

Mapping the Global Vaccine Manufacturing Workforce: Preliminary Results of a Survey among Influenza Vaccine Manufacturers

Background

The World Health Organization (WHO), the U.S. Department of Health, and Human Services (HHS) and other like-minded organizations and governments are committed to assisting in the creation of regionally-based, independent and sustainable vaccine production capacity in developing countries through capacity building and technology transfer. As a means of initiating a coordinated discussion among the international community regarding this shared goal, WHO and HHS convened the Sustainable Influenza Vaccine Production Capacity Stakeholders' Workshop in Washington D.C. in January 2010. A recurring theme during the workshop discussions was the fact that international support to the strengthening of vaccine production capacity in developing and emerging economy countries must also include relevant and concurrent efforts to train and retain a skilled local workforce.

Building upon the Stakeholders' Workshop, WHO and HHS are developing a Workshop on Enhancing the Global Workforce for Vaccine Manufacturing (WEGWVM) which will take place December 2011. As a preliminary step in the planning process, the WEGWVM organizers initiated the process of gathering information on the workforce situation among influenza vaccine manufacturers. They discovered that even after expanding the search parameters to include all vaccine manufacturers there is a lack of baseline data on this topic. An extensive literature review conducted by a biomedical librarian in March 2011 yielded only two relevant articles in trade magazines. WHO determined that surveying influenza vaccine manufacturers worldwide could be one way of addressing this knowledge gap. Information generated from this survey will be used to provide content and context for the WEGWVM as well as build the knowledge base in this area of focus.

The primary objectives of the survey were to:

1. Map the global influenza vaccine manufacturing workforce
2. Gather information on influenza vaccine manufacturers' approaches to recruitment and retention of a skilled local workforce
3. Determine what type of trainings are available to the workforce, how they are funded, and which occupational groups have access to the trainings

Methodology

WHO developed a web-based survey instrument consisting of multiple choice and short answer questions¹. The questionnaire was divided into six sections:

- general information
- company goals
- employee demographics
- employee training
- workforce recruitment and retention
- international affiliations and vaccine manufacturing networks

¹ Available in appendix 1

The survey questionnaire was developed in English. Due to resource constraints it was not possible to translate it into any other languages. In light of this limitation, the survey was pilot tested by a volunteer company in a country where English is not the primary spoken language, who provided input on issues related to readability and ease of understanding as well as on substantive issues. The survey team made final revisions to the survey based on the company's valuable feedback as well as input from WHO and HHS subject matter experts.

The WHO survey team identified a total of 52 influenza vaccine manufacturers worldwide that met the survey inclusion criteria: produces seasonal and/or pandemic influenza vaccine² and/ or has licensed (or has started the licensing procedure) of such a product in at least one country. WHO ultimately invited 46 companies to complete the survey in April 2011; contact information was unavailable for the remaining 6 companies. Of the 46 companies surveyed, 24 (52%) submitted replies.

The data presented in this report are based entirely on the respondents' replies to the self-administered survey. All data is presented in aggregate form in order to maintain confidentiality.

Respondents' Characteristics

- The 24 respondents are distributed among five of the six WHO Regions (AMR: 2; EMR:1; EUR: 6; SEAR: 7; WRP: 8). At the time the survey was implemented, there was no influenza vaccine manufacturer in the AFR region.
- 67% of the respondents are based in developing countries and 33% are based in high-income countries.³
- 54% of the respondents are public companies, 38% are private entities and 8% are public private partnerships.

Selected Survey Findings

Current state of seasonal and pandemic influenza vaccine production

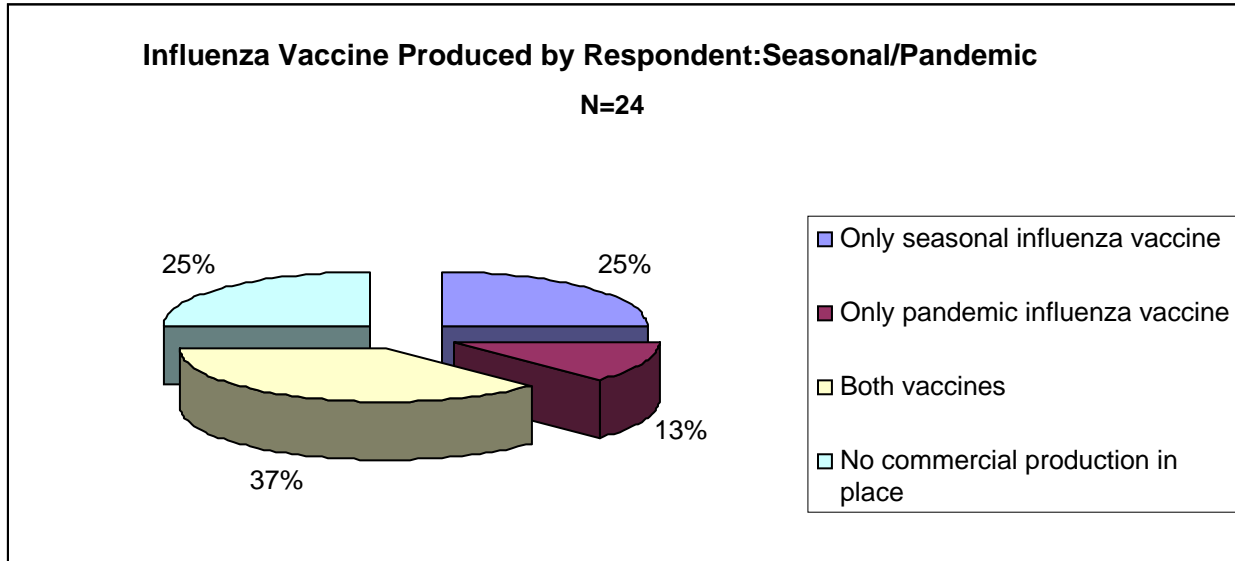
- The total worldwide capacity for production of trivalent seasonal influenza vaccine is estimated to be approximately 876M⁴ doses. 15 of the 24 companies surveyed provided information regarding their seasonal influenza vaccine production. Collectively, these companies produce ~ 241M doses (28%).

² Throughout the document when referring to pandemic influenza production the survey team refers to the 2009-2010 production and their current capacity to resume production if need be. Currently, no vaccine manufacturers are producing pandemic influenza vaccines, so we refer to its potential capacity.

