preclinical study	Clinical application	IND
10	Recombinant MERS Virus Vaccine	Preclinical study	Preclinical study	Preclinical study
11	DPT-based Combination Vaccine	Preclinical study	Preclinical study	IND
12	Pentavalent Meningococcal Conjugate Vaccine	Preclinical study	Preclinical study	IND
13	Multivalent Pneumococcal Conjugate	Preclinical study	Preclinical study	IND

	Vaccine			

Note: The above disclosed projects under development do not include other COVID-19 vaccine candidates under development except for Zifivax.

(II) Deeply digging in the market and creating value

In 2021, the Company's professional sales team introduced our R&D achievements into the market, which created social benefits while safeguarding shareholders' interests and enhancing corporate profits. The Company expanded sales team to 2816 professionals with a 48% year-on-year increase to better serve both Company and market need. Under the new epidemic prevention and control situation with normalized dynamic zero-COVID policy, the Company innovated and conducted academic meetings in various forms. Meanwhile, through training and meetings, the Company continuously strengthened the promotion skills and service awareness of sales team, improved the quality of academic meeting promotion, and laid a foundation for market channel development, market operation and service enhancement. In addition, the Company has made efforts to meet the people's health needs and contribute in preventing infectious diseases, thus serving the public and creating social benefits.

The Company's vaccine products are marketed and sold in strict compliance with the requirements of the relevant national laws and regulations after the batch release approval.

1. Proprietary product

Manufacturer	Product Name	Annual Batch Release Quantity in 2021 (Dose)	Annual Batch Release Quantity in 2020 (Dose)	Growth Rate (%)
Zhifei Lvzhu	$ACYW_{135}$ polysaccharide vaccine	6,952,244	6,062,370	14.68
	AC conjugate vaccine	3,867,093	4,404,060	-12.19
	Hib vaccine	3,104,995	3,697,744	-16.03
	AC polysaccharide vaccine	223,098	0	100.00

2. Agent product

Manufacturer	Product Name	Annual Batch Release Quantity in 2021	Annual Batch Release Quantity in 2020	Growth Rate (%)

		(Dose)	(Dose)	
MSD	Quadrivalent HPV vaccine	8,802,500	7,219,462	21.93
	9-valent HPV vaccine	10,206,168	5,066,376	101.45
	Pentavalent rotavirus vaccine	7,308,624	3,993,333	83.02
	23-valent pneumonia vaccine	1,475,653	478,488	208.40
	Inactivated hepatitis A vaccine	807,151	482,040	67.44

(III) Operating in compliance with regulations and putting quality first

The Company always adheres to "keeping compliance in mind and putting responsibility into action" principle and commits to developing a first-class quality system that is scientific, compliant and can be improved continuously. The Company conducted production and operation activities following "prioritizing social benefits over corporate profits" and in strict accordance with the laws and regulations including the Vaccine Administration Law, the Regulations on the Release and Approval of Biological Products, and the Biosafety Law. In 2021, given the new requirements for corporate development under new situation, the Company continuously improved its compliance policy, strengthened personnel training, monitored project risks, and developed a compliance control system integrating prevention, monitoring and punishment. Meanwhile, in active response to the latest national and industry compliance policies, the Company continuously enhanced compliance monitoring efforts, and continued to improve its risk control capabilities.

Advancing toward the mission of "safeguarding life and delivering healthy outcomes", the Company has continuously strengthened the awareness of legal and compliant operations based on its business objectives and plans. The Company strengthens quality control over the product life cycle to deliver quality products and provide professional service to the clients. All these commitments helped the Company to win recognition and trust from consumers.

(IV) Promoting international cooperation and sharing development opportunities

The Company actively develops global partnerships and deeply promotes international cooperation to implement international development and product export strategies. In 2021, the

international multi-region phase III clinical trial of Zifivax was successfully progressed in Uzbekistan, Indonesia, Pakistan and Ecuador, and Zifivax was formally approved for conditional marketing in China in March 2022. In order to enhance the accessibility and affordability of its COVID-19 Vaccine, the Company committed to the WHO EUL qualification to help achieve fair distribution of vaccines and facilitate the construction of a global immunological barrier. Moreover, positive progress was made in the international drug registration and commercial cooperation for Zifivax and other self-developed products.

