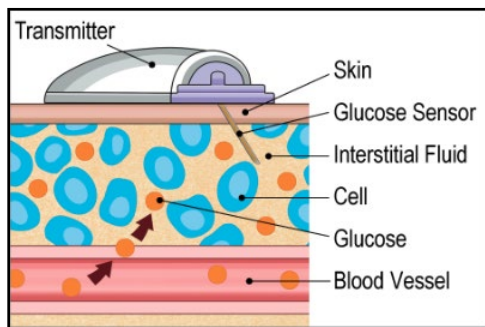


CONTINUOUS GLUCOSE MONITORING: OVERVIEW

What is Continuous Glucose Monitoring (CGM)?

Continuous glucose monitoring uses a small device that is worn to measure interstitial glucose. This is glucose that has left the bloodstream and has moved into the tissues. This device allows you to see your glucose readings every 5 minutes, 24 hours a day, even when you are not checking your blood glucose. This allows you to fill in the gaps.

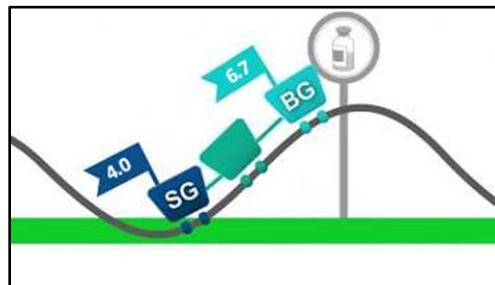
How Do Sensors Work?



Blood glucose (BG) is measured by using a BG meter and measures the amount of glucose in the capillaries right under your skin.

Sensor glucose (SG) measures the amount of glucose that is in your interstitial fluid (glucose that has left the blood stream and entered the cells)

Glucose enters the bloodstream first, then other areas, so the readings on a meter and sensor may be different. This difference is called a lag time and can be between 5 to 15 minutes

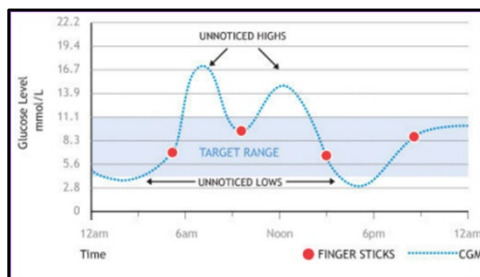


© Medtronic Diabetes

CGM displays a sensor glucose reading every 5 minutes, providing you with information about glucose and trends in between BG checks. This provides 288 glucose points per day

Because the glucose is measured in two different areas, your meter BG will not be the same as your SG, and can vary up to 20%. As the numbers get bigger, the variation gets bigger. It is normal for these numbers not to match exactly

How Can CGM Help?



Able to set alerts to catch the highs and lows before they happen.

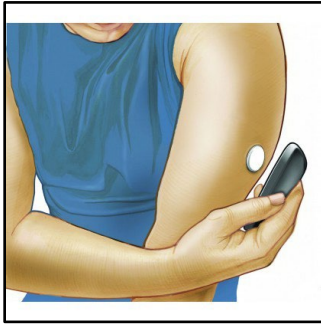
Able to enter your insulin, carbohydrates, and exercise so you can see the whole picture.

Allows you to look back at the upload for patterns and trends to make changes to prevent the highs and lows.

Types of CGM

There are 2 types of glucose monitoring systems: flash glucose monitoring (FGM) and real-time continuous glucose monitoring (CGM)

Flash Glucose Monitoring



Flash glucose monitoring requires the user to scan the sensor with a reader or phone to see either current or stored results.

The flash glucose monitor does not have a transmitter

You cannot set alerts and it doesn't have alarms.

Continuous Glucose Monitoring



Sensor sends glucose readings every 5 minutes to a receiver in real-time

Can set alerts when sensor glucose goes outside of set ranges or change very quickly.