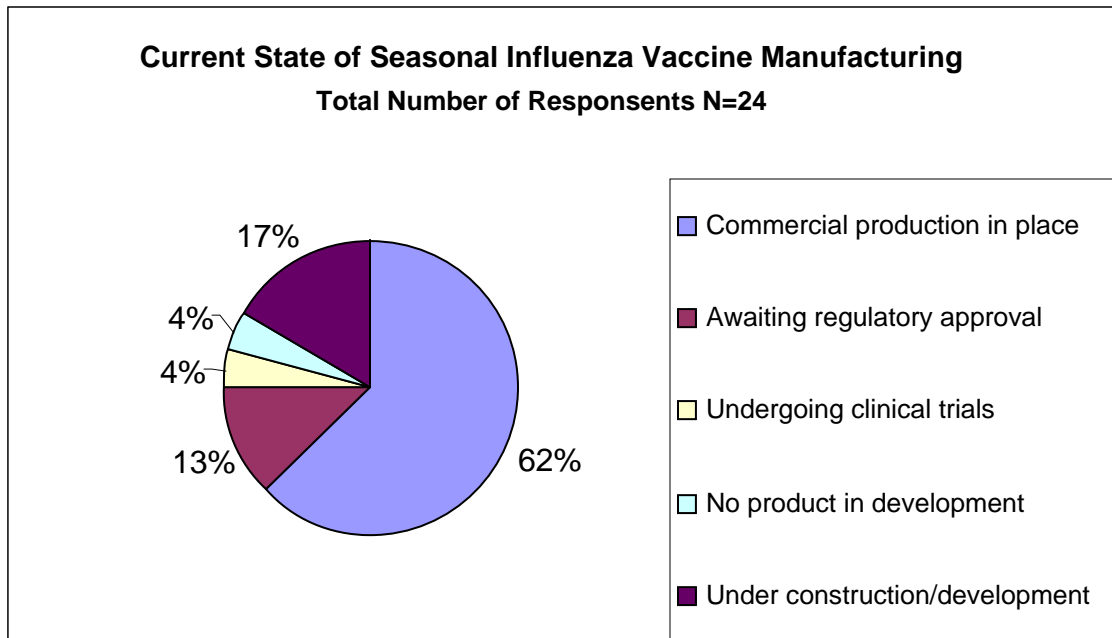
³ Using the classification of the World Bank and OECD 2011 to determine country's income level (web site accessed 6 June 2011)

⁴ *Vaccine production capacity for seasonal and pandemic (H1N1) 2009 influenza*, Nicolas Collin, Xavier de Radiguès and the World Health Organization H1N1 Vaccine Task Force, available on line at: <http://www.sciencedirect.com/science/article/pii/S0264410X09008858>

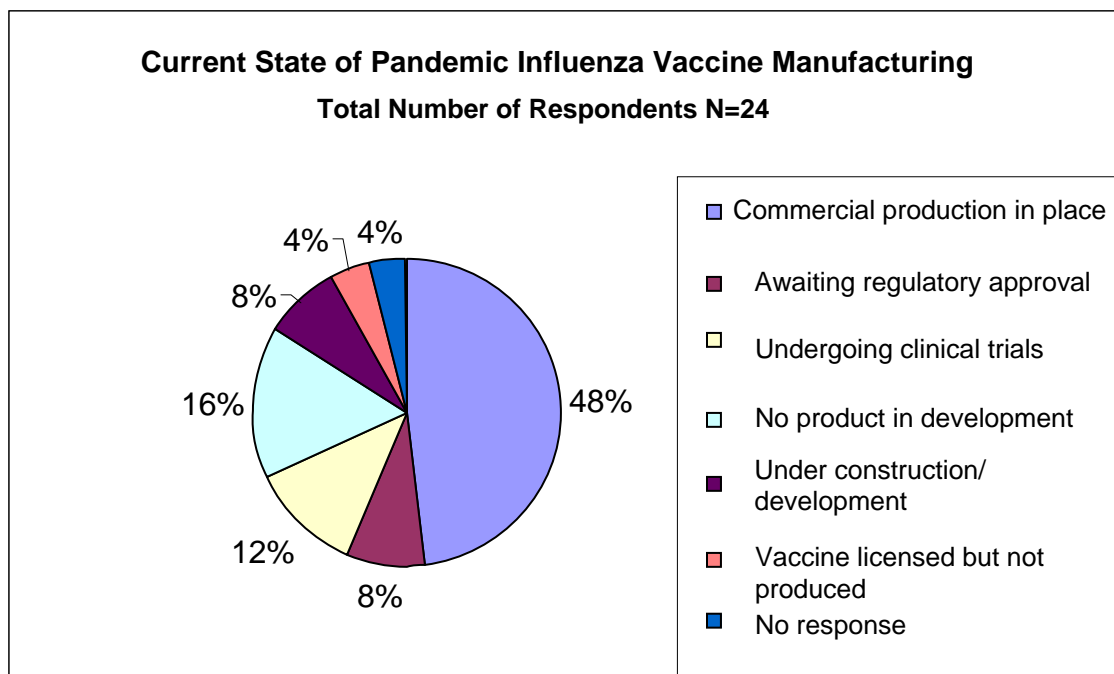
- Among the respondents 37% (9 facilities) currently produce both seasonal and pandemic influenza vaccines⁵, 25% (6 facilities) produce only seasonal influenza vaccine, 13% (3 facilities) produce only pandemic influenza vaccines⁵ and 25% (6 facilities) are not currently producing vaccine.



- The current state of seasonal and pandemic influenza production among the 24 respondents is as follows:



