World Health Organization

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Prequalification Team Inspection services
WHO PUBLIC INSPECTION REPORT
of the Quality Control laboratory

<table>
<tr><th>Part 1</th><th>General information</th></tr>
<tr><td colspan="2">Laboratory Details</td></tr>
<tr><td>Name</td><td>National Drug Quality Control Laboratory
Located at Mulago Hill, Kampala Uganda, c/o National Drug Authority,</td></tr>
<tr><td>Address</td><td>c/o National Drug Authority,
P.O Box 23096,
Kampala-Uganda.
Website: www.nda.or.ug</td></tr>
<tr><td>GPS Coordinates</td><td>0°20'06.3"N; 0.335078
32°34'36.3"E; 32.576759</td></tr>
<tr><td colspan="2">Inspection details</td></tr>
<tr><td>Date of inspection</td><td>19 – 20 June 2019</td></tr>
<tr><td>Type of inspection</td><td>Routine</td></tr>
<tr><td colspan="2">Introduction</td></tr>
<tr><td>Brief description of testing activities</td><td>
<table>
<tr><th>Type of analysis</th><th>Finished products</th><th>Active pharmaceutical ingredients</th></tr>
<tr><td>Physical/ Chemical analysis</td><td>pH, loss on drying, water content, density, friability, dissolution, uniformity of dosage units (mass, content)</td><td>pH, loss on drying, water content, density, melting point</td></tr>
<tr><td>Identification</td><td>IR, HPLC (UV-VIS detection), UVVIS spectrophotometry</td><td>FTIR, HPLC (UV-VIS detection), UV-VIS spectrophotometry</td></tr>
<tr><td>Assay, impurities and related substances</td><td>HPLC (UV-VIS detection), UVVIS spectrophotometry, volumetric titrations, polarimetry</td><td>HPLC (UV-VIS detection), UVVIS spectrophotometry, volumetric titrations, polarimetry</td></tr>
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</td></tr>
<tr><td>General information</td><td>The National Drug Quality Control Laboratory (NDQCL) is under the Directorate of laboratory services of National Drug Authority (NDA). NDA is a government regulatory agency established in 1993. The Directorate of Laboratory services is one of the 5 Directorates of NDA; all Directors report to the Secretary to the Authority.

The laboratory is located adjacent to Mulago main referral hospital; about 2 km from the Capital city, Kampala.

The laboratory has been in existence since the year 2000. It was pre-qualified by WHO in 2015 (Medicines Unit) and was also ISO/IEC 17025:2005 accredited</td></tr>
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<tr><td></td><td>for medical devices testing in Dec 2016. The scope of accreditation was expanded in January 2019 to include the Medicines Laboratory.

The laboratory tests mainly medicines, medical devices and public health products such as Insecticide found in Long lasting insecticide treated mosquito nets (LLINs). The majority of test samples received are finished products; however, the capacity to test APIs exists. Sampling is carried out by the Directorate of Inspectorate and Enforcement as well as Product Safety. A total of 500-600 samples are tested annually.</td></tr>
<tr><td>History</td><td>The Medicine testing section was last inspected by the WHO in 2014.

Laboratory was inspected by the following authorities:
<table>
<tr><th>Authority</th><th>Date/s of inspection</th><th>Scope of inspection</th></tr>
<tr><td>ANAB (ISO/IEC:17025: 2005</td><td>2016</td><td>Medical Devices; Condoms</td></tr>
<tr><td>EAC</td><td>2017</td><td>Medicines and Medical devices Laboratory</td></tr>
<tr><td>ANAB (ISO/IEC:17025: 2005</td><td>2017</td><td>Medical Devices; Condoms and Gloves</td></tr>
<tr><td>ANAB (ISO/IEC:17025: 2005</td><td>2019</td><td>Medical Devices; Condoms, Gloves and Medicines</td></tr>
</table></td></tr>
<tr><td colspan="2">Brief report of inspection activities undertaken – Scope and limitations</td></tr>
<tr><td>Areas inspected</td><td>See section 2 below</td></tr>
<tr><td>Restrictions</td><td>N/A</td></tr>
<tr><td>Out of Scope</td><td>The microbiological laboratory</td></tr>
<tr><td>Abbreviations</td><td>Meaning</td></tr>
<tr><td>ALCOA</td><td>Attributable, legible, contemporaneous, original and accurate</td></tr>
<tr><td>API</td><td>Active pharmaceutical ingredient</td></tr>
<tr><td>CoA</td><td>Certificate of analysis</td></tr>
<tr><td>FPP</td><td>Finished pharmaceutical product</td></tr>
<tr><td>FTIR</td><td>Fourier transform infrared spectrophotometry or spectrophotometer</td></tr>
<tr><td>GC</td><td>Gas chromatography or Gas chromatography equipment</td></tr>
<tr><td>GMP</td><td>Good manufacturing practices</td></tr>
<tr><td>HPLC</td><td>High-performance liquid chromatography (or high-performance liquid chromatography equipment)</td></tr>
<tr><td>KF</td><td>Karl Fisher titration</td></tr>
<tr><td>LIMS</td><td>Laboratory information management system</td></tr>
<tr><td>MB</td><td>Microbiology</td></tr>
<tr><td>MR</td><td>Management review</td></tr>
<tr><td>NC</td><td>Non-conformity</td></tr>
<tr><td>NCA</td><td>National control authority</td></tr>
<tr><td>NCL</td><td>National control laboratory</td></tr>
<tr><td>NRA</td><td>National regulatory agency</td></tr>
</table>

