April 27, 2020

binx health Inc
Sarah Kalil
Advisor
77 North Washington Street, 5th Floor
Boston, Massachusetts 02114

Re: K200533
Trade/Device Name: binx *io* CT/NG Assay and binx *io* CT/NG System
Regulation Number: 21 CFR 866.3393
Regulation Name: Nucleic Acid Detection System For Non-Viral Microorganism(S) Causing Sexually Transmitted Infections
Regulatory Class: Class II
Product Code: QEP, LSL, MKZ, NSU
Dated: March 2, 2020
Received: March 2, 2020

Dear Sarah Kalil:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. Although this letter refers to your product as a device, please be aware that some cleared products may instead be combination products. The 510(k) Premarket Notification Database located at https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm identifies combination product submissions. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's

requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801 and Part 809); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803) for devices or postmarketing safety reporting (21 CFR 4, Subpart B) for combination products (see https://www.fda.gov/combination-products/guidance-regulatory-information/postmarketing-safety-reporting-combination-products); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820) for devices or current good manufacturing practices (21 CFR 4, Subpart A) for combination products; and, if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to https://www.fda.gov/medical-devices/medical-device-safety/medical-device-reporting-mdr-how-report-medical-device-problems.

For comprehensive regulatory information about medical devices and radiation-emitting products, including information about labeling regulations, please see Device Advice (https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance) and CDRH Learn (https://www.fda.gov/training-and-continuing-education/cdrh-learn). Additionally, you may contact the Division of Industry and Consumer Education (DICE) to ask a question about a specific regulatory topic. See the DICE website (https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance/contact-us-division-industry-and-consumer-education-dice) for more information or contact DICE by email (DICE@fda.hhs.gov) or phone (1-800-638-2041 or 301-796-7100).

Sincerely,

Steven Gitterman, M.D., Ph.D.
Deputy Director
Division of Microbiology Devices
OHT7: Office of In Vitro Diagnostics
and Radiological Health
Office of Product Evaluation and Quality
Center for Devices and Radiological Health

Enclosure

510(k) SUMMARY

SUBMITTER NAME:	binx health, Inc.
SUBMITTER ADDRESS:	77 N. Washington Street, 5th Floor Boston, MA 02114 USA
CONTACT PERSON:	Sarah Kalil Regulatory Advisor binx health, Inc. Phone: (646) 847 8573 Email: sarah.kalil@mybinxhealth.com
DATE PREPARED:	March 2, 2020
DEVICE TRADE NAME:	binx *io* CT/NG Assay
CLASSIFICATION:	21 C.F.R. § 866.3393 (Nucleic acid detection system for non-viral microorganism(s) causing sexually transmitted infections) Class II
PRODUCT CODE:	QEP
SUBSEQUENT PRODUCT CODES:	NSU
REVIEW PANEL	Microbiology
REQUESTED CLIA CLASSIFICATION:	Moderate Complexity
PREDICATE DEVICES:	binx health *io* CT/NG Assay for female vaginal swab (K191352)
INTENDED USE:	The binx health *io* CT/NG Assay, when tested using the binx health *io* Instrument, is a fully automated, rapid, qualitative test intended for use in point-of-care or clinical laboratory settings for the detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* DNA by polymerase chain reaction. The binx health *io* CT/NG Assay is intended for use with female vaginal swab specimens, collected either by a clinician or self-collected by a patient in a clinical setting, or male urine specimens, as an aid in the diagnosis of symptomatic or asymptomatic *Chlamydia trachomatis* and/or *Neisseria gonorrhoeae* infection. For a symptomatic male patient with a chlamydia negative test result, further testing with a laboratory-based molecular test is recommended.

Device Description:

The binx health *io* CT/NG Assay System (the "binx *io* System", "binx *io* CT/NG Assay" or "the System") is a rapid qualitative *in vitro* diagnostic system consisting of the following:

1. The binx *io* Instrument for running the Cartridge (the "Instrument")
2. The binx *io* CT/NG Cartridge (the "CT/NG Cartridge", "Cartridge" or "Cartridges"), that contains all the necessary reagents to perform the binx *io* CT/NG Assay (the "Assay") on the binx *io* Instrument
3. A single-use, fixed-volume transfer pipet (packaged with the Cartridge) for transferring the sample to the Cartridge
4. A Male Urine Collection Kit consisting of sample Collection tube containing preservation medium and a transfer pipet (the "Male Urine Collection Kit")

All reagents are contained in the Cartridge as a combination of liquid reagents in blister packs and dried reagents. The Instrument is a small, desk top, fully-integrated instrument that uses air pressure to open and close valves on the binx *io* CT/NG Cartridge which, in turn, controls the movement of solutions within the Cartridge; the Instrument takes full control of the Cartridges once they are inserted, and no further user interaction is required. The operation of the Instrument is designed to be simple and intuitive; a user follows simple instructions on the graphical user interface (GUI) screen to load the Cartridge onto the Instrument with no further interaction required.

