Public Health England

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Output Based Specification for Blood Spot Barcoded NHS Number label

April 2021 V1.0

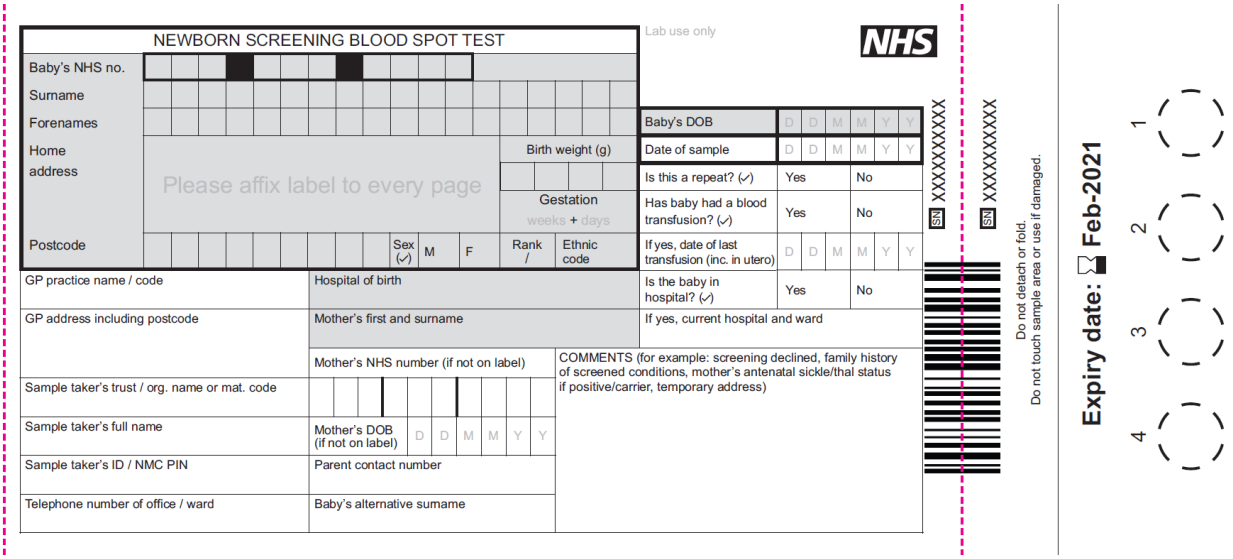
1. Introduction

This is the Output Based Specification (OBS) for the production of barcoded NHS Number label so that all maternity can print blood spot card labels with the NHS Number both in human-readable numeric '3-3-4' format and encoded as a GS1-128 linear barcode.

2. Objectives

The objective is to make sure that newborn screening laboratories receive blood spot cards (Figure 1) with the NHS Number represented as a GS1-128 linear barcode as well as in an human-readable format, and also basic birth and demographic details on a sticky label (see figure 2 for example of sticky label).

Figure 1: Example of a blood spot card. Note that the barcode on this image is produced by the card manufacturer and has nothing to do with the barcode printed on a baby's sticky label.



The aim is to enable all maternity units to print labels with the NHS Number to give to the mother with the personal child health record (PCHR), usually before discharge from the maternity unit.

The label will include some birth and demographic information from the birth notification data set (see section 3) as well as the NHS Number. This is necessary so that both midwives and laboratories have as much personal demographic details about the baby to ensure as far as possible that the correct labels are being attached to the relevant sample or to facilitate management of screening in the event of IT failures.

Midwives will use these labels when they carry out the newborn blood spot screening thus saving time and reducing errors on both the writing and reading stages. Use of the labels also reduce data transcription error in the laboratories. It is recognised, however, that parent(s) do move, and in such cases, demographic details will need to be manually updated when required.

The use of barcoded labels will enable the NHS Number to be automatically captured from a Global Service Relation Number (GSRN) when the GS1-128 linear barcode is scanned. The GSRN ensures the patient identifier is globally unique across the NHS in England, and enables the NHS Number to be used within the screening process and be able to track babies throughout the screening care pathway.

Being able to correctly identify and track the progress of babies is fundamental to reducing the risk of babies going untested or not being tested in a timely manner.

3. Label content and format

The contents of the label are derived from the Personal Demographic Service (PDS).