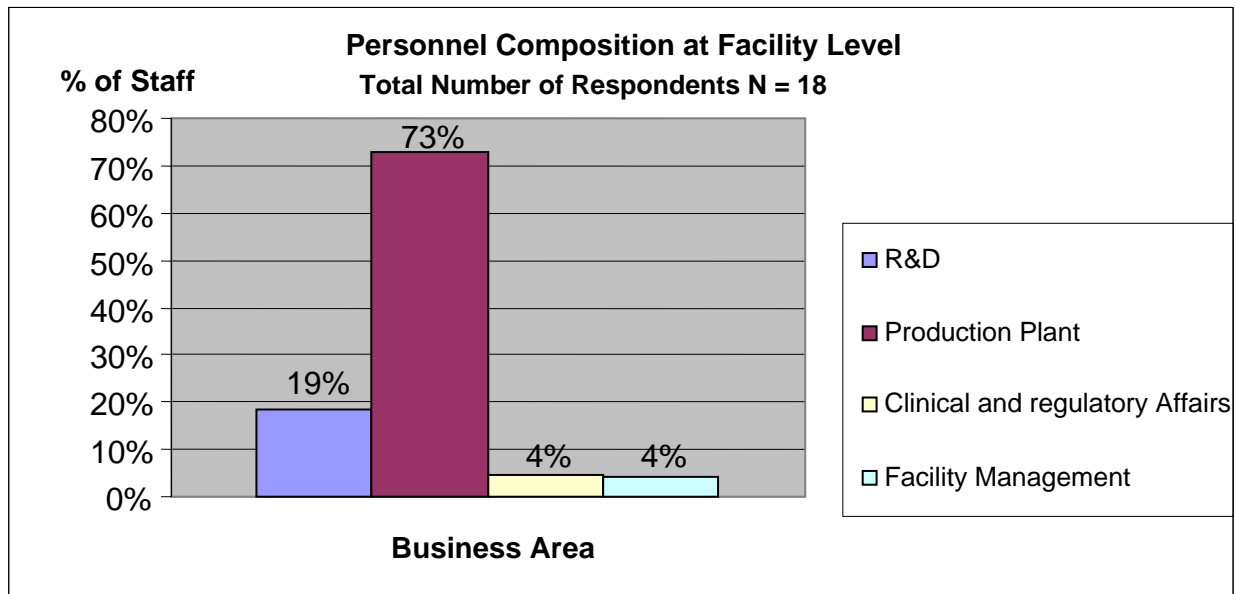
⁵ See footnote 2.



- Primary Technology used in manufacturing seasonal influenza vaccine
 - Inactivated subunit vaccine 17%
 - Inactivated split vaccine 45%
 - No response 38%
- Primary Technology used in manufacturing pandemic influenza vaccine
 - Whole or split inactivated vaccine 34%
 - Adjuvanted split/subunit vaccine 8%
 - Multiple techniques (live attenuated and inactivated, with adjuvant and not) 4%
 - No production of pandemic influenza vaccines 25%
 - No response 29%
- Only 2 of the survey respondents use cell-based techniques to manufacture influenza vaccines

Workforce Composition

- Production plant staff comprise the largest personnel group among influenza vaccine manufacturers.



- Composition of Personnel in the R&D Area: 81% laboratory and 19% management staff..
 - On average management staff held master degrees or PhDs and entry level R&D managers are required 3 to 5 years of professional experience.
 - Laboratory staff had tended to hold bachelor's or master degrees and at least 1 year of experience.
- Composition of Personnel in the Production Plant: 94% technical and 6% management staff.
 - Management staff had on average a bachelor's or master's degree with at least 3 years of professional experience when they are hired by the facility.
 - The technical staff tended to have, on average, high school diploma and a professional experience of 1 to 2 years when they started working in the facility.
- Composition of Personnel in the Regulatory Affairs Area: 62% Administrative Staff⁶ and 38% Management staff.
 - Management staff has on average a master degree and are required to have an entry level professional experience of 3 to 5 years.
 - Administrative staff has a bachelor degree and at the entry level they have at least 1 to 3 years of professional experience.

⁶ Administrative staff in the clinical and regulatory affairs department provide diverse project, administrative and logistical support and is responsible for managing day-to-day departmental activities, including ensuring regulatory documentation is appropriately maintained and tracked, assisting in the preparation of regulatory filings for new and modified products and various other administrative activities.

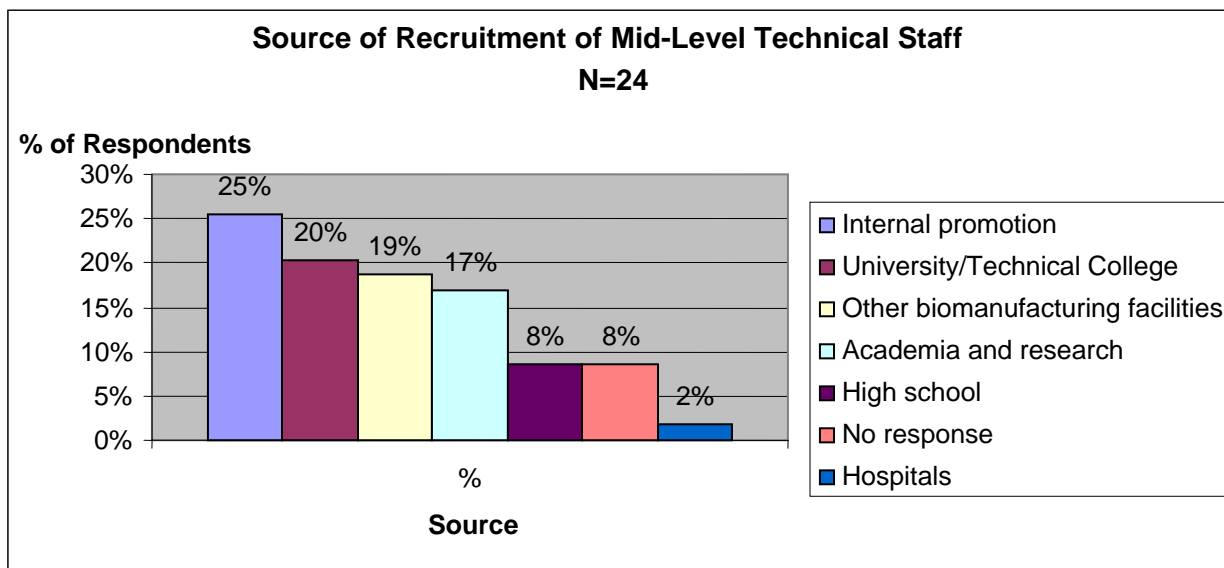
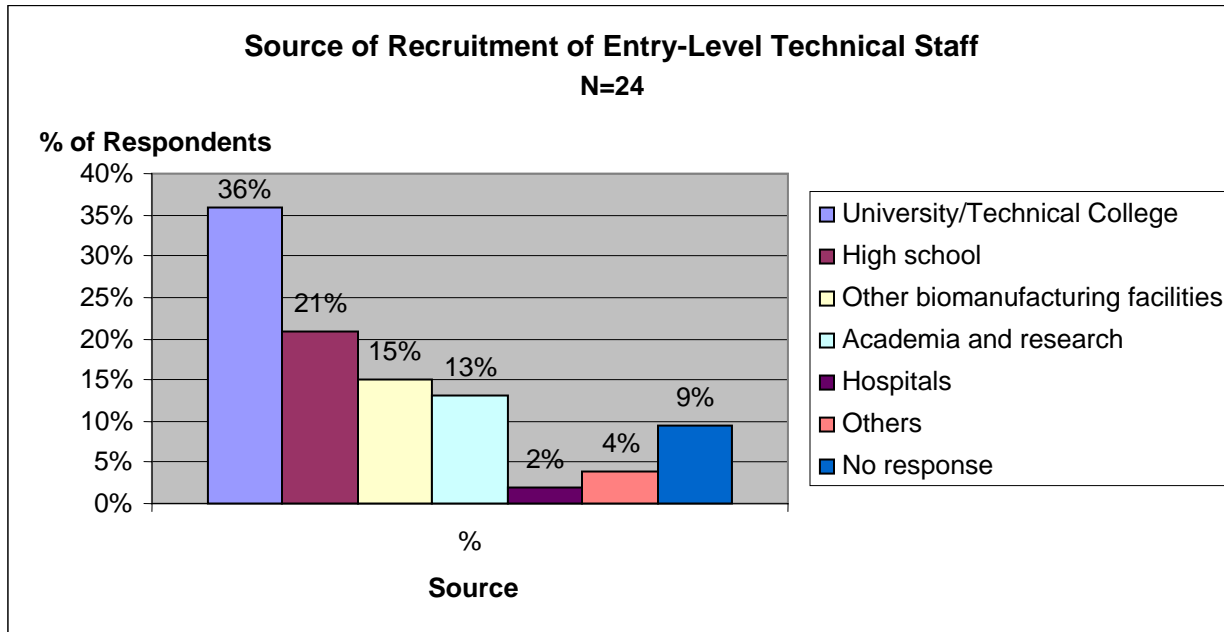
- Personnel in the Facility Management Area: The majority of facility managers have bachelor's degrees and at least 3 years of experience when they are hired.