OOS	Out-of-specifications test result
PM	Preventive maintenance
PQ	Performance qualification
PQR	Product quality review
PQS	Pharmaceutical quality system
PW	Purified water
QA	Quality assurance
QC	Quality control
QCL	Quality control laboratory
QMS	Quality management system
QRM	Quality risk management
RA	Risk assessment
RCA	Root cause analysis
SOP	Standard operating procedure
URS	User requirements specifications
UV	Ultraviolet-visible spectrophotometry or spectrophotometer

Part 2	**Summary of findings and recommendations**

1. Organization and management

The laboratory was legally authorized and had managerial and technical personnel to oversee the quality management system and procedures for performing tests and/or calibrations, validation and verification, and to initiate corrective actions when required. Roles and responsibilities were specified in signed job descriptions. Analyst's declarations of no conflict of interest and declaration of confidentiality were available.

2. Quality management system

The laboratory had established, implemented and maintained a quality management system appropriate to the scope of its activities, the elements of quality system were documented. The laboratory had an up-to-date master list of standard operating procedures (SOPs) for testing, equipment and for the quality management system which listed all SOPs by number along with their version, effective date and expiry date as well. QMS was ISO 17025 accredited.

Various SOPs were reviewed. They were easily retrievable and version control appeared to be appropriate. List of SOPs was presented to the inspectors.

Quality manual (QM)

NDQCL Quality Manual was checked. QM contained explanation of Quality Management System. According to QM all personnel are required to sign the oath of secrecy form and declaration of conflict of interest form.

Organization structure

NDA MACRO organization structure and Directorate of laboratory services organization structure were presented to inspectors. Under director Laboratory Services were three units:

- Laboratory Quality Management System
- Medicines
- Medical devices

Director Laboratory Services was reporting to Secretary to the Authority/Executive Director

Change controls (CC)

SOP "Laboratory change control" and CC register 2017/2018 were checked. The SOP was applicable to equipment, facilities and documents, including changes to the test methods. Major changes to validated test methods shall require method verification/revalidation. Changes were categorized as:

- Minor
- Major

Deviations

"SOP for Handling deviations in the laboratory" and register for 2017/2018 were checked. Deviations were classified as major and minor. Classification was done by LQMS. unit Trending was carried out every six months.

Complaints

SOP "Handling of laboratory complaints" and complaints register for 2017/2018 were checked. Complaints were handled by the LQMS unit, classification of complaints was also done by LQMS unit as:

- Major
- Minor

According to the SOP a team of at least 2 persons shall carry out investigation. Director was responsible to communicate the findings of the investigation to the complainant through the Secretary to the Authority.

Corrective and preventive actions (CAPAs)

The following SOPs were checked:

- "Preventive actions" – preventive actions shall be identified and pro-actively taken without waiting for identification of a problem with an objective of identifying opportunities for improvement.
- "Corrective and preventive action" and CAPA register Medicines Unit internal audit February 2018

Management reviews (MR)

SOP "Laboratory Management reviews" and MR minutes of were checked. According to the SOP MR shall be held at least once in a year. Standard agenda was specified. Meetings shall be attended by the Director. Manager LQMS, analysts, Managers and Principal Officers and other persons invited by Director. Performance of the LQMS shall be evaluated using the quality metrics, having quantifiable parameters. Minutes of the 2nd MR meeting, 2018 was checked

Internal audits

SOP "Internal audit for the laboratory" and internal audit schedule were checked. According to the SOP internal audits elements listed in the schedule should be carried out at least once per year. Internal audit schedule for 2019 was presented to the inspectors. According to the SOP Audit team shall be independent of the activities to be audited. Audits were performed using check lists. Non-conformities were recorded, report was signed by all auditors, CAPAs were submitted by auditee and implementation was checked by LQMS unit.