The following fields must be printed on the blood spot label according to the format outlined in the ISB 1555 Birth Notifications specification:

- barcoded baby's NHS Number (see section 4 for more information about barcode and data format)
- baby's NHS Number (displayed under the barcode) in 3-3-4 format for example 123 456 7890
- baby's family name
- baby's first given name
- baby's birth date (CCYY-MM-DD)
- baby's gender
- baby's usual address line 1 (either address line 1 or address line 2 must be present)
- baby's usual address line 2 (either address line 1 or address line 2 must be present)
- baby's usual address line 3 (optional)
- postcode of baby's usual address
- birth weight
- ethnic category (available on the back of the blood spot card see appendix A)
- birth order
- number of births in this confinement
- gestation age (weeks)

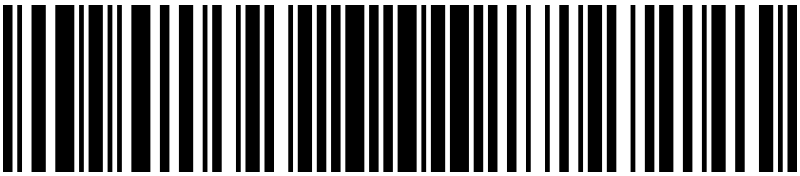
- mother’s family name
- mother’s first given name
- mother’s birth date (CCYY-MM-DD) (If both the mother’s birth date and NHS Number are present on the birth notification, then the mother’s NHS Number must be printed in preference to the mothers’ date of birth)
- mother’s NHS Number must be displayed in 3-3-4 format (If both the mother’s birth date and NHS Number are present on the birth notification, then the mother’s NHS Number must be printed in preference to the mothers’ date of birth)
- GP Practice name (the name of the GP Practice where the mother is registered) must be present if national GP Code is blank
- national GP Practice Code must be present if GP practice name is blank
- delivery place name
- date labels printed (CCYY-MM-DD) including the text description ‘date printed’, see figure 2 example of barcoded label below

Format Overview

The format of the label design is as in figure 2 below (not to scale).

The font size **MUST** be a minimum of size 8

Figure 2: Example of a barcoded label (not to scale)



NHS No: 999 000 5451

Baby Surname, Forename	Date of Birth	Sex
Address lines 1, 2 and 3		Postcode
Birth Weight (g)	Ethnic Category (Baby)	
Rank: Birth Order/No. Births	Gestation Length (weeks/days)	
Mother Forename, Surname	Mother NHS Number/DoB	
GP name	National GP Practice Code	
Name of Hospital where born	Label printed on: Date Printed	

The data fields (underlined in figure 2 above are for illustrative purposes only and should not be printed as being underlined on the label) **MUST** have a text description preceding the field as follows:

- NHS No:
- Rank:
- Label printed on:

Data fields requiring units (birth weight and gestation age) **MUST** include the units following the field. Examples are:

- 3175 g - birth weight
- 40 + 0 weeks - gestation age

Mother NHS Number / date of birth:

- where a birth is notified to the PDS which contains the *mothers' NHS Number*, then the *mother's NHS Number* **MUST** be printed (in 3-3-4 format) in preference to the mother's date of birth.
- where a birth is notified to the PDS which **DOES NOT** contain the mothers' NHS Number, then the *mother's date of birth* should be printed.

Address:

- if '*baby's usual address line 1'* is insufficient to locate a baby for example only depicts house name or flat number, then '*baby's usual address line 2'* **MUST** be included. Where '*address line 3'* is present this should also be printed on the label.

Delivery place name:

- for the purpose of identifying a baby, the '*delivery place name'* **MUST** be the name of the **hospital or maternity unit where baby was born**, not the NHS Trust.

Baby's family name and first given name:

- the baby's full family name and full first given name should be printed on the label.
- if space prevents the above, then the baby's family name MUST be printed in full in preference to the baby's first given name – but as much of the first given name that can be printed MUST also be printed.
- if space then prevents this, then as much of the baby's family name MUST be printed

4. Barcode content and format

Barcode Content: Data Requirements

Across the NHS in England, the Global Service Relation Number (GSRN) enables the globally unique and unambiguous identification of a patient.

Table 1- Format of the GSRN Element String

GS1 Application Identifier	Global Service Relation Number (GSRN) - RECIPIENT																	
	GS1 Company Prefix →									← Service reference								Check digit
8 0 1 8	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	N_{11}	N_{12}	N_{13}	N_{14}	N_{15}	N_{16}	N_{17}	N_{18}

Further information on the GSRN data format can be found in section 3.9.14 of the GS1 General Specifications.