The Male Urine Collection Kit consists of a tube containing a small volume of preservative medium and a Urine Transfer Pipet. To obtain a sample suitable for use on the CT/NG Cartridge, a 20-30 mL first-catch urine sample is collected by a patient in a suitable sterile vessel. The Urine Transfer Pipet provided with the Male Urine Collection Kit is used to transfer a sufficient volume of urine (nominally 4 mL in 2x 2 mL steps) into the collection tube such that the total volume falls between the two indicated lines on the collection tube.

Once a sample has been correctly collected, the required sample volume (0.5 mL) is transferred from the sample collection tube to the Cartridge using the Sample Transfer Pipet provided with the Cartridge. The Cartridge has a visual sample addition indicator window which turns from light to dark to show the user that a sample has been added to the Cartridge.

The Cartridge has three main Assay steps: sample preparation to isolate and purify target DNA; ultra-rapid polymerase chain reaction (PCR), which amplifies specific regions of DNA from the target organisms; and a proprietary electrochemical detection method to identify the presence of amplified DNA.

When the specimen is added to the Cartridge, it is automatically mixed with a lysis solution to disrupt the cells present and release DNA which also rehydrates the Internal Process Control (IPC) sample. DNA extraction takes place and the eluted DNA is transferred to a homogenization chamber.

The DNA in solution is transferred into two separate amplification chambers and reconstitutes the dried PCR reagents as it enters the chambers which are located over the Instrument-controlled PCR heater. Ultra-rapid PCR is carried out using sequence-specific primers for CT, NG (two separate genomic targets) and the IPC.

Following amplification, the amplified target DNA is transferred from each PCR chamber into two separate detection chambers (four detection chambers in total) which contain a carbon-based screen-printed electrode. When the target is present and amplified, the target-specific

probes and amplicon hybridize. The electrochemical labels are cleaved using a double-strand specific exonuclease. The cleaved electrochemical label diffuses to the electrode surface generating an electrical current that can be measured at a distinct voltage in nano Amps (nA) for each electrochemical label used.

The presence of a measurable peak to a fixed cut-off parameter for each target returns a qualitative result without the need for any user interpretation or calculations.

INTERNAL PROCESS CONTROL

The Assay incorporates a positive IPC which is processed along with a patient sample and therefore is exposed to the same testing steps as the sample from DNA extraction and purification through to detection.

The IPC verifies all aspects of the Assay process have functioned as expected. In an Assay where CT and/or NG is not detected, the IPC is measured by the Instrument to ensure it is within an acceptable range to validate a negative result. If it is outside the acceptable range the binx *io* Instrument will return an "Assay Invalid" message and no result will be displayed or recorded against that specimen. If it is within the acceptable range the "CT Not Detected" and/or "NG Not Detected" result will be displayed and recorded by the Instrument.

ASSAY OUTCOMES

Qualitative results are provided to the user in text format only. Assay results are displayed with the Specimen ID and Assay type. To maintain patient confidentiality, the Patient ID (if one has been entered) will not be displayed on the same screen as the Assay result.

The results shown below are the only results the Instrument will return following completion of a test.

Assay Result	Interpretation of Assay Result
CT Not Detected	*Chlamydia trachomatis* target DNA **was not detected** in the patient specimen. The IPC passed specification. This is a valid result
CT Detected	*Chlamydia trachomatis* target DNA **was detected** in the patient specimen. This is a valid result.
NG Not Detected	At least one of the DNA targets for *Neisseria gonorrhoeae* **was not detected** in the patient specimen. The IPC passed specification. This is a valid result.
NG Detected	Both DNA targets for *Neisseria gonorrhoeae* **were detected** in the patient specimen. This is a valid result.
Assay Invalid	The presence or absence of the DNA targets for *Chlamydia trachomatis* and/or *Neisseria gonorrhoeae* **could not be ascertained** in the patient specimen. If a CT or NG Not Detected result is obtained, the IPC was outside the acceptable range indicating a failure in the Assay process.

	The Assay should be repeated using the same patient specimen.
User Aborted	A user cancelled the Assay. No result is given.
Error	An internal fault occurred that terminated the Assay before it finished.

PERFORMANCE EVALUATION

ANALYTICAL PERFORMANCE

Analytical testing was performed to evaluate the performance of the binx *io* CT/NG Assay using the following studies:

ANALYTICAL SENSITIVITY - LIMIT OF DETECTION

Studies were carried out to determine the analytical limit of detection (LoD) of the binx *io* CT/NG Assay using cellular CT and NG material, for which the genome equivalents (GE)/mL were quantified. Two cartridge lots were used for each estimate of LoD to enable a lot to lot reproducibility comparison.