To meet the national demand for disease prevention, the Company has continued to develop more excellent products with its partners through technological innovation. With introduction of innovative products, the Company expects to enhance vaccine recognition and vaccination rates through market promotion. The Company continues to bring excellent products in and out, so that we can truly benefit more people and protect more families in China and overseas.

IV. Analysis of Principal Business

（I）Composition of operating income

1. Overview of operating income

Unit: RMB

	2021		2020		Year-on-year increase or decrease
	Amount	As a percentage of operating income	Amount	As a percentage of operating income	
Total operating income	30,652,415,906.61	100%	15,190,366,231.21	100%	101.79%
By industry					
Biological products	30,628,958,674.52	99.92%	15,156,138,395.65	99.77%	102.09%
Others	23,457,232.09	0.08%	34,227,835.56	0.23%	-31.47%
By category					
Proprietary products	9,697,480,143.81	31.64%	1,200,756,840.83	7.91%	707.61%
Agent products	20,931,478,530.71	68.28%	13,955,381,554.82	91.86%	49.99%
Others	23,457,232.09	0.08%	34,227,835.56	0.23%	-31.47%
By region					
Northeast China	890,420,461.18	2.90%	590,599,863.25	3.89%	50.77%
North China	4,695,279,774.24	15.32%	2,100,498,897.80	13.83%	123.53%

Northwest China	1,106,754,079.81	3.61%	633,716,024.00	4.16%	74.65%
Central China	4,773,032,920.95	15.57%	2,397,183,366.85	15.78%	99.11%
East China	9,545,517,145.04	31.15%	5,191,826,815.43	34.18%	83.86%
Southwest China	4,118,610,388.48	13.44%	1,828,589,300.26	12.04%	125.23%
South China	4,359,780,775.46	14.22%	2,436,024,991.83	16.04%	78.97%
Export	1,163,020,361.45	3.79%	11,926,971.79	0.08%	9,651.18%

2. Industries, products, regions, and sales models that account for more than 10% of the Company's operating income or profit

Unit: RMB

	Operating income	Operating cost	Gross margin	Year-on-year increase or decrease in operating income	Year-on-year increase or decrease in operating cost	Year-on-year increase or decrease in gross margin
By industry						
Biological products	30,628,958,674.52	15,615,365,198.06	49.02%	102.09%	68.66%	25.98%
By category						
Proprietary products	9,697,480,143.81	958,260,081.36	90.12%	707.61%	490.51%	4.20%
Agent products	20,931,478,530.71	14,657,105,116.70	29.98%	49.99%	61.14%	-13.90%
By region						
Northeast China	890,403,516.18	512,240,713.15	42.47%	50.76%	36.81%	16.04%
North China	4,693,738,589.06	2,210,219,049.58	52.91%	123.61%	75.55%	32.21%
Northwest China	1,106,754,079.81	641,295,240.16	42.06%	74.65%	60.79%	13.49%
Central China	4,773,032,920.95	2,116,876,157.72	55.65%	99.11%	53.63%	30.88%
East China	9,545,461,311.01	5,364,618,430.30	43.80%	83.86%	63.78%	18.67%
Southwest China	4,118,451,915.71	1,966,388,454.53	52.25%	125.24%	75.20%	35.29%
South China	4,338,095,980.35	2,679,888,721.98	38.22%	80.49%	85.45%	-4.14%
Export	1,163,020,361.45	123,838,430.64	89.35%	9,651.18%	2,235.56%	60.88%

3. The Company's income from physical sales

By industry	Item	Unit	2021	2020	Year-on-year increase or decrease
Biological products	Sales volume	Dose	284,180,087	29,450,087	864.95%
	Production volume	Dose	289,950,244	16,134,555	1,697.08%
	Inventory	Dose	53,573,357	16,628,417	222.18%