Workforce Recruitment

- Overall, survey respondents find it relatively easy to hire technical staff for the production plant and administrative staff for the clinical and regulatory affairs area. The majority of respondent reported that hiring of staff for all the other categories represents a challenge. Details in the table below:

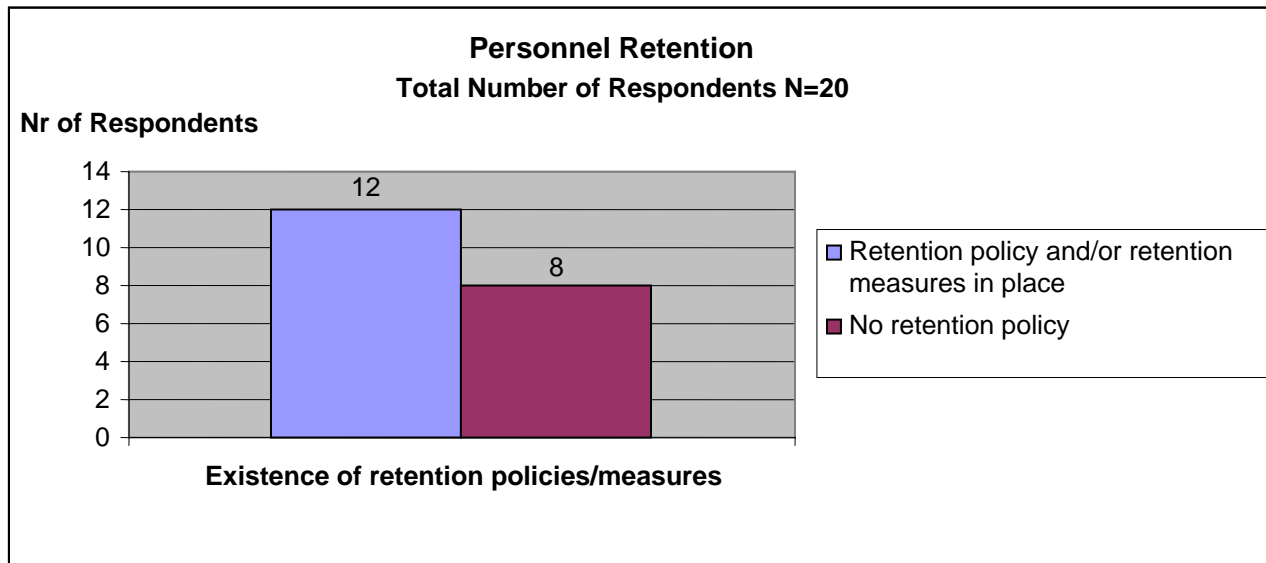
Business Area	Employee Profile	% of Respondents	
		Difficult to hire	Easy to hire
R&D	Manager	93%	8%
	Laboratory Technician	62%	38%
Production Plant	Manager	80%	20%
	Technical Staff	31%	69%
Clinical and Regulatory Affairs	Manager	83%	17%
	Administrative Staff	45%	55%
Facility Management	Manager	83%	17%

- Most respondents rely on the local market to recruit personnel (69%) followed by direct contacts with academia (23%) and in fewer cases, the international market (8%).
- Companies based in countries such as India, China, Japan, Korea and Switzerland indicated an ability to recruit from the international workforce market. Among the companies that declared difficulties in recruiting staff and that didn't have any of their staff recruited from the international market there were 2 based in AMR, 1 in EMR, 3 in EUR, 3 in SEAR and 3 in WRP.
- The majority of entry level technical staff is recruited directly from Universities and technical colleges (36%) and high schools (21%). Mid-level technical staff are recruited through a variety of mechanisms with internal promotion (25%), universities and technical colleges (20%), and recruitment from other biomanufacturing facilities (19%) being the primary ones.
- The most frequently cited challenge to hiring entry level technical staff is the lack of experience and knowledge in production of biologicals of candidates/applicants, and in particular the lack of practice in clean/sterile areas.
- Regarding hiring mid-level technical staff, another frequently cited challenge is the belief that other industries may offer more attractive salaries.