The NHS Digital Information Standard DCB1077: AIDC for Patient Identification defines the use of a GSRN for barcoded patient identification, and requires the data items shown in table 2 below, to form the GSRN as per the format described above in table 1:

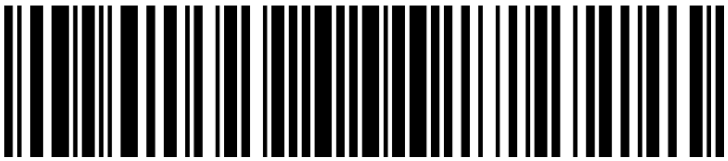
Table 2 – Data items required to form a GSRN

Data Item	Description	Data Format	Permissible Values
Application Identifier (AI)	Indicates the meaning of the following data string. For a patient, this is always 8018, as they are the recipient of the service/care in this instance.	4 numeric characters, fixed length	8018 = Global Service Relation Number – service recipient (as the patient is a service recipient)
GS1 Company Prefix (GCP)	A GCP is a unique string of digits, issued and licensed by GS1 Member Organisations (MO) for the creation of GS1 identification keys, such as the GSRN. For the NHS in England, this is always the NHS Digital's GCP.	7 numeric characters, fixed length	5050898 = NHS Digital's GCP (as NHS Digital is the service provider of the NHS Number)
Service Reference	The Service Reference is used by the organisation providing the service, to enable identification of each service relation. For the NHS in England, this is always the patient's NHS Number.	10 numeric characters, fixed length	Baby's NHS Number e.g. 9990005451
Check Digit	The Check Digit is calculated with the Modulo 10 algorithm and ensures the number is correctly composed and transmitted. GS1's online check digit calculator can be found here.	1 numeric character, fixed length	GSRN check digit e.g. 3 Further information can also be found in section 7.9.1 of the GS1 General Specifications.

Barcode format: GS1-128 structure and production requirements

For the Output Based Specification for Blood Spot Barcoded NHS Number Label, **the GSRN MUST be encoded to a GS1-128 linear barcode**, as shown in figure 3, with an overview of GS1-128 printing requirements in section 6:

Figure 3: Example of GS1-128 linear barcode, encoded with the GSRN data string shown in Table 3. The encoded data string is: (8018)505089899900054513. Please note, the brackets shown around the AI (8018) are for demonstrative purposes only and should not be encoded.



NHS No: 999 000 5451

The Double Character Start Pattern

The GS1-128 symbology has special double character start patterns consisting of start (A, B, or C) and Function 1 Symbol Character (FNC1). These special start characters differentiate GS1-128 barcodes from the more generalised Code 128 symbols, by transmitting the symbology identifier **]C1**.

Start characters A, B, and C define the corresponding code set to be used initially in the symbol.

The Function 1 Symbol Character (FNC1) as a start character indicates the symbol must be read and interpreted in accordance with the GS1 system.

For the Output Based Specification for Blood Spot Barcoded NHS Number Label, as the data to be encoded is purely numeric, **Code Set C MUST be used** to ensure the barcode is produced at the minimum length. Please refer to Appendix B for further information on the GS1-128 barcode structure.

For further information on the production of GS1 compliant GS1-128 linear barcodes, system providers should refer to section 5.4 of the GS1 General Specifications.

5. System requirements

System handling of the barcode

The GSRN data string which includes the GS1 Application Identifier, the GS1 Company Prefix (GCP), patient's NHS number and GSRN check digit, is a 22-digit element string

encoded to a GS1-128 linear barcode. Systems will have to both validate and process the new format by:

- recognising and discarding the application identifier “8018” (positions 1 to 4)
- recognising the GS1 Company Prefix for NHS Digital “5050898” (positions 5 to 11)
- validating the GSRN check-digit (position 22) - this validation is done by the scanner. The check digit is not sent by the scanner to the host system
- returning the 10-digit NHS Number (positions 12 to 21)

6. Printing requirements

Dimensions of the barcode

Table 3: When encoding a GSRN to a GS1-128 linear barcode, the following specifications MUST be applied:

Symbol(s) specified	X-dimensions mm(inches)			Minimum symbol height for given X mm (inches)			Quiet Zone		Minimum quality specification
	Minimum	Target	Maximum	For minimum X-dimension	For target X-dimension	For maximum X-dimension	Left	Right	
GS1-128	0.170 (0.0067")	0.250 (0.0098")	0.495 (0.0195")	12.70 (0.500")	12.70 (0.500")	12.70 (0.500")	10*X*	10*X*	1.5/05/660

Specifically, the minimum symbol height indicated is for bar height only and does not include the Human Readable Interpretation (HRI), or in the context of this specification, the NHS

Number displayed in the 3-3-4 format. Please refer to Appendix C for definitions of some common barcode terms.

For further information on GS1-128 Symbol Size Specifications for GSRNs, system providers should reference Table 11, in section 5.12.3.11 of the GS1 General Specifications.