4. Composition of operating costs

Unit: RMB

By category	Item	2021	2020	Year-on-year

		Amount	As a percentage of operating costs	Amount	As a percentage of operating costs	increase or decrease
Proprietary biological products	Where, direct materials	166,300,296.49	1.06%	60,306,765.11	0.65%	175.76%
	Direct labor	105,430,010.65	0.67%	23,439,167.33	0.25%	349.80%
	Manufacturing expenses	641,537,075.04	4.11%	41,064,730.97	0.44%	1,462.26%
	Shipping costs	44,992,699.18	0.29%	37,465,102.46	0.41%	20.09%
	Subtotal	958,260,081.36	6.13%	162,275,765.87	1.75%	490.51%
Agent biological products	Where, procurement costs	14,575,294,222.20	93.31%	9,009,247,248.12	97.21%	61.78%
	Shipping costs	81,810,894.50	0.52%	86,792,780.34	0.94%	-5.74%
	Subtotal	14,657,105,116.70	93.83%	9,096,040,028.46	98.15%	61.14%
Others	Others	6,435,835.02	0.04%	9,693,479.94	0.10%	-33.61%
Total		15,621,801,033.08	100.00%	9,268,009,274.27	100.00%	68.56%

（II）Expenses

Unit: RMB

	2021	2020	Year-on-year increase or decrease	Description of significant changes
Selling expenses	1,834,807,366.30	1,197,507,001.78	53.22%	Mainly as a result of strengthening the sales team and increasing market promotion efforts in 2021
Overhead expenses	300,195,513.05	212,259,192.32	41.43%	Mainly due to the increase in employee compensation, depreciation and amortization, and other costs in 2021
Financial expenses	21,821,270.29	131,384,401.77	-83.39%	Mainly due to the increase in interest income and the decrease in interest expenses in 2021
R&D expenses	552,625,543.34	299,650,350.21	84.42%	Mainly due to the increase in investment in R&D projects in 2021

（III）Investments in R&D

1. The Company's R&D personnel

	2021	2020	Change ratio
Number of R&D personnel (person)	566	414	36.71%
Number of R&D personnel as a percentage of total staff	11.79%	12.25%	-0.46%
Educational background of R&D personnel			
PhD	6	4	50.00%
Master	332	226	46.90%

Bachelor and below	228	184	23.91%
Age composition of R&D personnel			
Under 30 years old	336	221	52.04%
Between 30 and 40 years old	199	169	17.75%
Over 40 years old	31	24	29.17%

2. The Company's amount of R&D investment and the percentage of R&D investment over operating income in the past three years

	2021	2020	2019
Amount of R&D investment (RMB)	813,971,655.07	480,550,074.99	258,903,384.50
Percentage of R&D investment over operating income	2.66%	3.16%	2.45%
Amount of capitalization of R&D expenditures (RMB)	261,346,111.73	180,899,724.78	89,352,106.10
Percentage of capitalization of R&D expenditures over R&D investment	32.11%	37.64%	34.51%
Percentage of capitalization of R&D expenditures over net profit for 2021	2.56%	5.48%	3.78%

（IV）Cash flow

Item	2021	2020	Year-on-year increase or decrease	Description of significant changes
Subtotal cash inflow from operating activities	25,468,301,329.83	13,533,881,835.94	88.18%	Mainly due to the increase in sales and payments received from sales in 2021
Subtotal cash outflow from operating activities	16,960,709,512.48	10,037,192,895.82	68.98%	Mainly due to the increase in payments for procurement of agent products in 2021
Net cash flows from operating activities	8,507,591,817.35	3,496,688,940.12	143.30%	Mainly due to the increase in sales volume in 2021
Subtotal cash inflow from investing activities	501,793,935.27	101,092.99	496268.68%	Mainly due to new cash management business in 2021
Subtotal cash outflow from investing activities	2,521,130,952.23	896,982,638.25	181.07%	Mainly due to the increase in payments for equipment and construction in 2021
Net cash flows from investing activities	-2,019,337,016.96	-896,881,545.26	-125.15%	Mainly due to the increase in payments for equipment and construction in 2021
Subtotal cash inflow from financing activities	2,682,429,814.10	7,389,312,874.73	-63.70%	Mainly due to the decrease in short-term loans received in 2021
Subtotal cash outflow from financing activities	6,272,341,051.80	9,502,901,215.29	-34.00%	Mainly due to the decrease in short-term loans repaid in 2021
Net cash flows from financing activities	-3,589,911,237.70	-2,113,588,340.56	-69.85%	Mainly due to the decrease in short-term loans received in 2021
Net increase in cash and cash	2,888,682,246.32	481,292,626.45	500.19%	Mainly due to the increase in payments