At least five separate input concentrations were used to cover a wide range (0.01-99%) of detection rates and each input concentration was tested with at least 20 replicates. A probit regression analysis was used to model the 'CT Detected/NG Detected' rate and identify the concentration level that demonstrated a detection rate of 95%. The LoD was then verified for each CT serovar and each NG strain, using a further total of 40 Cartridges per serovar/strain per Cartridge lot using two further preparations of the claimed LoD generated by two different operators. The LoD for each CT serovar and NG strain was set as the highest value generated from the two reagent lots and of the two tested serovars/strains.

Organism	GE/mL	IFU/mL	CFU/mL
CT serovar E (ATCC-VR-348B)	485.3	6.6	N/A
CT serovar F (ATCC-VR-346)	769.3	0.3	N/A
NG strain ATCC 49226	125.6	N/A	1.1
NG strain ATCC 700825	212.3	N/A	2.5

ANALYTICAL REACTIVITY (INCLUSIVITY)

Analytical reactivity of additional CT serovars and NG strains was evaluated in the LoD studies described above.

CT serovars A, B, Ba, C, D, I, J, L2, nvCT were detected at 384.7 GE/mL. Serovars G, H, K, L1, L3 were detected at 769.3 GE/mL in ≥19/20 replicates.

Thirty additional NG strains (including two fluoroquinolone resistant isolates) and the reported detectable level was confirmed by testing three replicates at or near the LoD. Sixteen strains were detected at 212.3 GE/mL in three out of three replicates. Thirteen strains were detected at 1,061.0 GE/mL in ≥19/20 replicates. The remaining strain (NG California 201304 #1) was detected in 17/20 replicates and was therefore subjected to a Probit LoD study which yielded an LoD of 553.38 GE/mL, confirmed by a verification study (40/40 replicates detected).

ANALYTICAL REACTIVITY (EXCLUSIVITY)

A panel of 62 species was investigated for cross-reactivity. A panel of microorganisms and *H. sapiens* were assessed using cultured organisms at a concentration of 1 x 10^6 CFU/mL for bacteria or 1 x 10^5 PFU/mL for viruses, or at a concentration of 2 ng/mL of genomic DNA generated by reverse transcription as available. Two further species were evaluated *in silico* by bioinformatic analysis of the genetic targets used in the binx health *io* CT/NG Assay against the published genome sequences for these organisms. *In silico* analysis concluded that neither of these organisms would be detected by the Assay.

All isolates were reported as CT Not Detected/NG Not Detected with the exception of *Corynebacterium xerosis* which gave a single NG positive result and Herpes Simplex virus 2 which gave a single CT positive result from 20 replicates in male urine and may therefore be cross-reactive with the NG and CT analytes, respectively.

Microorganisms tested in the binx *io* CT/NG Assay

*Bacteriodes fragilis**	*Neisseria meningitidis Serogroup D**
*Bacteriodes ureolyticus**	*Neisseria meningitidis Serogroup W135**
*Clostridium perfringens**	*Neisseria meningitidis Serogroup Y**
Corynebacterium genitalium	*Neisseria cinerea*
Corynebacterium xerosis	*Neisseria denitrificans*
Escherichia coli	*Neisseria elongata* (4)
*Gardnerella vaginalis**	*Neisseria gonorrhoeae**
*Haemophilus ducreyi**	*Neisseria flava*
Herpes simplex virus 1*	*Neisseria flavescens* (3)
*Homo sapiens**	*Neisseria lactamica* (3)
Human papilloma virus 16*	*Neisseria mucosa* (4)
Kingella dentrificans	*Neisseria perflava* (2)
Kingella kingae	*Neisseria polysaccharea*
Lactobacillus acidophilus	*Neisseria sicca* (4) *
Lactobacillus brevis	*Neisseria subflava* (2)
Lactobacillus jensenii	*Trichomonas vaginalis*
Lactobacillus lactis	*Ureaplasma urealyticum**
Moraxella lacunata	*Ureaplasma parvum**
Staphylococcus epidermidis	*Atopobium vaginae**
Streptococcus agalactiae	*Bifidobacterium longum**
Candida albicans	BVAB-2†
Candida glabrata	*Enterococcus faecalis*
Candida parapsilosis	Herpes Simplex Virus 2*
*Chlamydia pneumoniae**	*Klebsiella pneumoniae*
*Chlamydia psittaci**	*Megasphaera* type 1†
*Mycoplasma genitalium**	*Mobiluncus curtisii**
*Mycoplasma hominis**	*Mobiluncus mulieris**
*Neisseria meningitidis Serogroup A**	*Peptostreptococcus anaerobius**
*Neisseria meningitidis Serogroup B**	*Proteus mirabilis*
*Neisseria meningitidis Serogroup C**	*Pseudomonas aeruginosa*
-	*Staphylococcus aureus*
-	*Chlamydia trachomatis**

(n) number of strains tested

*Organisms tested with genomic DNA (2 ng/mL)

† *In silico* analysis

ANALYTICAL SPECIFICITY - INTERFERENCE

The analytical performance of the *io* CT/NG Assay was evaluated in the presence of a panel of potentially interfering substances that may be found in male urine specimens. The substances were diluted to the concentrations shown in the table below and spiked into negative pooled male urine matrix. The substances were tested in the absence of CT and NG (negative) and at 2x LoD of both CT serovar F (ATCC VR-346) and NG strain ATCC 49226. No interference was observed with the exception of one substance, leukocytes, which produced one false negative result for *Neisseria gonorrhoeae* out of 20 replicates tested.