Label size

The following measurements are a guide as to the minimum and maximum label sizes recommended by the UK Newborn Screening Laboratories Network (UKNSLN) so as to be able to fit on the blood spot card:

- Minimum dimensions: 6.35 cm wide by 3.81 cm deep
- Maximum dimensions: 8.89 cm wide by 5.08 cm deep

The standard operation procedure specifies a minimum of 9 labels per baby to be produced.

7. Barcode Verification

Verification Overview

As the primary function of any barcode is to carry data, to be automatically captured when scanned, barcode verification aims to check that the symbol can fulfil this function, effectively and consistently.

Barcode verification is a vital part of any barcode production process, as it assesses and grades the overall symbol quality of a barcode, in its final configuration. This provides an assurance and high level of confidence that the barcode quality is sufficient to scan in an open environment, within its intended scanning environment (e.g. point-of care), at all times.

Barcode quality

The process of verifying a physical sample in its final configuration provides diagnostic information about any potential symbol defects or data encoding or decoding problems, ahead of the issue occurring in the live environment

In accordance with international standards ISO/IEC 15416, symbol quality parameters are graded between 4.0/A – 0.0F to measure the overall symbol quality. **To meet compliance to GS1 Standards, a minimum grade of 2.0/C is required to pass verification.**

For further information on Barcode Verification and Quality Assessment, please see section 5.12.5 of the GS1 General Specifications.

It should be noted that some symbols which fail verification will still be readable by some barcode readers. However, it is important not to confuse scanning with verification. At best, scanning a symbol can be used to check whether a symbol can be read by that particular scanner, but it will not indicate if there are any data validation problems, or other potential issues with the printed barcode in other environments or with other hardware.

Testing process – System Suppliers

Once the System Supplier has developed their system to enable the functionality detailed in this specification, the System Supplier must send a **physical sample of the barcoded label** (with personal details blacked out) to GS1 UK for barcode verification.

GS1 UK can also support by validating any soft samples (i.e. photos of barcode labels, or image files of the GS1-128 barcode), to sense check the data structure and barcode type is valid, ahead of sending any physical samples for verification. Please contact healthcare@gs1uk.org for further information on how GS1 UK can support with barcode verification and validation.

Testing Process - Maternity Unit

Once the System Supplier has upgraded the installation in the Maternity Unit, maternity staff should send a sample to their regional newborn screening lab to verify that the sample

scans. This step can also be undertaken by the System Supplier on behalf of the Maternity Unit.

The local screening coordinator should inform the regional Screening Quality Assurance Service (SQAS) the result of verification by the laboratory.

Please note, if any label hardware or software (e.g. new printer, new ink, new material, or new barcode generation software) is different when installed, we recommend having a revised physical sample verified.

Testing process - Laboratories

Newborn screening laboratories should check the barcoded label sample to make sure the barcode scans and brings up a 22-digit GSRN in the format outlined in section 4. The laboratory should inform the maternity unit of the result. If the sample fails to scan and extract the NHS number correctly, the laboratory should inform the maternity unit so that they can investigate with the suppliers.

8. What to do if a barcoded NHS number label fails to scan

A barcode may fail to scan or extract the correct data for a number of reasons, however the most common reason is that the wrong barcode type is used.

The GS1-128 linear barcode is intended for use exclusively with the GS1 data syntax. In other words, GS1 barcodes are used purely for the encoding of GS1 identification keys and application identifiers, as they are designed to understand and interpret GS1 data, unlike non-GS1 barcodes.

For the Output Based Specification for Blood Spot Barcoded NHS Number Label, users MUST ensure a GS1-128 barcode is selected when configuring the label, rather than the non-GS1 symbol type, Code 128.

A Code 128 barcode (or any non-GS1 barcode type) will not understand that the data encoded is a GSRN and that the NHS number needs to be extracted from the data string, hence failing to scan or read correctly.

Besides the incorrect barcode type, another common reason for a failed scan or read, is that the barcode has not been produced to the right specifications, as defined by GS1 Standards. Some simple visual checks that can optimise barcode readability includes the following:

1. **Do not print barcodes that are too small or too big**. Ensure barcode dimensions are printed within the specified thresholds outlined in the Printing Requirements in section 6.
2. **Ensure that nothing is obscuring the barcode, and that it is not damaged or creased**
3. **Ensure there is sufficient space around the code** (This is known as the quiet zone. Barcode readers use this space to understand where the barcode starts and finishes, in order to decode the data represented as lines and spaces. If there is no sufficient space on either

side of the barcode, the reader is unable to detect or recognise the symbol. See appendix B and C.