equivalents				received from sales in 2021

（V）Analysis of assets and liabilities

	End of 2021		Early 2021		Percentage increase/ decrease	Description of significant changes
	Amount	As a percentage of total assets	Amount	As a percentage of total assets		
Monetary funds	4,307,751,548.35	14.34%	1,437,457,839.96	9.44%	4.90%	Mainly due to the increase in payments received from sales in 2021
Accounts receivable	12,867,543,957.77	42.82%	6,624,170,327.47	43.52%	-0.70%	
Inventory	7,385,396,274.99	24.58%	3,405,589,379.38	22.38%	2.20%	
Investment properties	10,934,636.91	0.04%	11,720,960.89	0.08%	-0.04%	
Fixed assets	1,718,614,087.38	5.72%	1,480,235,222.89	9.73%	-4.01%	Mainly due to the increase in total assets in 2021
Construction in progress	1,824,933,243.40	6.07%	906,486,675.55	5.96%	0.11%	
Right-of-use assets	13,649,613.93	0.05%	4,701,866.00	0.03%	0.02%	
Short-term borrowings	568,858,956.43	1.89%	2,873,987,838.27	18.88%	-16.99%	Mainly due to the decrease in short-term bank credit loans in 2021
Long-term borrowings	236,412,360.31	0.79%		0.00%	0.79%	
Lease liabilities	12,240,480.90	0.04%	4,701,866.00	0.03%	0.01%	

（VI）Analysis of major companies in which the Company holds shares or controlling shares

Company name	Company type	Principal business	Registered capital	Total assets	Net assets	Operating income	Operating profit	Net profit
Anhui Zhifei Longcom Biopharmaceutical Co., Ltd.	Subsidiary	Biological products	765,000,000	4,541,876,415.03	2,168,130,691.94	8,418,684,466.12	6,523,261,165.62	5,580,370,213.28

V. Analysis of Core Competitiveness

(I) Excellent R&D strength

The Company has always focused on developing and improving its R&D and innovation capabilities. Over the past two decades, through continuous capital investment, the Company has built a professional and efficient research team and constructed a hierarchical, systematic and forward-looking matrix layout. With diversified and innovative development platform as well as deep understanding of industry development, the Company achieves high-quality development.

1. Strengthening the foundation of innovation through continuous investment in R&D

R&D, innovation and technological breakthroughs are the core drivers of the Company's development. Since its establishment, the Company has driven its development with R&D and innovation, continuously broadened its presence in emerging technologies through diversified approaches to strengthen its independent R&D capabilities. Furthermore, the Company has accelerated technical cooperation, and attached importance to technology introduction to continuously improve endogenous and exogenous innovation capabilities, and promote the transformation of technological innovation into greater benefits. By the end of 2021, the Company was with 566 R&D personnel, and had invested RMB 814 million in R&D for the whole year, providing a more sufficient talent pool and financial guarantee for its independent R&D and innovation.

At present, the Company has built several vaccine R&D platforms covering a wide range of vaccine development pathways, including the polysaccharide and polysaccharide conjugate vaccine technology platform, component technology platform, inactivated vaccine technology platform, genetic recombination technology platform, mRNA vaccine technology platform, adenovirus vector vaccine technology platform, human diploid cell line technology platform, novel multiplex polyvalent technology platform, and novel adjuvant technology platform. A gradually expanding network of R&D platforms strongly promotes the synergistic development of the R&D matrix, and effectively motivates the progress of each R&D project.