Interfering substances tested in the binx *io* CT/NG Assay with male urine

Interfering Substance	Concentration / Details
Human blood	1% (v/v)
Seminal fluid	5% (v/v)
Mucin	0.5% (w/v)
Albumin (BSA)	10 mg/mL
Glucose	10 mg/mL
Bilirubin	0.2 mg/mL
Leukocytes	$1x10^6$ cells/mL
Progesterone	7 mg/mL
β-Estradiol	0.25% (v/v) (Estrace cream)
Paracetamol	3.2 mg/mL
Aspirin	40 mg/mL
Acidic Urine	pH 4.0
Alkaline Urine	pH 9.0
Azithromycin	0.8 mg/mL
Doxycycline	3.6 mg/mL

Microbial Interference

The performance of the CT/NG Assay was evaluated when 2x LoD of both CT serovar F (ATCC VR-346) and NG strain ATCC 49226 were spiked into negative pooled male urine matrix, aliquots of which were subsequently spiked with a panel of ten microorganisms at a concentration of 1×10^5 CFU/mL. No interference was observed and an expected result of CT, NG Detected was obtained in all cases.

Panel of organisms used for microbial interference testing with male urine

Organism
Corynebacterium xerosis
Escherichia coli
Lactobacillus acidophilus

Lactobacillus brevis
Lactobacillus jensenii
Lactobacillus lactis
Staphylococcus epidermidis
Streptococcus agalactiae
Candida albicans
Candida glabrata

PRECISION - REPRODUCIBILITY

CT and NG organisms were seeded into male urine matrix at concentrations representing low positive (1x LoD), moderate positive (3x LoD) and high positive (4.15 x 10^6 GE/mL CT or 8.4 x 10^5 GE/mL NG) samples. Negative (non-seeded) pooled male urine samples were also included. The resulting panel of 11 pooled male urine samples were tested three times per day for five consecutive days by two operators at three sites (11 specimens x 3 replicates x 5 days x 3 sites x 2 operators). *io* CT/NG Assays were performed according to the Assay procedure. The rate of agreement for male urine matrix samples with expected CT and NG results for each panel member is shown below:

Summary of reproducibility results in male urine: percent agreement by study site

Panel No.	Sample	Analyte	Site 1 % agreement	Site 2 % agreement	Site 3 % agreement	% Total Agreement
1	**CT: Neg**	CT	100.0% (30/30)	100.0% (30/30)	96.7% (29/30)	**98.9% (89/90)**
	NG: High Positive	NG	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
2	**CT: Neg**	CT	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
	NG: Mod. Positive	NG	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
3	**CT: Neg**	CT	96.7% (29/30)	100.0% (30/30)	100.0% (30/30)	**98.9% (89/90)**
	NG: Low Positive	NG	93.3% (28/30)	96.7% (29/30)	93.3% (28/30)	**94.4% (85/90)**
4	**CT: High Positive**	CT	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
	NG: Neg	NG	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
5	**CT: Mod. Positive**	CT	96.7% (29/30)	100.0% (30/30)	100.0% (30/30)	**98.9% (89/90)**
	NG: Neg	NG	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
6	**CT: Low Positive**	CT	93.3% (28/30)	83.3% (25/30)	96.7% (29/30)	**91.1% (82/90)**
	NG: Neg	NG	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
7	**CT: High Positive**	CT	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
	NG: High Positive	NG	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
8	**CT: High Positive**	CT	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
	NG: Low Positive	NG	96.7% (29/30)	93.3% (28/30)	96.7% (29/30)	**95.6% (86/90)**
	CT: Low Positive	CT	100.0% (30/30)	100.0% (30/30)	93.3% (28/30)	**97.8% (88/90)**

9	**NG: High Positive**	NG	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**
10	**CT: Low Positive**	CT	86.7% (26/30)	100.0% (30/30)	93.3% (28/30)	**93.3% (84/90)**
	NG: Low Positive	NG	90.0% (27/30)	100.0% (30/30)	93.3% (28/30)	**94.4% (85/90)**
11	**CT: Neg**	CT	93.3% (28/30)	100.0% (30/30)	100.0% (30/30)	**97.8% (88/90)**
	NG: Neg	NG	100.0% (30/30)	100.0% (30/30)	100.0% (30/30)	**100.0% (90/90)**

Neg = Negative **Low Positive = 1x LoD** **Mod. Positive = 3x LoD**

CT High Positive = 4.15 x 10^6 GE/mL **NG High Positive = 8.40 x 10^5 GE/mL**

SAMPLE STORAGE AND STABILITY

Specimen stability studies were carried out to determine the length of time samples can be stored prior to testing on the binx *io* CT/NG Assay.