Proficiency testing

SOP "Proficiency testing" and Proficiency log for medicines / medical devices sample were checked. The SOP also explained intra-laboratory comparisons. Laboratory participated in the following proficiency testing schemes:

- WHO
- EAC (East African community) - PTB
- NOMCol (National Official Medicines Control Laboratories)
- USP Ghana

Out of Specifications (OOS)

SOP "Handling of out of specification results for the Medicines unit, and OOS register 2017/2018 were checked. According to the SOP three stages of investigation shall be followed:

- Preliminary investigation
- Phase I
- Phase II.

OOS were trended at least annually and before management review meeting.

SOP "SOP for control of non-conforming work" was checked. SOP was applicable to non-conforming work identified in the quality assurance system and technical operations. SOP had two appendices "Non-conformance report" and "Non-conformance register".

Selection of service providers and suppliers

SOP "Purchasing of services and suppliers for the laboratory" was checked. Suppliers/service providers were selected (evaluated) as per the PPDA (Public Procurement and Disposal of Public Assets Authority act) and regulation, 2003. PDU (procurement and disposal unit) was part of NDA. PDU deals with centralized procurement of all items required at NDA. Pre-qualified list of service providers for the financial years 2018/2019 to 2020/2021, including reagents and other items was presented to the inspectors.

Job descriptions of the following personnel were briefly discussed:

- Laboratory technician – stores
- Analyst
- Principal Officer Physical Chemistry

Job descriptions contained section Acceptance statement which was signed by Directors and person to whom belongs job description.

3. Control of documentation

Documented procedures were in place. Generally, documents had a unique identification number, version number and date of implementation. A system of change control was in place to inform staff of new and revised procedures. Both electronic and paper records were kept for 7 years as per national regulations and the SOP for record handling and management.

SOP "Laboratory document control" was checked. Lab used the following documents:

- SOPs
- Lab test methods
- Equipment procedures
- Lab protocols
- Lab reports
- Forms
- Registers
- CoA

4. Records

Original observations, calculations and derived data, calibration, validation and verification records and final results, were retained. The records included the data obtained and recorded in analytical worksheets.

5. Data processing equipment

The HPLC systems, GC system, Ultra Violet Spectroscopy and Infrared spectroscopy equipment were linked to the computers operated by their respective software. It was checked that software versions present during qualification were still used. For these systems access rights were given to user groups that were defined in forms.

Validation of software

On software updates the Validation Master Plan, stated that after software changes a re-validation should be done.

For HPLCs XX and YY it was checked if the software version of OpenLab ChemStation running on them was validated. This proved to be the case. Documentation was sufficient.

FTIR device VV was updated in 2018. The original qualification was shown, as well as the qualification after updating to the newest version.

Backup of electronic data

SOP "Data backup, restoration and disaster recovery" was checked. Reports showed that regular validation of backed- up data was performed.

6. Personnel

Generally, the laboratory had sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned functions. Staff members undergoing training were supervised and were assessed on completion of the training. Personnel performing specific tasks were qualified in terms of their education, training and experience, as required. Current job descriptions were maintained. During inspection 7 positions were vacant.

Laboratory had experienced and knowledgeable personnel.

Training

SOP "Training of laboratory personnel" was checked. This SOP was applicable for new and existing employees, intern students and external trainees. The following trainings were specified: orientation, induction, assessment of competence and continuous training. Qualification of analysts and technicians: recently analyzed and approved sample was selected and given for analysis. Training was well documented. Competency tests were carried out after 6-month training.

Analysts competency matrix and signature specimens were presented to the inspectors.

7. Premises

Physical-chemical laboratory premises were spacious and were designed to suit the functions and operations to be conducted in them. Rest and refreshment rooms were separate from laboratory areas. Laboratory had storage facilities for storage of samples, and for reagents. Access to work or storage areas was fingerprint controlled. The laboratory facilities had adequate safety equipment located appropriately and measures were in place to ensure good housekeeping. Laboratory was equipped with adequate instruments and equipment, including work benches, work stations and fume hoods.