Workforce Retention

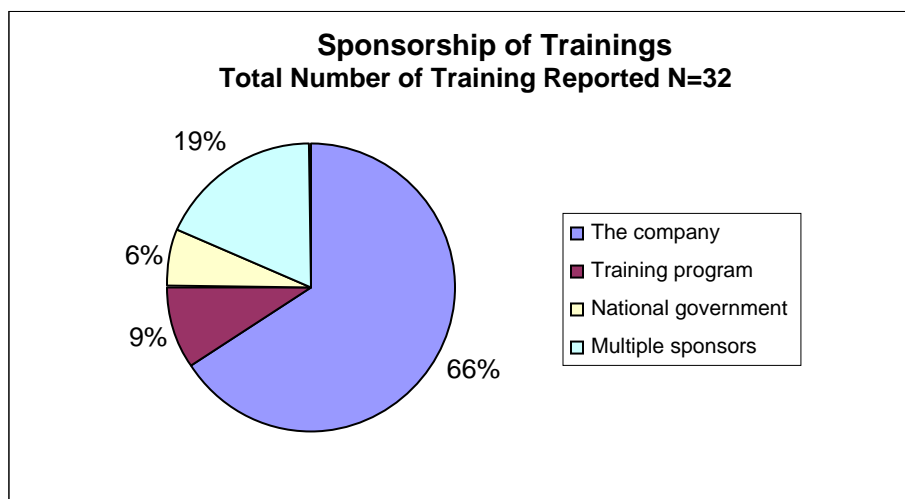
Among the 20 respondents, 4 did not explicitly indicate whether or not they had retention policies. However, these respondents listed a series of activities that the company had developed which fell into the category of retention measures, indicating that 60% of the respondents have strategies to retain their personnel.



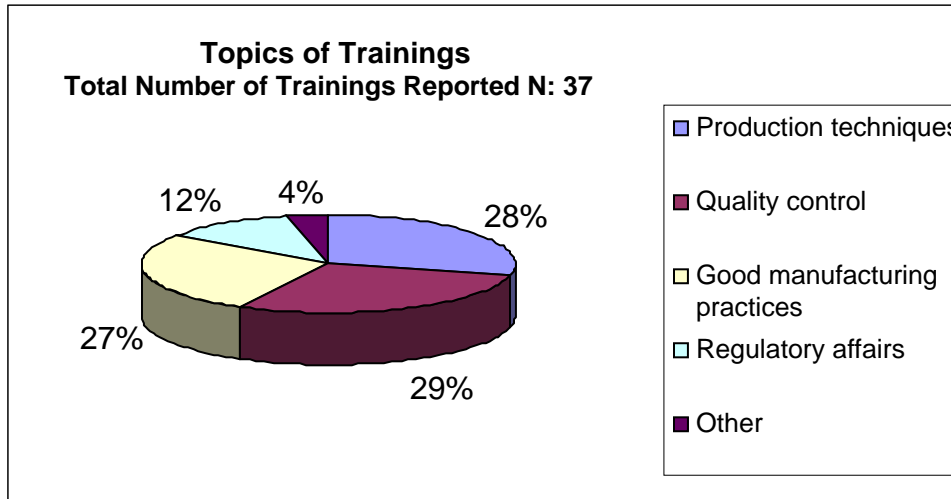
- The various types of retention measures currently employed by the respondents include:
 - Economic advantages: higher welfare packages than other companies; salary raises; discounted or free company shares, income protection
 - Working conditions: on site childcare centre, extra leave days, volunteer leave days, flexible work arrangements
 - Individual capacity development: internal exchanges; promotion; employee assistance program; study assistance; internal and external training opportunities (GMP); continuing education program.

Workforce Training

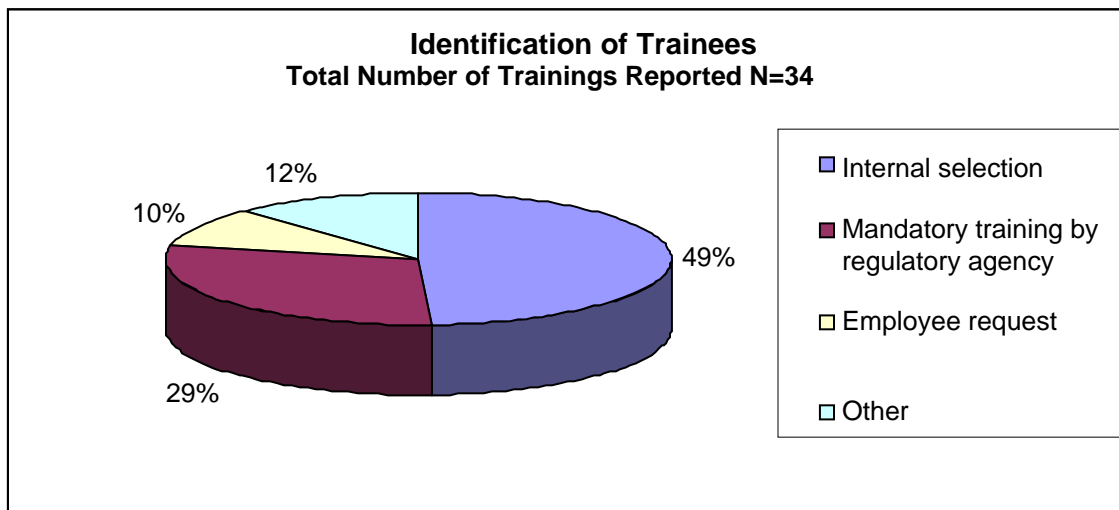
- 59% of the survey respondents indicated that their workforce had received training in the previous 18 months.
- The majority of the trainings (66%) were paid for directly by the companies.



- The vast majority of the trainings (84%) focused on production techniques, good manufacturing practices and quality control. This aligns with the fact that 91% of all staff trained in the previous 18 months were employed in the production process.