Six batches of collection kits were tested: three that were within expiry and three batches that were expired (12 months (expiry date) +32 days). Of the three batches that were expired, each were stored at 4°C and at 30°C.

The overall agreement for both positive and negative samples was 100% after storage for 25 hours at 25°C or 8 days at 2-8°C irrespective of whether the collection kits were within expiry date or past the expiry of 12 months and had been stored within the labeled temperature or at 4°C or 30°C. The study indicated that male urine samples are stable for up to 24 hours at 25°C and 7 days at 2-8°C prior to testing with the Assay.

OPERATIONAL ENVIRONMENT

A study was carried out to verify the performance of Instruments and Cartridges when run beyond the extremes of typical ambient temperatures and at high and low levels of relative humidity. Performance of the binx *io* Instruments was evaluated by placing the Instruments in validated and monitored environmental chambers held at a range of temperatures and humidity levels that were outside the typical normal Instrument operating range.

Summary of operational environment testing

Environmental Temperature (°C)	Environment Humidity (RH%)	Expected results: Positive samples	% correct results	Expected results: Negative samples	% correct results
9°C	40%	CT Detected NG Detected	100%	CT Not Detected NG Not Detected	100%
37°C	40%	CT Detected NG Detected	100%	CT Not Detected NG Not Detected	100%
22°C	83%	CT Detected NG Detected	100%	CT Not Detected NG Not Detected	100%
30°C	83%	CT Detected NG Detected	100%	CT Not Detected NG Not Detected	100%
20°C	15%	CT Detected NG Detected	100%	CT Not Detected NG Not Detected	100%

Open pack stability

A study was carried out to verify the performance of the Instrument and Cartridge when subjected to a range of temperature and humidity levels.

The study was carried out using CT/NG Cartridges tested with 4x LoD for CT serovar F (ATCC-VR-346) and NG strain ATCC 49226 spiked into eNAT buffer. Cartridges were removed from their packaging and CT and NG spiked into eNAT buffer (positives) or eNAT buffer (negatives) were added. Cartridges were placed in a controlled and monitored incubator for 1, 2, 3, 4, 5 and 6 hours at +30°C. In addition, a set of Cartridges were loaded with a sample and incubated for six hours at +30°C at low (≤20% Relative Humidity (RH)) and high humidity (≥60% RH) using a monitored environmental chamber.

All samples gave the expected results and verified that the CT/NG Assay generates the correct results when a sample is loaded into a Cartridge and stored at 30°C in both high and low humidity conditions following up to six hours storage.

Cartridge performance when run immediately from 2-8ºC storage

A study was carried out using Cartridges that had been stored at 2-8°C for a minimum of 12 hours using samples that had either been stored at room temperature or stored refrigerated at 2-8°C for a minimum of 12 hours. All replicates generated correct results.

Shipping stability

The performance of the Assay was assessed following simulated shipping conditions in order to demonstrate performance after undergoing two temporary storage and shipping cycles. This study was carried out using eNAT samples spiked with 4x LoD for positives, or eNAT buffer for negatives. All samples tested generated correct results.

ISTA 3A testing

An ISTA (International Safe Transit Association) 3A study was carried out by an accredited test site followed by subsequent inspection and test performance. The study used a total of 50 Cartridges within a shipper of five cartons containing 10 CT/NG Cartridges each. No damage was observed to the packaging or Cartridges and all Cartridges tested with 4x LoD CT/NG spiked into eNAT buffer for positives and eNAT buffer for negatives generated correct results.

Cross contamination

A study was conducted to demonstrate that the CT/NG Cartridge prevents run-to-run cross contamination when negative samples containing pooled vaginal matrix were run following very high CT/NG double positive samples (containing 2.26×10^6 GE/mL CT and 1.18×10^7 GE/mL NG). The study consisted of four separate Instruments, with 50 Cartridges run per Instrument, alternating between negative samples and very high CT/NG double positive samples (200 Cartridges run across all Instruments, comprising 100 negative and 100 very high positive). All negative samples were correctly detected as CT, NG Not Detected and all positive samples were correctly identified as CT, NG Detected.

Internal Control Function

A study was carried out to demonstrate the IPC function. The objective was to demonstrate that a Cartridge lacking internal control DNA would report an Assay Invalid result. A panel of conditions was tested including Cartridge manufactured specifically with no IPC present. All samples tested generated the expected results including the Cartridges with no IPC which delivered the expected Assay Invalid result.

All experiments carried out to evaluate analytical performance met established acceptance criteria.