Laboratory storage facilities

Chemicals, reagents and flammables for daily use were stored in cupboards in the laboratory.

Documentation archive

Documentation archive was located in extension building No 2. Documents were stored in locked metal mobile racks in good order.

8. Equipment, instrument and other devices

Generally, the laboratory had test equipment, instruments and other devices for the performance of the tests and/or calibrations, validations and verifications. Calibration status labels were attached to instruments. Laboratory instruments had "instrument log books".

Columns for HPLC analyses were adequately identified and stored properly.

Qualifications of the following equipment were checked:

- Dissolution tester No XX
- Disintegration tested No CC
- HPLC No YY
- GC No AA
- UV No BB

Maintenance
SOP "Equipment maintenance" was checked. The SOP referred to Annual planned preventive maintenance schedule. Schedules were seen for 2017/2018 and 2018/2019, these were both executed as planned.

9. Contracts
A number of contract laboratories were used for certain tests. Technical Agreements were drafted according to the SOP which stated that subcontracting was possible to WHO Pre-qualified labs or ISO 17025 accredited labs, and also to recognized national (government) laboratories after physical inspection. The Technical Agreement for XX was seen.

10. Reagents
Reagents, chemicals and flammable liquids were received and checked in front office. Receipt forms were filled manually. After receipt, reagents and chemicals were moved to storage room located in extension Building No 2. Reagents and chemicals were stored in mobile metal racks under appropriate conditions. Storage was observed to be in good order. Reagents and chemicals inventory was managed by electronical register. AHU was provided to ensure required storage conditions. T&RH was checked and recorded daily. The labels indicate expiry date/date of receipt and date of opening.

SOP "Receipt, storage and handling of laboratory chemicals and reagents" was checked. Upon delivery consignments were inspected for intactness, labelling, specifications and quantities delivered, name of manufacturer, expiry date and storage conditions. Issuance of items followed FIFO system, however items with shorter expiry dates shall be issued in preference.

Water
The equipment to produce purified water was checked. The main components were filters, RO membrane, EDI unit and storage tank. The system looked well maintained. Type II – reagent grade water was produced by Millipore Elix 70 equipment. For HPLC test water was filtered through 0.22 µm filter to remove particulate matter. Conductivity was checked on-line and off-line. Off-line checks were performed daily.

Gases
Gases N_2 and H_2 used in chromatography were produced at the laboratory. The equipment was well maintained.

11. Reference substances and reference materials
According to the explanation the laboratory mainly used primary reference substances purchased from USP and EDQM. In case primary reference substances were not available, reference materials were purchased from Sigma Aldrich. Primary and secondary reference substances were stored either at 2-8 ℃ or -21±1℃. The temperature was recorded twice per day.

The following SOPs were checked:
- "Preparation and handling of secondary reference standards". As explained by QMS manager this SOP was written thinking that lab would prepare secondary reference standards, but till the date of inspection this was never done. Instead all standards were freshly prepared from reference substance with a known potency.

- Receipt and handling of primary chemical reference standards". Upon receipt primary chemical reference standards were checked for name, standard/specification, quantity, Lot No/Control No, name of manufacturer, expiry date, purity, CoA, storage conditions, MSDS. Validity of primary chemical reference standards was monitored by lab technician (stores). Receipt of the primary chemical reference standards was recorded in the central register.

12. Calibration, verification of performance and qualification of equipment, instruments and other devices

Mettler Toledo balances were used for weighing. Time and date on the printouts could only be changed by the person with Administrator rights. Calibration records of a number of laboratory equipment was checked.

13. Traceability

Test results were generally traceable to analysts, analytical instruments, equipment, reagents, reference substances and test procedures.

14. Incoming samples

Registration and labelling

Incoming samples were received, checked, marked with a QC number and logged the same day in an MS-Access database, with logbooks as a backup. The room in which they were received was not temperature controlled. Samples were submitted by either the Directorate of Product Safety or the Directorate of Inspectorate and Enforcement.