Readings can be sent to a smartphone reader or phone

Can allow up to 5 people to share data with

Components



All systems have 2-3 main pieces:

- Sensor
- Transmitter
- Receiver or display device in the form of a pump, cell phone or scanner

Benefits of CGM



Can help you identify trends or patterns

Able to set alerts to catch low or high sensor glucose (SG)

Regular review of your information will help you make safe treatment decisions

Less fingerpokes

Easier to evaluate overall diabetes management (ICR/ISF/Basal)

Can discreetly view SG values

Trend arrows allow you to act as needed

Challenges to Consider



Attached to body, have to carry a device

Still have to check using BG meter

Can feel overwhelmed by amount of info

Time Lag between SG and BG

Need to review information regularly for CGM to be helpful

Tendency to respond only to what is on the screen

SG discrepancies within first 24 hours

Limited coverage and/or test strips may be limited

May not be supported in schools

Current sensors

Dexcom G6®



Receiver can be smartphone or stand alone device

Can be worn on stomach or backside for up to 10 days

No calibrations

Approved to dose off sensor glucose value

Follow app- up to 5 users can follow- primary user needs wifi/data to share

Can set high and low alerts (different days)

Urgent low soon alert

Dexcom Clarity App / Dexcom G6 app

Freestyle Libre



Flash glucose monitoring, needs to be scanned every 8 hours to get the full picture

Worn on arm for up to 14 days

Shows current SG reading, 8-hour history, and arrows - no alerts or alarms

Approved for adults aged 18 years and older

Taking vitamin C can falsely elevate sensor readings, taking aspirin can falsely lower sensor readings.

LibreLink and LibreLinkUp apps

Freestyle Libre 2



Approved for children 4 years and older

Improved sensor accuracy

Has 3 optional alarms

System scans glucose every minute in background to enable alarms

Libre 2 phone app uses Bluetooth

Medtronic Enlite™ 2 Sensor



Used in conjunction with Medtronic 630G Insulin Pump

SmartGuard™ Technology, suspends basal insulin delivery if the SG reaches or goes below a certain level

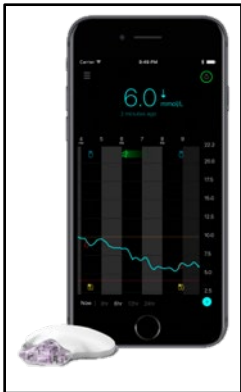
Must be calibrated minimum every 12 hours by BG, but recommended calibrating 3–4x per day for best accuracy

Can set high and low alerts

Not approved for bolusing off of SG value

6-day sensor wear

Medtronic Guardian™ Connect



Stand alone sensor with built in Bluetooth

Ages 3 years and above

Predictive alerts 10-60 minutes ahead

Guardian 3 transmitter

SmartGuard technology to predict high and low SG

Transmitter lasts 12 months and is rechargeable

Uploads automatically to Carelink™

Up to 7 day wear

Not approved for dosing off of SG value

iOS operating system only

Medtronic Guardian™ 3 Sensor



Used with Medtronic 670G Insulin Pump

Algorithm is in transmitter

SmartGuard™ Technology, suspends basal insulin delivery if the SG reaches or goes below a certain level (can be used also in AutoMode)

Must be calibrated minimum every 12 hours by BG, but calibrating 3-4x per day provides best accuracy

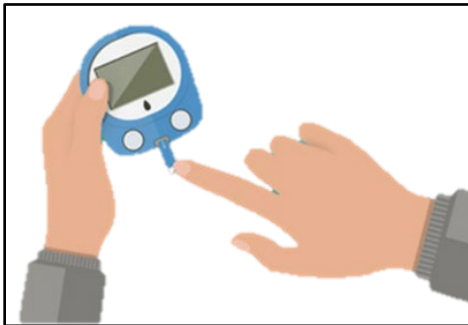
Can set high and low alerts

Suspend before low

Up to 7 day wear

Not approved for dosing off of SG value

When To Confirm with BG



After treating a low glucose

Symptoms don't match sensor glucose (SG)