CLINICAL PERFORMANCE

A prospective, multi-center study was carried out to evaluate the performance of the binx *io* CT/NG Assay with specimens collected at nine investigational sites throughout the U.S. The Assay was compared to the (i) Hologic Aptima Combo 2 (AC2) Chlamydia/Gonorrhea Assay run on Panther, (ii) BD ProbeTec *Chlamydia trachomatis* (CT) Q^x, and BD ProbeTec *Neisseria gonorrhoeae* (GC) Q^x assays run on the Viper XTR™, and (iii) Roche cobas CT/NG v2.0 test run on the cobas 4800 System. The three reference tests were used to form a Composite Infected Status (CIS) where a patient was considered infected if at least two out of the three reference tests were positive and not infected if at least two out of the three reference tests were negative.

Urine samples were prospectively collected from men with and without symptoms of infection from a variety of clinical venues in the United States. Clinical sites included sexually transmitted disease clinics, family planning clinics and HIV clinics.

Site personnel that carried out testing using the CT/NG Assay were, in the vast majority (94% overall), point-of-care personnel trained in the use of the binx *io* CT/NG System, but not trained or experienced in general laboratory testing procedures.

There were 1,157 total participants enrolled into the study of which eight were ineligible or withdrew consent and 227 participants were excluded due to deviations to the study protocol.

A total of 922 male urine specimens were fully evaluable. Of the total number of male urine specimens collected, 614 were from asymptomatic participants and 308 were from symptomatic participants.

A total of 120 eligible specimens were classified as infected for CT, of which 60 were symptomatic and 60 were asymptomatic. A total of 802 participants were classified as not infected for CT, of which 248 were symptomatic and 554 were asymptomatic. A total of 74 participants were classified as infected for NG, of which 62 were symptomatic and 12 were asymptomatic. A total of 848 participants were classified as not infected for NG, of which 246 were symptomatic and 602 were asymptomatic.

The median age of participants was 28, ranging from 17 to 76 years.

Positivity rates for the binx *io* CT/NG assay observed in the clinical study spanned a range across clinical sites from 0.0%-24.7% (average 12.7%) for chlamydia and 0.0%-22.2% (average 7.8%) for gonorrhea.

binx *io* CT/NG Assay Positivity Rates in Males (observed during the Clinical Study)

				CT		NG	
Site No.	**Type of Clinic**	**US State**	**Total No. Samples**	**No. Positive by binx**	**% Positivity Rate**	**No. Positive by binx**	**% Positivity Rate**
1	STD	IN	89	22	24.7%	16	18.0%
2	STD	MD	125	11	8.8%	12	9.6%
3	STD	LA	258	38	14.7%	18	7.0%
4	HIV	MS	12	2	16.7%	0	0.0%
5	Family Planning	TX	127	19	15.0%	6	4.7%
6	Family Planning	PA	33	4	12.1%	1	3.0%
7	STD	AL	59	9	15.3%	7	11.9%

8	HIV	CA	181	11	6.1%	9	5.0%
9	STD	NC	9	0	0.0%	2	22.2%
10	STD	MS	29	1	3.4%	1	3.4%
Total			**922**	**117**	**12.7%**	**72**	**7.8%**

Composite Infected Status for *Chlamydia trachomatis* by symptom status for male urine samples

CIS	Comparator System			binx *io*®	Symptom Status		Total
	NAAT1	NAAT2	NAAT3		Sx	Asx	
NI	-	-	-	-	243	542	785
NI	-	-	+	-	0	3	3
NI	-	+	-	-	0	0	0
NI	+	-	-	-	0	1	1
NI	-	-	IND	-	2	1	3
NI	-	IND	-	-	1	0	1
NI	IND	-	-	-	1	2	3
NI	-	-	-	+	1	5	6
NI	-	-	+	+	0	0	0
NI	-	+	-	+	0	0	0
NI	+	-	-	+	0	0	0
NI	-	-	IND	+	0	0	0
NI	-	IND	-	+	0	0	0
NI	IND	-	-	+	0	0	0
NI	-	-	-	IND	0	0	0
NI	-	-	+	IND	0	0	0
NI	-	+	-	IND	0	0	0
NI	+	-	-	IND	0	0	0
NI	-	-	IND	IND	0	0	0
NI	-	IND	-	IND	0	0	0
NI	IND	-	-	IND	0	0	0
	Total Not Infected				248	554	802
I	+	+	+	+	54	56	110
I	+	+	-	+	0	0	0
I	+	-	+	+	0	0	0
I	-	+	+	+	0	0	0
I	+	+	IND	+	0	0	0
I	+	IND	+	+	0	0	0
I	IND	+	+	+	1	0	1
I	+	+	+	-	3	3	6
I	+	+	-	-	1	0	1
I	+	-	+	-	1	0	1
I	-	+	+	-	0	1	1
I	+	+	IND	-	0	0	0
I	+	IND	+	-	0	0	0
I	IND	+	+	-	0	0	0
I	+	+	+	IND	0	0	0
I	+	+	-	IND	0	0	0
I	+	-	+	IND	0	0	0
I	-	+	+	IND	0	0	0
I	+	+	IND	IND	0	0	0
I	+	IND	+	IND	0	0	0
I	IND	+	+	IND	0	0	0
	Total Infected				60	60	120