SOP "Receiving and handling of samples for laboratory analysis" described that incoming samples were registered along with brand name, generic name, customer number, QC number, quantity received, dosage form, batch No., manufacturing date, expiry date, name and address of manufacturer, analyzed by, disposition, release date and remarks. Samples were then transferred to the samples store medicines room which was a temperature-controlled room. The temperature and humidity were monitored and noted on the form "Temperature and relative humidity monitoring at NDQCL". The issuing of samples was recorded in the Sample distribution logbook. After testing the samples were returned to this room, logged into the Retained sample logbook and placed in passed, failed or quarantined areas as appropriate and retained for one year after expiry. Overall, the samples were considered to be appropriately stored.

15. Analytical worksheet

Analytical worksheets were used for analysis and was part of sample test file. Artefan (Artemether/Lumefantrine 20/120 mg), batch No XX, sample No YY (post marketing surveillance sample) sample file was cross checked with original data and meta data, no discrepancies noted.

When samples from multiple products were tested in the same sequence, results from HPLC or GC were printed and copied so that each worksheet had the raw data. However, in HPLC and GC logbooks runs were sometimes recorded with the QC number of just one sample.

16. Validation of analytical procedures

Pharmacopeia analytical tests methods were verified, customer analytical methods were validated.

17. Testing

Testing was done by an analyst. The input of raw data into the validated method specific Excel sheet was done by a separate data analyst and then checked by a supervisor. Final results were reviewed by QA.

18. Evaluation of test results

SOP "Review, release and reporting of test" was checked". Procedure was applicable to all test results generated in-house and from sub-contracted laboratories. The Principal Officer was responsible for reviewing of analytical work sheets, raw data and analytical test reports. The Principal Officer was performing only review and did not perform analytical tests. Final review and release of test results was done by Director DLS. The final results were presented as certificate of analysis.

19. Certificate of analysis

SOP "Review, release and reporting of test" was checked. Evaluation of test results also explained issuance and approval of CoA. CoA was reviewed by the Manager Medicines and approved by Director DLS.

20. Retained samples

Samples were retained for 1 year past shelf life.

21. Safety

Safety data sheets were available. Smoking, eating and drinking in the laboratory was prohibited. Staff wore laboratory coats, gloves and used eye protection. Safety showers were available.

PART 4 CONCLUSION

Inspection outcome

Based on the areas inspected, the people met, and the documents reviewed, and considering the findings of the inspection including the observations listed in the Inspection Report, **National Drug Quality Control Laboratory, located at Mulago Hill, Kampala Uganda** (postal address: c/o National Drug Authority, P.O Box 23096, Kampala-Uganda) was considered to be operating at an acceptable level of compliance with WHO Good Practices for Pharmaceutical Quality Control Laboratories guidelines.

All the non-compliances observed during the inspection that were listed in the full report as well as those reflected in the WHOPIR, were addressed by the manufacturer, to a satisfactory level, prior to the publication of the WHOPIR

This WHOPIR will remain valid for 3 years, provided that the outcome of any inspection conducted during this period is positive.

Part 4	**List of WHO Guidelines referenced in the inspection report**

1. WHO Good Practices for Pharmaceutical Quality Control Laboratories. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-Fourth Report. Geneva, World Health Organization, 2010 (WHO Technical Report Series, No. 957), Annex 1.
   Short name: WHO GPPQCL Guidelines or ***TRS No. 957, Annex 1***
   http://www.who.int/medicines/publications/44threport/en/

2. WHO good practices for pharmaceutical microbiology laboratories. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-Fifth Report Geneva, World Health Organization, 2011 (WHO Technical Report Series, No. 961), Annex 2.
   Short name: WHO TRS No. 961, Annex 2
   http://whqlibdoc.who.int/trs/WHO_TRS_961_eng.pdf?ua=1

3. WHO good manufacturing practices: water for pharmaceutical use. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Fourth-Sixth Report. Geneva, World Health Organization, 2012 (WHO Technical Report Series, No. 970), Annex 2.
   Short name: WHO TRS No. 970, Annex 2
   http://www.who.int/medicines/areas/quality_safety/quality_assurance/expert_committee/trs_970/en/
4. WHO guidelines for sampling of pharmaceutical products and related materials. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Thirty-Ninth Report. Geneva, World Health Organization, 2005 (WHO Technical Report Series, No. 929), Annex 4.
   Short name: WHO TRS No. 929, Annex 4
   http://whqlibdoc.who.int/trs/WHO_TRS_929_eng.pdf?ua=1