2. Facilitating matrix development with three major R&D bases

The Company has built three major R&D and manufacture bases, namely Zhifei Lvzhu, Zhifei Longcom, and Zhirui Biopharmaceutical Industrial Park, to speed up the R&D and registration of

high-quality self-developed products and promote the long-term sustainable development of the Company. With the support of Zhifei Lvzhu and Zhifei Longcom, the Company has steadily promoted R&D pipeline to keep well-positioned in the industry competition. By leveraging the resources of the Zhirui Biopharmaceutical Industrial Park, the Company has continuously deepened its presence in the comprehensive biological field, incubated and developed preventive and therapeutic biotechnologies and products, and promoted the continuous improvement of its R&D capabilities.

Currently, there are 29 projects in development, including 16 in clinical trial stage or applications for registration. A well-structured and sufficient pool of projects has formed a product matrix with synergistic effects, further boosting the Company's competitiveness in the industry.

Matrix	Projects under research
Tuberculosis product matrix	Lyophilized Recombinant Tuberculosis Vaccine (AEC/BC02), BCG Vaccine for Intradermal Injection, and BCG-PPD.
Rabies vaccine matrix	Lyophilized Rabies Vaccine for Human Use (MRC-5 Cell), and Lyophilized Rabies Vaccine for Human Use (Vero Cell).
Respiratory virus vaccine matrix	Four-valent Influenza Virus-split Vaccine, Influenza Virus-split Vaccine, and Respiratory Syncytial Virus (RSV) Vaccine.
Pneumococcal vaccine matrix	15-Valent Pneumococcal Conjugate Vaccine, Pneumovax 23 - Pneumococcal Vaccine, and Multivalent Pneumococcal Conjugate Vaccine.
Enteric disease vaccine matrix	S. flexneri and S. sonnei Bivalent Shigella Conjugate Vaccine, Intestinal Virus Type 71 Inactivated Vaccine, Quadrivalent Recombinant Norovirus Vaccine (Pichia Pastoris), Bivalent HFMD Vaccine, Inactivated Rotavirus Vaccine, and Bivalent Recombinant Rotavirus Vaccine (Pichia Pastoris).
Meningococcal vaccine matrix	$ACYW_{135}$ Meningococcal Conjugate Vaccine, Recombinant Meningococcal Group B Vaccine, and Pentavalent Meningococcal Conjugate Vaccine
Note: The above matrices do not cover all of the Company's projects under research. Further information on the R&D progress, please refer to the relevant section of this report.	

Since its listing in 2010, the Company has realized a revenue of more than RMB 16.8 billion from proprietary products on a cumulative basis, paving the way for investment in R&D. Advancement in R&D further increased our competitiveness and promoted the following commercialization.

(II) Mature and standardized marketing

The Company has built a development model featuring "technology + market", under which the good complementarity between R&D advancements and commercial achievements results in a circular mechanism of mutual promotion and transformation. Moreover, the Company has accelerated the process of product development and registration to provide more products to meet the national needs of disease prevention. The Company is on its way toward “the dreams of health, biology, Zhifei and China”.

1. Constantly building an industry-leading marketing network

The company attaches importance to the development of marketing strategies and the construction of marketing teams. While consolidating the foundation of marketing team operation and management, the Company continues to optimize market paths, refine market services and enhance resource integration. An all-round and integrated business model strengthens risk control capabilities while boosting cost efficiency. The Company pays attention to the demonstration, formulation, implementation and feedback for the sales promotion strategy. The Company constantly improves its team management model and flexibly adjusts its sales strategy to respond to market changes to maintain a strong position.

2. Wide-ranging marketing network

In 2021, the Company set up a professional marketing team of nearly 3,000 members, and established a marketing network covering more than 30,000 points of vaccination (POV) in more than 300 cities and more than 2,600 districts and counties across 31 provinces, autonomous regions and municipalities directly under the central government. The marketing team continues to provide professional, meticulous and comprehensive services to our clients, which helps us to achieve our business objectives.

(III) Professional and efficient business management

Over the past two decades, by adhering to the business principle of "prioritizing social benefits over corporate profits", the Company has put quality, standards, disciplines and integrity in the first place, and practiced the idea of "keeping compliance in mind and putting responsibility into action" in all aspects of R&D, production, promotion, sales and distribution.