CIS = Comparator Infected Status NI = Not Infected I = Infected IND = Indeterminate
Sx = Symptomatic Asx = Asymptomatic

Composite Infected Status for *Neisseria gonorrhea* by symptom status for male urine samples

CIS	Comparator System			binx *io*®	Symptom Status		Total
	NAAT1	NAAT2	NAAT3		Sx	Asx	
NI	-	-	-	-	241	594	835

NI	-	-	+	-	1	4	5
NI	-	+	-	-	0	0	0
NI	+	-	-	-	1	2	3
NI	-	-	IND	-	2	1	3
NI	-	IND	-	-	1	0	1
NI	IND	-	-	-	0	1	1
NI	-	-	-	+	0	0	0
NI	-	-	+	+	0	0	0
NI	-	+	-	+	0	0	0
NI	+	-	-	+	0	0	0
NI	-	-	IND	+	0	0	0
NI	-	IND	-	+	0	0	0
NI	IND	-	-	+	0	0	0
NI	-	-	-	IND	0	0	0
NI	-	-	+	IND	0	0	0
NI	-	+	-	IND	0	0	0
NI	+	-	-	IND	0	0	0
NI	-	-	IND	IND	0	0	0
NI	-	IND	-	IND	0	0	0
NI	IND	-	-	IND	0	0	0
		Total Not Infected			246	602	848
I	+	+	+	+	59	10	69
I	+	+	-	+	0	0	0
I	+	-	+	+	0	0	0
I	-	+	+	+	0	0	0
I	+	+	IND	+	0	0	0
I	+	IND	+	+	0	0	0
I	IND	+	+	+	2	1	3
I	+	+	+	-	0	1	1
I	+	+	-	-	0	0	0
I	+	-	+	-	1	0	1
I	-	+	+	-	0	0	0
I	+	+	IND	-	0	0	0
I	+	IND	+	-	0	0	0
I	IND	+	+	-	0	0	0
I	+	+	+	IND	0	0	0
I	+	+	-	IND	0	0	0
I	+	-	+	IND	0	0	0
I	-	+	+	IND	0	0	0
I	+	+	IND	IND	0	0	0
I	+	IND	+	IND	0	0	0
I	IND	+	+	IND	0	0	0
		Total Infected			62	12	74

CIS = Comparator Infected Status NI = Not Infected I = Infected IND = Indeterminate
Sx = Symptomatic Asx = Asymptomatic

Results from the CT/NG Assay were compared to the CIS for the determination of sensitivity and specificity. Sensitivity and specificity for CT and NG with male urine, by symptom status, are shown below.

Clinical Performance of the binx health *io* CT/NG Assay Against CIS for *Chlamydia trachomatis* with male urine specimens

Symptom Status	Total N	TP	FN	TN	FP	Sensitivity (95% CI)	Specificity (95% CI)
Asymptomatic	614	56	4	549	5	93.3% (84.1% - 97.4%)	99.1% (97.9% - 99.6%)
Symptomatic	308	55	5	247	1	91.7% (81.9% - 96.4%)	99.6% (97.8% - 99.9%)
Total	922	111	9	796	6	92.5% (86.4% - 96.0%)	99.3% (98.4% - 99.7%)

N= Number of specimens TP = True Positive FN = False Negative TN = True Negative FP = False Positive
Confidence Intervals (CI) for Sensitivity and specificity: Wilson Score Method

Clinical Performance of the binx health *io* CT/NG Assay Against CIS for *Neisseria gonorrhoeae* with male urine specimens

Symptom Status	Total N	TP	FN	TN	FP	Sensitivity (95% CI)	Specificity (95% CI)
Asymptomatic	614	11	1	602	0	91.7% (64.6% - 98.5%)	100.0% (99.4% - 100.0%)
Symptomatic	308	61	1	246	0	98.4% (91.4% - 99.7%)	100.0% (98.5% - 100.0%)
Total	922	72	2	848	0	97.3% (90.7% - 99.3%)	100.0% (99.5% - 100.0%)

N= Number of specimens TP = True Positive FN = False Negative TN = True Negative FP = False Positive
Confidence Intervals (CI) for Sensitivity and specificity: Wilson Score Method

Overall clinical performance

Target	Overall Sensitivity	Overall Specificity
CT	111/120 (92.5%)	796/802 (99.3%)
NG	72/74 (97.3%)	848/848 (100.0%)

Rate of Invalid Results

In cases where the Assay returned a Test Invalid result, the patient specimen was retested. The result of the retest was used in the analysis. A Test Invalid result was reported in 15 of the 937 cartridges tested (1.6%) in this study. If three successive assays returned a Test Invalid result on a single specimen this was recorded as indeterminate. Of the 922 specimens for which a CIS could be determined, none of the specimens generated a final indeterminate result.