For calibration

Rapidly changing levels

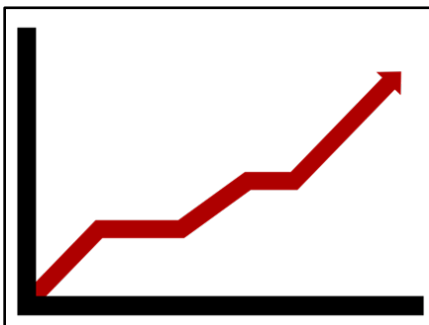
Insulin for food or corrections

Compression low

Only Dexcom G6® is approved for dosing insulin off sensor glucose

How to Review Your Sensor Glucose

Trends, Arrows, Glucose (TAG)



Trend: view the graph on the screen to see where the glucose has been and where it is going

Arrows: 1,2 or 3 arrows tell you how fast the glucose is changing

Glucose: the current glucose at the moment

Insulin Stacking



Rapid-acting Insulin:

- Starts working in 15 minutes
- Works it's hardest at 60-90 minutes
- Stays in your body for up to 4 hours

Do not give additional correction bolus for at least 3 hours

Stacking can lead to low blood glucose

<https://www.joslin.org/patient-care/diabetes-education/diabetes-learning-center/insulin-stacking>

Reviewing Information



Review sensor information at home on weekly basis, this will allow you to see the whole picture to make safe insulin dose adjustments

Regular review is required to help maximize the benefits of this technology

Enter your carbohydrates and insulin doses into Dexcom and Libre so all the information is in one place

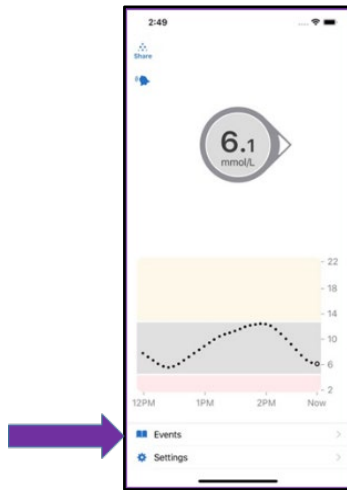
Not reviewing your data is like buying a smart phone only to make phone calls.

Entering Information

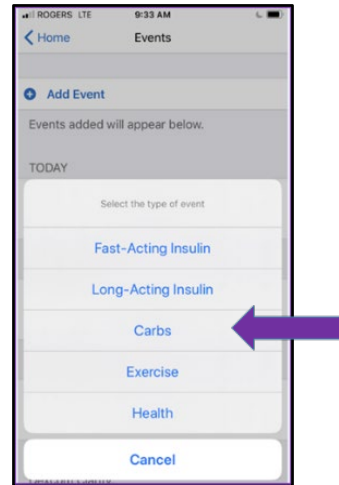
All sensor systems allow you to enter in carbohydrates, insulin doses and exercise directly into them. This will put all the information in one place. The more information entered directly into the system, the more valuable it is to help make informed adjustments.