1. Strict production quality control system

With the capabilities of large-scale production, standardized quality control, specialized commercial development, and domestic first-class industrialization, the Company has established a strict quality management system, and has actively improved its production and quality control capabilities according to international standards. In actual production, we strictly control every step of raw material procurement, manufacture, inspection, release and sales to ensure the safety, effectiveness and traceability of our products. We have developed a strict quality and safety mechanism, a risk control mechanism and an adverse reaction monitoring system.

The Company's subsidiaries, Zhifei Lvzhu and Zhifei Longcom, are two major manufacture and R&D bases equipped with modern equipment for production as well as professional and dedicated production teams. Meanwhile, the Company has established long-term and stable cooperation with a number of outstanding domestic and international suppliers. Since 2008, when the first batch of its products were released and approved, the Company has maintained a 100% release and approval rate for its proprietary products.

2. Professional and experienced management team

We believe talents are critical for the development of a company. Our core management personnel have extensive management and industry experience as well as in-depth insights into disease prevention and control. The stable, professional, and efficient management team supports the Company's operation and management activities. Following the blueprint set by the management team, the Company actively responds to market changes, continuously strengthens its innovation capabilities and core competitiveness.

Focusing on the Zhifei's mission and culture, the Company attracts, unites and retains people with shared aspiration and ambition for innovation and biology. The Company implements a diversified incentive mechanism, a sound benefit sharing mechanism and a stable talent development strategy, which further provides talent support for its long-term sustainable development.

VI. Prospects for the future development of the company

I. Industry status quo and trends

The year 2021 marked a good start for *China's 14th Five-Year Plan*. Our country built a moderately prosperous society in an all-round way as scheduled, and achieved the first centenary goal. China embarked on a new journey to build a modern socialist country while marching towards the second centenary goal. The *14th Five-year plan for national economic and social development of the PRC, and the outline of vision for 2035,* both released in 2021, clearly strengthened the significant position of the biomedical industry in the country's strategic development. As a segment of the biopharmaceutical industry, the vaccine industry plays a key role in the control of infectious diseases. Vaccine remains the most effective, simple and economical means to prevent the occurrence of diseases. It is the mission of the whole industry to improve vaccine recognition and vaccination rates, prevent and control infectious diseases, and safeguard national health.

According to the EvaluatePharma World Preview 2021, the international COVID-19 pandemic has a profound impact on the development of the world's biopharmaceutical industry. The vaccine industry has received extensive attention and has become the focus of the biopharmaceutical sector. The industry will continue to develop at a compound annual growth rate (CAGR) of 12%. R&D technology upgrades every day, and innovative vaccines are continuously launched, which greatly contributes to the further expansion of the global vaccine market and brought more vitality and changes to the global biopharmaceutical industry.

In China, domestic pharmaceutical companies have continued to increase their investment in vaccine R&D to improve vaccine accessibility. The sustained high growth in the size of the vaccine market indicates the rise of the biopharmaceutical industry. According to a report of Frost & Sullivan, the value of China's vaccine market grew from RMB 27.1 billion in 2016 to RMB 75.3 billion in 2020, and is expected to reach RMB 333.3 billion in 2030, with a CAGR of 16.0% from 2020 to 2030. China's huge population base provides great opportunities for the development of the industry. With the strong support for vaccine R&D from governments and related institutions at all levels and the public's increasing demand for vaccination, the size of China's vaccine market is gradually growing at a rate higher than the average growth rate of the global vaccine market. At the same time, the

public's knowledge and awareness of vaccination have been increased by the joint efforts of all stakeholders. In particular, COVID-19 vaccine has become a well-known product to fight against the pandemic. By the end of 2021, 2.83 billion doses of COVID-19 vaccine had been vaccinated nationwide, and the full vaccination coverage rate was over 85%. The unprecedented annual global consumption of this single product has played a vital and central role in building a global immunological barrier.