4. **Make sure that the barcode has been printed in the correct “picket fence” orientation.** This specification requires the GS1-128 barcode to be printed in the picket fence orientation (with vertical lines), not the ladder orientation (with horizontal lines).

5. **Ensure there are no printing defects visible.** Any mis-printed bars, ink spread, or visible print imperfections can cause a failed scan or incorrect data to be extracted. This can indicate that the printer hardware or label material may have a fault or is not suitable for the application.

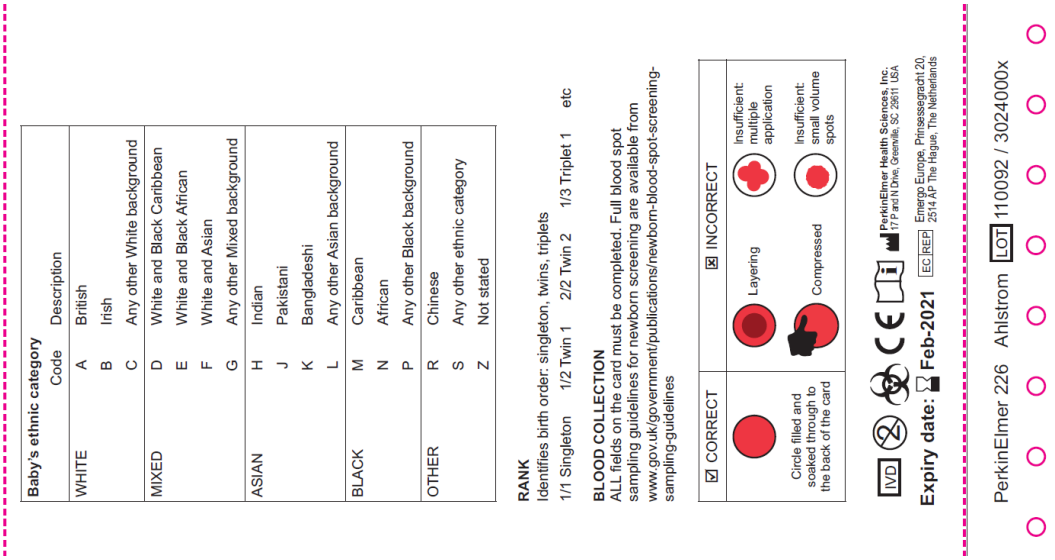
Contact information

For further advice and support on producing GS1 compliant barcodes for the Output Based Specification for Blood Spot Barcoded NHS Number Label, please contact healthcare@gs1uk.org

9. Appendices

Appendix A

List of ethnic codes on the back of a blood spot card



Appendix B

The GS1-128 barcode is made up as follows, reading from left to right:

- Left Quiet Zone
- The double character start pattern:

A start character (A, B, or C)
The Function 1 Symbol Character (FNC1)

- Data (including the GS1 Application Identifier represented in character set A, B, or C).
- A symbol check character.

- The stop character.
- Right Quiet Zone.

Appendix C

Barcode terminology

Term	Definition
GS1	GS1 is a not-for-profit organisation that develops and maintains global standards for business communication. The best known of these standards is the barcode, a symbol printed on products that can be scanned electronically.
Human Readable Interpretation (HRI)	Human readable interpretation (HRI) is the information below, beside or above a barcode or tag which is encoded in the barcode or tag and represents the same characters as carried in the barcode or tag. **Within this specification, HRI is not applicable, as the NHS number in the 3-3-4 format MUST be displayed instead.**
Ladder (orientation)	A barcode printed in ladder orientation, has its lines positioned horizontally. Generally used for small cylindrical items, as the curvature of the product can affect the barcode's readability. **Within this specification, ladder orientation MUST NOT be used.**
Picket fence (orientation)	A barcode printed in picket fence orientation, has its lines positioned vertically. This is the most common orientation for linear barcodes. **Within this specification, the GS1-128 linear barcode MUST be placed as picket fence orientation only.**
Quiet zone	Also known as a light margin, the quiet zone is a clear space which MUST be present on both sides of a 1D linear symbol, or all sides of a 2D symbol. Quiet zones are crucial for most barcode types as it ensures the scanner is able to locate the barcode's start or finder pattern, in order to understand where the data is so it can be decoded and extracted.

Symbology identifier	A symbology identifier is a sequence of characters which identifies the type of barcode symbology being scanned e.g. GS1-128 = **]C1** and GS1 DataMatrix = **]d2**. Symbology identifiers are not encoded to barcodes but are transmitted by scanners to enable systems to correctly interpret the GS1 data string encoded. Further information may be found in section 5.1.3 of the GS1 General Specifications.
X-dimension	The specified width of the narrowest element of a barcode