Positive and Negative Predictive Values

The sensitivity and specificity of the binx health *io* CT/NG Assay when used with male urine, was used to calculate the hypothetical positive predictive values (PPV) and negative predictive values (NPV) at a range of hypothetical prevalence rates.

Hypothetical PPV and NPV: Male urine specimens

	Chlamydia trachomatis			*Neisseria gonorrhoeae*		
Hypothetical Prevalence	*binx CT/NG* Sens./Spec.	% PPV 95% CI	% NPV 95% CI	*binx CT/NG* Sens./Spec.	% PPV 95% CI	% NPV 95% CI
1%	Sensitivity =92.5%	57.2% 33.3%-78.1%	99.9% 99.4%-100.0%	Sensitivity =97.3%	100.0% 70.0-100.0%	100% 99.5%-100.0%

	Chlamydia trachomatis			*Neisseria gonorrhoeae*		
Hypothetical Prevalence	***binx CT/NG* Sens./Spec.**	**% PPV 95% CI**	**% NPV 95% CI**	***binx CT/NG* Sens./Spec.**	**% PPV 95% CI**	**% NPV 95% CI**
2%	Specificity =99.3%	72.9% 52.7%-86.7%	99.8% 99.3%-100.0%	Specificity =100.0%	100% 82.4%-100.0%	99.5% 99.5%-100.0%
5%		87.4% 75.3%-94.1%	99.6% 98.9%-99.9%		100% 92.1%-100%	99.9% 99.3%-100%
10%		93.6% 86.6%-97.1%	99.2% 98.3%-99.6%		100% 95.9%-100%	99.7% 99.0%-99.9%
15%		95.9% 91.0%-98.2%	98.7% 97.6%-99.3%		100% 97.2%-100%	99.5% 98.7%-99.8%
20%		97.1% 93.4%-98.7%	98.1% 96.9%-98.9%		100% 97.9%-100%	99.3% 98.4%-99.7%
25%		97.8% 94.8%-99.1%	97.5% 96.1%-98.5%		100% 98.3%-100%	99.1% 98.1%-99.6%

SUBSTANTIAL EQUIVALENCE

Item	Predicate Device: binx *io* CT/NG Assay and binx *io* CT/NG System (K191352)	Proposed Device: binx *io* CT/NG Assay and binx *io* CT/NG System
Regulation	866.3393	866.3393
Regulation Specialty	Microbiology	Microbiology
Device Class	Class II	Class II
Technology	Automated multiplex polymerase chain reaction with electrochemical detection	Same
Intended Use	The binx health *io* CT/NG Assay, when tested using the binx health *io* Instrument, is a fully-automated rapid, qualitative test intended for use in point-of-care or clinical laboratory settings for the rapid detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* DNA in female vaginal swab specimens collected either by a clinician or	The binx health *io* CT/NG Assay, when tested using the binx health *io* Instrument, is a fully automated, rapid, qualitative test intended for use in point-of-care or clinical laboratory settings for the detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* DNA by polymerase chain reaction. The binx health *io* CT/NG Assay is

	self-collected by a patient in a clinical setting, to aid in the diagnosis of symptomatic or asymptomatic infection in female patients with *Chlamydia trachomatis* and/or *Neisseria gonorrhoeae*.	intended for use with female vaginal swab specimens, collected either by a clinician or self-collected by a patient in a clinical setting, or male urine specimens, as an aid in the diagnosis of symptomatic or asymptomatic *Chlamydia trachomatis* and/or *Neisseria gonorrhoeae* infection. For a symptomatic male patient with a chlamydia negative test result, further testing with a laboratory-based molecular test is recommended.
Indications	Symptomatic and asymptomatic female patients	Symptomatic and asymptomatic female patients Symptomatic and asymptomatic male patients
Assay Target	DNA from *Chlamydia trachomatis* and/or *Neisseria gonorrhoeae*	Same
Specimen Types	Clinician-collected female vaginal swabs Patient-collected female vaginal swabs (in a clinical setting)	Clinician-collected female vaginal swabs Patient-collected female vaginal swabs (in a clinical setting) Patient-collected male urine specimens (in a clinical setting)
CT Analyte Target	CT Genomic DNA	CT Genomic DNA
NG Analyte Target	NG Genomic DNA	NG Genomic DNA
Collection Kit	Vaginal Swab Specimen Collection Kit	Male Urine Specimen Collection Kit Vaginal Swab Specimen Collection Kit
Nucleic Acid Extraction	Yes	Yes
Assay Results	Qualitative	Qualitative
Assay Controls	Internal Process Control External controls available but not supplied	Internal Process Control External controls available but not supplied
Instrument System	binx health *io*®	binx health *io*®