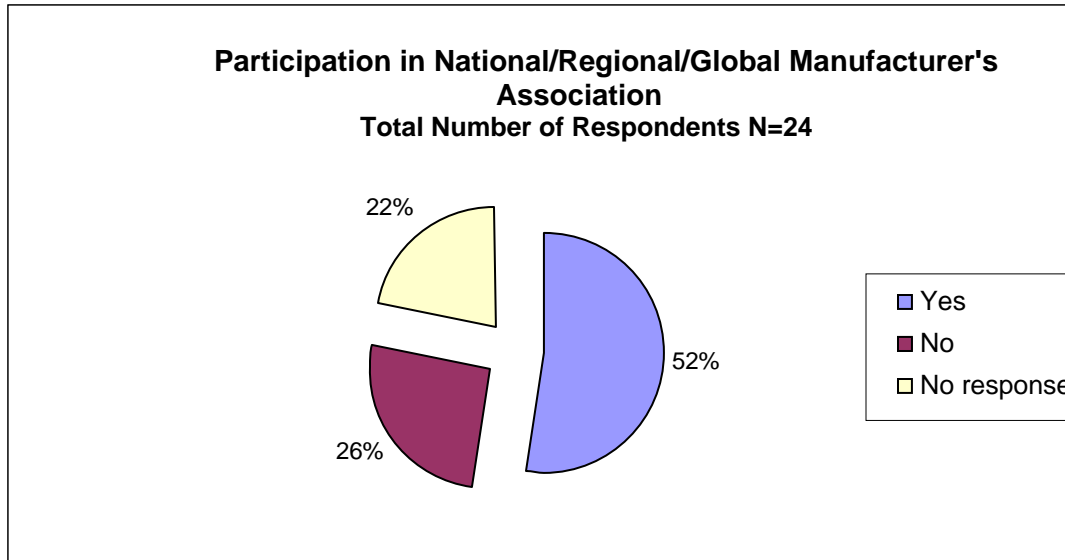


- 54% of all training courses were provided by external entities; 38% of the courses were organized in-house by the company; and the remaining 9% were through a combination of internal and external training resources. In the majority of cases (74%) trainees were selected through a combination of factors (training mandate by regulatory agency, internal decision, personnel direct request).

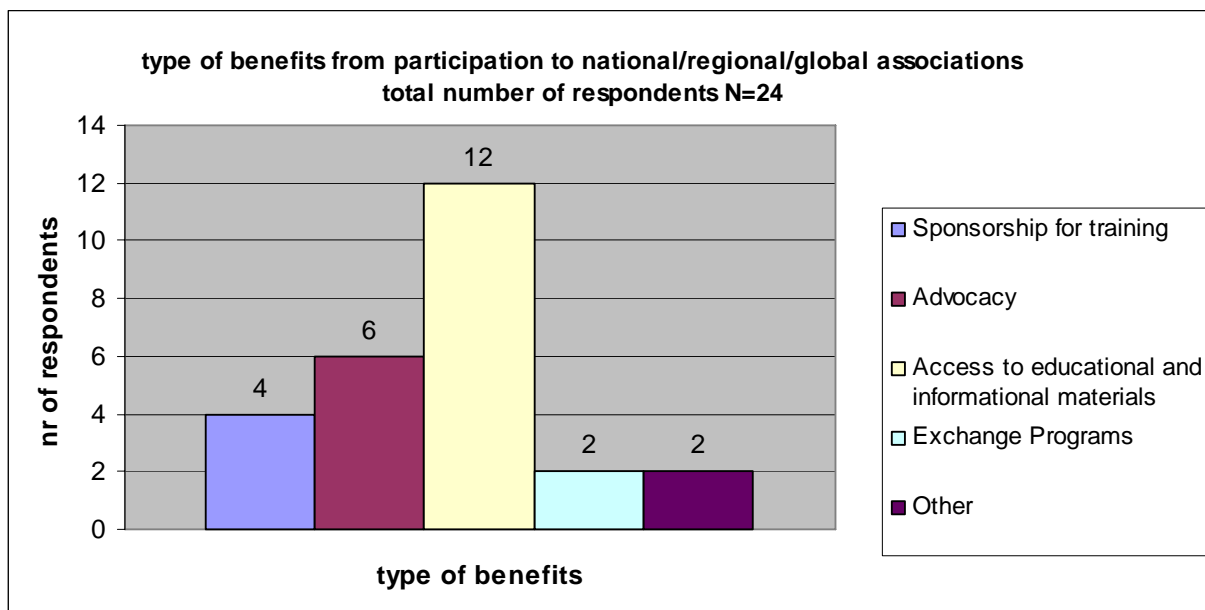


International affiliations and vaccine manufacturing networks

- 52% of the respondents indicated that they were affiliated with a national, regional and/or global association or network and that they benefited from their membership/affiliation.



- The most frequently cited benefit from the participation in an association/network is the belief that they facilitate access to educational and informational materials. The other commonly cited benefit refers to the sponsorship they provide for trainings and professional development.



Discussion

Strengths of this study

- The survey administered to almost 90% of all known influenza vaccine manufacturers, with a very good response rate (52 % of the companies responded).
- Responses were obtained from companies based in 5 out of 6 WHO Geographic regions, which collectively produce more than 28% of the world's seasonal influenza vaccine. This provides a valuable snapshot of the global influenza vaccine manufacturing industry and its workforce.

Limitations of this study

- The survey was only available in English which proved to be a challenge to some respondents in countries where English is not the primary spoken language.
- Companies may have had different interpretations of some of the questions leading to a wide range of responses; particularly in the case of open ended questions.
- The quantity and quality of information provided by each company varied greatly. Some provided extensive information and detail whereas others did not. Breadth/ depth of response was difficult to control for.
- Given the nature of the information being sought, the respondents were not always able to provide certain information due to company disclosure policies.

Survey highlights and points for consideration

- Production plant staff comprise the largest personnel group among influenza vaccine manufacturers. Technical staff in the production area usually had high school diplomas and an entry level professional experience of 1 to 2 years.
- The main source of recruitment of personnel is the local market (69%).
 - 36% of entry level technical staff are recruited directly from University and technical college.
 - The staff categories that companies find difficult to hire are all related to management, indicating the need for experienced personnel who will contribute to the strategic direction and effective and efficient operation of the facilities.
 - The most frequently cited challenge to hiring entry level technical staff is the lack of experience and knowledge in production of biologicals (in particular the lack of practice in clean/sterile areas).
- The majority of respondents (60%) have retention policies/measures in place.
- Over half (59%) of the survey respondents indicated that their workforce had received training in the previous 18 months.
 - 54% of all training courses were provided by external entities; 38% of the courses were organized in-house by the company; and the remaining 9% of companies relied on a combination of internal and external training sources.
 - 84% of the trainings focused on production techniques, good manufacturing practices and quality control. This aligns with the fact 91% of the staff that attended training courses were employed in the production process.
 - With respect to how personnel were selected to participate in specific trainings, two common recurring themes, per the survey responses, were that specific

training was mandated by a regulatory body or a specific training need was identified internally.