5. Guidance on good data and record management practices. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Fiftieth Report Geneva, World Health Organization, 2016 (WHO Technical Report Series, No. 996), Annex 5.
   Short name: WHO GDRMP guidance or ***WHO TRS No. 996, Annex 5***
   http://www.who.int/medicines/publications/pharmprep/WHO_TRS_996_annex05.pdf

6. WHO good manufacturing practices for pharmaceutical products: main principles. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-Eighth Report Geneva, World Health Organization, 2014 (WHO Technical Report Series, No. 986), Annex 2. ***Short name: WHO GMP guidelines*** or ***TRS No. 986, Annex 2***
   http://www.who.int/medicines/areas/quality_safety/quality_assurance/expert_committee/trs_986/en/

7. WHO Good Practices for Pharmaceutical Products Containing Hazardous Substances. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-Fourth Report. Geneva, World Health Organization, 2010 (WHO Technical Report Series, No. 957), Annex 3.
   Short name: WHO TRS No. 957, Annex 3
   http://www.who.int/medicines/publications/44threport/en/

9. WHO good manufacturing practices for sterile pharmaceutical products. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-Fifth Report Geneva, World Health Organization, 2011 (WHO Technical Report Series, No. 961), Annex 6.
   Short name: WHO TRS No. 961, Annex 6
   http://whqlibdoc.who.int/trs/WHO_TRS_961_eng.pdf?ua=1

10. WHO guidelines on transfer of technology in pharmaceutical manufacturing WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-Fifth Report Geneva, World Health Organization, 2011 (WHO Technical Report Series, No. 961), Annex 7.
    Short name: WHO TRS No. 961, Annex 7
    http://whqlibdoc.who.int/trs/WHO_TRS_961_eng.pdf?ua=1

11. Model guidance for the storage and transport of time-and temperature-sensitive pharmaceutical products. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-Fifth Report Geneva, World Health Organization, 2011 (WHO Technical Report Series, No. 961), Annex 9. ***Short name: WHO TRS No. 961, Annex 9***
http://whqlibdoc.who.int/trs/WHO_TRS_961_eng.pdf?ua=1

12. General guidelines for the establishment maintenance and distribution of chemical reference substances. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-First Report Geneva, World Health Organization 2007 (WHO Technical Report Series, No.943) Annex 3. ***Short name: WHO TRS No. 943, Annex 3***
http://whqlibdoc.who.int/trs/WHO_TRS_943_eng.pdf?ua=1

13. Guidelines on heating, ventilation and air-conditioning systems for non-sterile pharmaceutical products. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Fifty-Second Report Geneva, World Health Organization, 2018 (WHO Technical Report Series, No. 1010), Annex 8. **Short name: WHO TRS No. 1010, Annex 8**
http://www.who.int/medicines/areas/quality_safety/quality_assurance/expert_committee/trs_1010/en/

14. Guidelines on heating, ventilation and air-conditioning systems for non-sterile pharmaceutical products. Part 2: Interpretation of Guidelines on heating, ventilation and air-conditioning systems for non-sterile pharmaceutical products. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Fifty-Third Report Geneva, World Health Organization, 2019 (WHO Technical Report Series, No. 1019), Annex 2. **Short name: WHO TRS No. 1019, Annex 2**
https://apps.who.int/iris/bitstream/handle/10665/312316/9789241210287-eng.pdf?ua=1

15. WHO guidelines on quality risk management. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-Seventh Report Geneva, World Health Organization, 2013 (WHO Technical Report Series, No. 981), Annex 2. ***Short name: WHO TRS No. 981, Annex 2***
http://www.who.int/medicines/areas/quality_safety/quality_assurance/expert_committee/trs_981/en/

16. Good manufacturing practices: guidelines on validation. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Fifty-Third Report Geneva, World Health Organization, 2019 (WHO Technical Report Series, No. 1019), Annex 3. **Short name: WHO TRS No. 1019, Annex 3**
https://apps.who.int/iris/bitstream/handle/10665/312316/9789241210287-eng.pdf?ua=1

17. WHO Technical supplements to Model Guidance for storage and transport of time – and temperature – sensitive pharmaceutical products. WHO Expert Committee on Specifications for Pharmaceutical Preparations. Forty-Ninth Report Geneva, World Health Organization, 2015 (WHO Technical Report Series, No. 992), Annex 5. ***Short name: WHO TRS No. 992, Annex 5***
http://www.who.int/medicines/areas/quality_safety/quality_assurance/expert_committee/WHO_TRS_992_web.pdf