II. The Company's development strategy and planning

The biopharmaceutical industry is in a stage of rapid development. The Company proactively seizes the opportunity to implement the new development concepts. The Company has proactively expanded its presence in the comprehensive biological field, and promoted its development through breakthrough and technology. The Company is committed to becoming a first-class internationally competitive enterprise with excellent products and brands, with innovation, integrity and quality.

1. Accelerating R&D and establishing a presence in cutting-edge technologies

Scientific and technological innovation and technological breakthroughs are important forces for the development of biopharmaceutical enterprises. The Company invests internally and externally to promote and expand pipeline advancement. The pipeline in development has gradually entered the harvest period. The Company continues recruiting people with shared ideas and ambition to improve its technology. Furthermore, the Company is working and collaborating with domestic and global partners to increase comprehensive innovation capabilities. Meanwhile, through investing in Zhirui Biopharmaceutical Industrial Park, the Company has strengthened its competitiveness in the industry. Zhirui makes investments in cutting-edge technologies including CAR-T, macromolecular drug and other promising innovative medicine to conduct our long-term development approach.

In 2022, the Company will, as always, emphasize innovation, advance the progress of the pipeline projects, and actively promote the advancement of more preclinical research projects into clinical trials and more ongoing clinical trial projects into the drug registration stage. The Company will maintain its position by rich innovative R&D technology platforms, and incubate high-quality projects to address the unmet needs of disease prevention and control. In the meantime, the Company

will continue to optimize the matrix projects under research to achieve the synergistic development of diagnosis, prevention and treatment.

2. Strengthening quality control to ensure product quality

The vaccine industry stands in the spotlight of the public, because the quality of vaccines is closely related to the health of the people. It is the top priority of the Company to control the production and quality of vaccines with the strictest standards. We always adhere to the concept of "quality first" and strictly follow the requirements of relevant laws and regulations to conduct quality management throughout each step of our work. Moreover, the Company has properly established R&D and production bases, conducted equipment procurement and replacement activities, and continuously improved the professional and technical skills of the production team to ensure the stability of the production process and production quality and safety, and safeguard the smooth progress of the product industrialization process.

In 2022, the Company will focus on product manufacturing and quality control according to market demand and ensure the supply of COVID-19 vaccine and other products. We are actively taking our responsibilities as a biopharmaceutical to increase the accessibility and affordability of health. The Company will continue to introduce advanced domestic and international production standards and complete the construction of R&D and manufacture bases to promote products registration and internalization strategy.

3. Refining service and optimizing market operation

The Company continues to enhance market operation management and related promotion services, flexibly adjusts regional market promotion strategies according to market demand, optimizes resource allocation, and combines industry policy interpretation with local market characteristics. We boost the energy of the professional marketing team and improve its competitiveness by continuously absorbing outstanding talents and cultivating existing talents, strengthening performance management and skills training.

In 2022, the Company will continue to build marketing team, improve the assessment mechanism, and vigorously reinforce market access. The Company strives to extensively explore,

develop and establish new approaches while continuously developing the existing market approaches in order to reach and help more families and individuals. Zhifei tries to increase the public's recognition and acceptance of vaccines, expand the influence of products to deliver more health, and promote products' commercialization process.

4. Improving compliance and promoting modern governance

Compliance is the foundation of the Company's various activities and an inherent requirement for achieving high-quality development. The Company strengthens internal control and compliance management, reinforces risk awareness and the concept of responsible operation, enhances internal training, and improves the quality and professionalism of team members. The Company motivates employees through a diversified incentive mechanism, improves governance by drawing on the advanced experience of outstanding domestic and international enterprises, and gains insight into industry development, thus empowering new high-quality development strategies.

In 2022, the Company will continue to strengthen compliance in accordance with the requirements of laws and regulations, industry guidelines and regulatory systems to ensure that its production, R&D, sales and promotion activities are carried out in an orderly and compliant manner. The Company's management will continue to pay attention to market changes, strengthen management and governance capabilities, and actively implement the Employee Stock Ownership Plan for Common Wealth (2022) while pursuing social responsibility, emphasizing the progress of key ESG issues, and promoting the long-term sustainable development.