- 52% of the respondents indicated that they are affiliated with a national, regional and/or global association or network and that they benefit from their membership/affiliation. The most frequently cited benefit from the participation in an association/network is the belief that they facilitate access to educational and informational materials

Questions raised by the survey

- One area that was slightly unclear was the selection process that was used to determine participants for specific training programs. Job position functions and requirements was one of the criteria used in many of the companies' selection process but it was not clear if that was the only factor considered when selecting participants for training.
- The production departments appeared to experience the least difficulties in hiring technical staff in comparison to the other departments. What does this imply regarding organizational needs, policies, or for company recruitment strategies?
- All departments cited significant difficulty in hiring managerial staff (production, facility, R&D, clinical and regulatory affairs), however the research and development departments appeared to show the greatest difficulty in hiring managerial personnel. What does this say about the functionality of the organizations or their organizational needs? Is there a link with the education system of the country (availability and affordability of PhD level courses in relevant academic subjects)?
- Are there regional/transnational synergies that could be better utilized in order to provide hands-on training to the vaccine manufacturing workforce, especially in the developing world?
- 60% of the respondents have retention policies or measures in place: are they effective in the developing countries? What is the turn over for each professional category?

Next Steps

Preliminary analysis of the survey results has yielded a significant amount of valuable data. WHO will undertake a more in-depth analysis of the data in the coming months. Moreover, the survey questionnaire will be adapted so that it can be administered to all vaccine manufacturers worldwide, excluding those already surveyed in the first phase. WHO plans to send this revised questionnaire to the second tranche of vaccine manufacturers by late 2011.

Appendix 1 - Survey Questionnaire

A Survey to Map Influenza Vaccine Manufacturers' Current Workforce Capacity at Facility Level

WHO is committed to fostering health innovation in developing countries through capacity building and technology transfer. Through initiatives linked to WHO's Global Strategy on Innovation and Public Health, WHO fully supports local production of health products and technologies to increase access for all. Human resource development represents an essential component of local capacity to innovate.

As part of an overall effort to strengthen influenza vaccine production capacity in developing and emerging economy countries, WHO is gathering information from influenza vaccine manufacturers across the world to gain an understanding of vaccine manufacturing workforce capacity needs.

When completing the survey please focus your answers to the primary (largest) influenza vaccine production facility based in your company's home country.

The survey will take between 45 minutes to 1 hour to complete. You are encouraged to collaborate in advance with your appropriate internal division leaders to ensure that you have the most accurate and complete information available to complete the survey.

Your institution's answers will be treated as confidential and will not be shared outside of the WHO survey team without your explicit consent. Data from the survey, however, will be presented and published in an aggregate form and will not identify individuals or institutions as previously mentioned.

Please contact Claudia Nannei (e-mail: nanneic@who.int) and/or Silvia Anike-Nweze (e-mail: anikenwezes@who.int) if you have any questions regarding the survey.

Thank you for your cooperation in completing this web-based survey administered by the World Health Organization (WHO).

General Information

Respondent's Details

Name of survey respondent:

Job title of respondent:

*Survey respondent's location (country, city):

*Company name:

*Location of company headquarters (city, country):

*Location of influenza vaccine production facility:

1. * Is the respondent a publicly owned or private company or a public-private partnership?

Private

Public

Public-Private Partnership

Other (please specify)

2. *Vaccine Technology, production technique and quantity of vaccines produced:

Seasonal Influenza Vaccine	Pandemic Influenza Vaccine
<p>Current Stage of vaccine manufacturing : Commercial Production begun</p>	<p>Current Stage of vaccine manufacturing : Commercial Production begun</p>
Primary Technology	
<p>Live attenuated <input type="checkbox"/></p> <p> Whole Inactivated Virus <input type="checkbox"/></p> <p> Inactivated Subunit Vaccine <input type="checkbox"/></p> <p> Inactivated Split Vaccine <input type="checkbox"/></p> <p>Recombinant <input type="checkbox"/></p> <p>Other (please specify)</p>	<p>Same as for seasonal vaccine <input type="checkbox"/></p> <p>Live attenuated <input type="checkbox"/></p> <p> Whole Inactivated Virus <input type="checkbox"/></p> <p> Split /Subunit + Water-in-Oil Adjuvant Vaccine <input type="checkbox"/></p> <p>Recombinant <input type="checkbox"/></p> <p>Other (please specify)</p>
Production Technique	
<p>Cell-Based <input type="checkbox"/></p> <p>Egg-based <input type="checkbox"/></p> <p>Others, please specify</p>	<p>Cell-Based <input type="checkbox"/></p> <p>Egg-based <input type="checkbox"/></p> <p>Others, please specify</p>
Volume Produced during last year	
<p>Total quantity of influenza vaccine manufactured (number of doses) 1 - 50,000</p>	<p>Total quantity of influenza vaccine manufactured (number of doses) 1 - 50,000</p>

3. Are there other influenza vaccine manufacturers or biotechnology institutions in your country?

Yes

No

a. If you answered "yes" above:

i. How would you describe the relationship between your company and other vaccine or biotechnology manufacturers:

Competitive

Collaborative

No relationship

ii. Do you collaborate on workforce development and training programmes Yes

No

1. If yes, please specify whom with

Goals

4. Does your company have plans to expand its manufacturing capacity?

Yes No

If you answered “yes” above:

a. What is the anticipated percentage increase in influenza vaccine manufacturing capacity over the next 5 years (if known)?

Cell-based:

Egg-based:

Employee Demographics

5. *Characterization of facility’s staff: number of personnel, academic qualifications, years of professional experience, etc.

		Number of Staff		FTE/year ⁷	Are you able to hire the required staff adequately trained in vaccine production applicable to influenza vaccines? YES/NO	Minimum Level of education required DROP BOX	Minimum years of experience required DROP BOX	Where does the company recruit its employees? CHECK ALL THAT APPLY		
		Current Number of Staff	Number of unfilled posts					Local Market	International Market	Direct Contact with Academia and Research Institutions
R&D including pilot plant	Management				Yes <input type="checkbox"/> No <input type="checkbox"/>	High School If “other”	<1 year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Laboratory staff				Yes <input type="checkbox"/> No <input type="checkbox"/>	High School If “other”	<1 year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Production Plant	Management				Yes <input type="checkbox"/> No <input type="checkbox"/>	High School If “other”	<1 year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

⁷ Full-time Employees per year

One FTE equals one person working 12 months per year and working 30 or more hours per week

Three people working 4 months per year equals one FTE

	Production staff				Yes <input type="checkbox"/> No <input type="checkbox"/>	High School If "other"	<1 year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clinical and Regulatory	Management				Yes <input type="checkbox"/> No <input type="checkbox"/>	High School If "other"	<1 year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Administrative staff				Yes <input type="checkbox"/> No <input type="checkbox"/>	High School If "other"	<1 year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Facility management					Yes <input type="checkbox"/> No <input type="checkbox"/>	High School If "other"	<1 year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. *Does the company have a formal workforce development strategy/policy?

Yes No

a. If you answered "yes" above:

i. Which of the following does it include:

School/college/university partnerships

Internal training External training External employee exchange programmes

Internal employee exchange programmes (e.g. at other facilities owned by the company)

Lateral hiring (from other bio manufacturers) Other (please specify)

7. *Does the company have a formal employee retention program or policy?

Yes No

b. If you answered "yes" above please elaborate:

Employee Training

8. *Please list the training events related to influenza vaccine manufacturing that your facility has sponsored, benefited from or provided in the past 18 months

Course Title	Topic/s covered CHECK ALL THAT APPLY	Who conducted the training CHECK ALL THAT APPLY				Who sponsored the trainees from your company to attend? CHECK ALL THAT APPLY			Professional category of trainees involved in the course CHECK ALL THAT APPLY	How many personnel were trained	How were the trainees selected to participate in the training CHECK ALL THAT APPLY
		Academic Institution	NGO	Internal	Government agency	Your company	Training program	Third party			
	Production Techniques <input type="checkbox"/> QC ⁸ <input type="checkbox"/> GMP ⁹ <input type="checkbox"/> Clinical <input type="checkbox"/> Regulatory Affairs <input type="checkbox"/> Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	National <input type="checkbox"/> International <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Management <input type="checkbox"/> Production <input type="checkbox"/> Laboratory <input type="checkbox"/> Administrative <input type="checkbox"/>		Need identified internally <input type="checkbox"/> Mandatory by regulator <input type="checkbox"/> Employee Request <input type="checkbox"/> Other
	Production Techniques <input type="checkbox"/> QC <input type="checkbox"/> GMP <input type="checkbox"/> Clinical <input type="checkbox"/> Regulatory Affairs <input type="checkbox"/> Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Management <input type="checkbox"/> Production <input type="checkbox"/> Laboratory <input type="checkbox"/> Administrative <input type="checkbox"/>		Need identified internally <input type="checkbox"/> Mandatory by regulator <input type="checkbox"/> Employee Request <input type="checkbox"/> Other

⁸ Quality Control

⁹ Good Manufacturing Practice

Production Techniques <input type="checkbox"/> QC <input type="checkbox"/> GMP <input type="checkbox"/> Clinical <input type="checkbox"/> Regulatory Affairs <input type="checkbox"/> Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Management <input type="checkbox"/> Production <input type="checkbox"/> Laboratory <input type="checkbox"/> Administrative <input type="checkbox"/>	Need identified internally <input type="checkbox"/> Mandatory by regulator <input type="checkbox"/> Employee Request <input type="checkbox"/> Other
Production Techniques <input type="checkbox"/> QC <input type="checkbox"/> GMP <input type="checkbox"/> Clinical <input type="checkbox"/> Regulatory Affairs <input type="checkbox"/> Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Management <input type="checkbox"/> Production <input type="checkbox"/> Laboratory <input type="checkbox"/> Administrative <input type="checkbox"/>	Need identified internally <input type="checkbox"/> Mandatory by regulator <input type="checkbox"/> Employee Request <input type="checkbox"/> Other
Production Techniques <input type="checkbox"/> QC <input type="checkbox"/> GMP <input type="checkbox"/> Clinical <input type="checkbox"/> Regulatory Affairs <input type="checkbox"/> Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Management <input type="checkbox"/> Production <input type="checkbox"/> Laboratory <input type="checkbox"/> Administrative <input type="checkbox"/>	Need identified internally <input type="checkbox"/> Mandatory by regulator <input type="checkbox"/> Employee Request <input type="checkbox"/> Other

9. *With respect to the influenza vaccine production process, what are the biggest challenges your company faces?

Upstream Processing Challenges <i>(Please list)</i>	Downstream Processing Challenges <i>(Please list)</i>
<i>Please list challenges</i>	<i>Please list challenges</i>

10. *What training would your junior level and mid level operations staff require in order to meet these challenges?

<p>Upstream Processing Challenges <i>(Please list)</i></p>	<p>Junior-level operations staff</p>	<p>Mid-level operations staff</p>
	<p><i>Please input training required</i></p>	<p><i>Please input training required</i></p>
<p>Downstream Processing Challenges <i>(Please list)</i></p>	<p>Junior-level operations staff</p>	<p>Mid-level operations staff</p>
	<p><i>Please input training required</i></p>	<p><i>Please input training required</i></p>

Supply of Workforce

11. *Is there a university or technical college in the city or political region (state, county, etc) where the facility is located?

Yes

No

c. If you answered "yes" above:

i. How many: Universities (Drop box) None Technical colleges (Drop box) None

ii. Which of the following departments are available

Medicine Biochemistry Veterinary science

Biotechnology/ medical technology Pharmacology Other relevant (please specify)

12. *Please provide information on workforce recruitment and retention

	Entry-level operations Staff	Mid-level operations Staff
Main sources	University or Technical College <input type="checkbox"/> High school <input type="checkbox"/> Other bio manufacturing facilities <input type="checkbox"/> Academia and research <input type="checkbox"/> Hospitals <input type="checkbox"/>	Promotion from within <input type="checkbox"/> University or Technical College <input type="checkbox"/> High school <input type="checkbox"/> Other bio manufacturing facilities <input type="checkbox"/> Academia and research <input type="checkbox"/> Hospitals <input type="checkbox"/>
Difficulties in recruitment	Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, please specify suspected reasons:	Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, please specify suspected reasons:
Difficulty in retention	Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, please specify suspected reasons:	Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, please specify suspected reasons:

International affiliations and vaccine manufacturing networks

13. *Does your company participate in an international or regional association of vaccine manufacturers?

Yes No

a. If you answered “no” above:

i. Please specify any reasons why

b. If you answered “yes” above:

i. Please specify which associations the facility is a part of

ii. At what level? Member Affiliate Sponsor Other (please specify)

iii. Does your company's workforce benefit from participation in these associations?

Yes No

1. If yes, please specify

Sponsorship for training Access to educational and informational materials Employee
exchange programs Advocacy Other (please specify)

If you wish to add any comments to this survey, please use the following space