5. Exploring global opportunities with roots in China

Practicing international development strategy is a driving force for the Company to achieve a greater efficiency, stronger competitiveness and greater influence. China's economic strength and manufacturing capacity continue to grow and the development of the biopharmaceutical industry continues to improve. Chinese companies should have the determination and confidence to develop into world-class enterprises and endeavor to grow to become stronger, better and larger in the highly competitive international and domestic markets. With a global vision, the Company continues to

enhance its innovation ability and expand its brand influence and product competitiveness based on the demand of our people.

In 2022, the Company will implement the international development strategy, continue to promote the export of high-quality products, actively explore international cooperation on R&D, production, and commercialization as well as advance the WHO qualification and international registration activities. We make continuous commitment to enable Zhifei and China to play a bigger role in taking the responsibilities of global health. The Company will accelerate its brand building, improve the domestic and international influence and reputation, and promote its core corporate culture of "prioritizing social benefits over corporate profits" and "safeguarding life and delivering healthy outcomes" to become a more reliable company for consumers.

VII. Risks and Countermeasures

(I) Policy risk

The pharmaceutical industry is one of the key prioritized industries in China and is highly regulated. Relevant policies and regulations have been delivered and implemented in recent years. Zhifei strictly implemented various systems in accordance with the Vaccine Administration Law and gradually improved its management, with the aim of enhancing its operation efficiency. However, with the rapid development of the economic society and increasingly stringent regulations, the subsequent policies may bring different changes in and have an impact on the production, sales and circulation of the Company. The Company will pay close attention to the changes in policies and make timely adjustments to its business strategies to comply with the applicable regulations and regulatory requirements. Zhifei has adhered to standardized operation. And our management team has profound professional knowledge and forward-looking thinking, which can help us to handle and respond to crises effectively when industry events occur and industrial policies are adjusted.

(II) Nonperforming debts

With the expansion of the Company’s sales scale and business, especially after the implementation of the “one invoice system” reform on the sales of non-EPI vaccines, the Company’s vaccine products are directly supplied to district and county-level disease control centers after bidding

and procurement, contributing to a gradual increase in the Company's accounts receivable. As the implementation of industry policies has entered the normal stage, the Company strengthens the risk control before vaccine sales, follows up the performance of contracts during the process and enhances the effectiveness of communication after the event to minimize risks of nonperforming debts.

(III) Talent management risk

By the end of 2021, the number of the sales staff reached 2,817. The large sales team is conducive to the implementation of the Company's business plans, sales of products and the improvement of corporate economic benefits. However, with the expansion of the Company's sales scale and staffing optimization, the increasing number of staff poses certain risks to the management of the Company. The Company strongly advocates the talent selection principle of "prioritizing integrity over capability", and integrated corporate culture into employee induction training and daily management to ensure the stability and standardization of the team.

(IV) Risks of AEFI

AEFI (Adverse Events After Immunization) refers to the adverse reactions that have damage to the human's body and functions of the subject during or after the standardized vaccination without fault of relevant parties. With the facilitation of vaccination and the improvement of national awareness of disease prevention, the scope and quantity of vaccination products are also gradually increasing, and there is a possibility of adverse reaction risks. Strictly complying with the requirements of laws and regulations, the Company has established a complete production and circulation chain, created a comprehensive sales and after-sales service system, and built a compliant and efficient emergency response mechanism. Moreover, Zhifei has purchased commercial insurance for all vaccine products on sale, and striven to minimize the risk of adverse reaction by improving the prevention and treatment mechanism.

(V) Risk of vaccine hesitancy

Despite the fact that vaccines are the most cost-effective way to prevent and control infectious diseases, "vaccine hesitancy" still affects vaccine acceptance. Reluctance or refusal to receive vaccines may reverse the progress made in vaccines for preventable diseases and may reduce the

prosperity of the vaccine industry for a period of time, thus affecting the company's performance. For a long time, the Company has consistently and continuously adhered to standardized operation, continued to invest in the academic promotion of vaccine value, actively participated in the popularization of vaccine knowledge and the cultivation of vaccination notification and demand, and promoted the public’s rational awareness of vaccination.