Dexcom G6

Click on Events

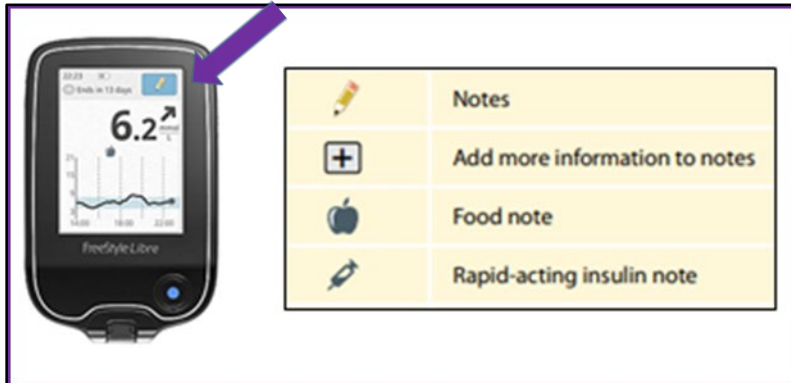


Click on Carbs and enter amount

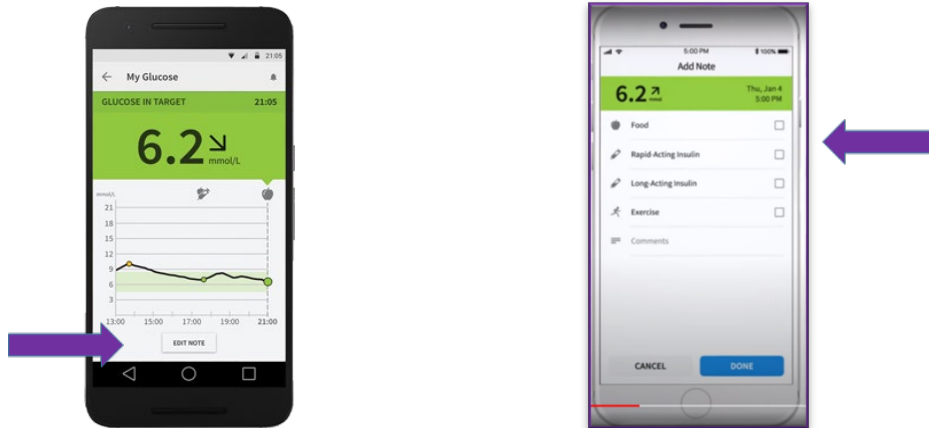


Libre and Libre 2

Reader



LibreLink App

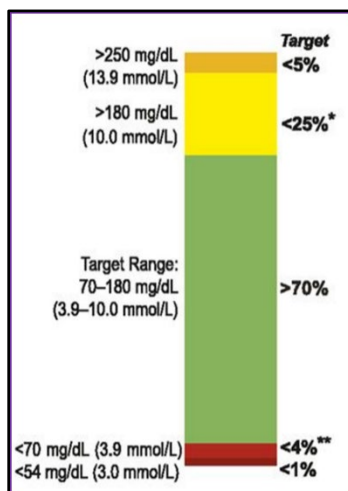


Medtronic Guardian Connect



Time in Range (TIR)

More emphasis is currently being placed on time in range versus A1C. When reviewed, Dexcom® Clarity, LibreView, and Medtronic CareLink® all use time in range for the selected period of time (i.e. 2 weeks, 1 month)



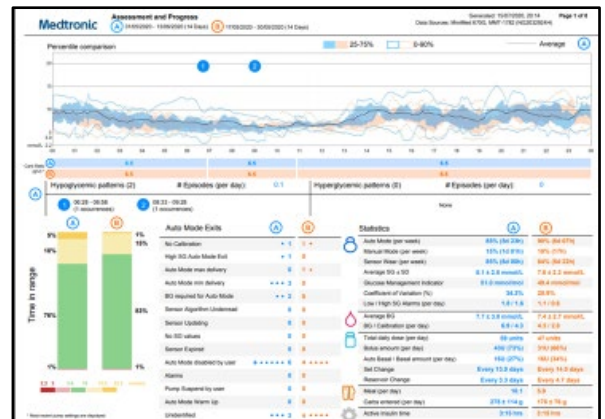
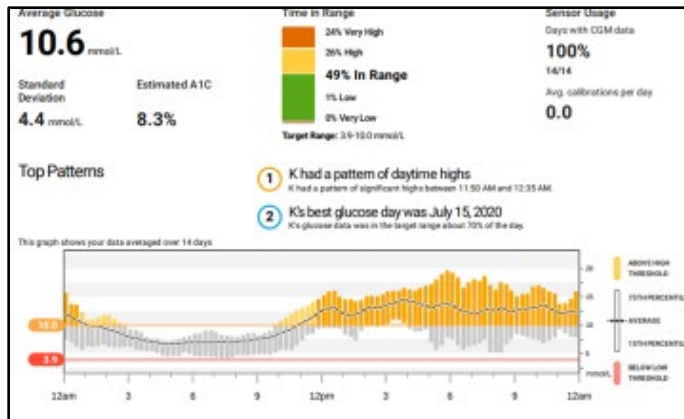
Time in Range for children and teens is:

Time spent between 4-10 mmol/L

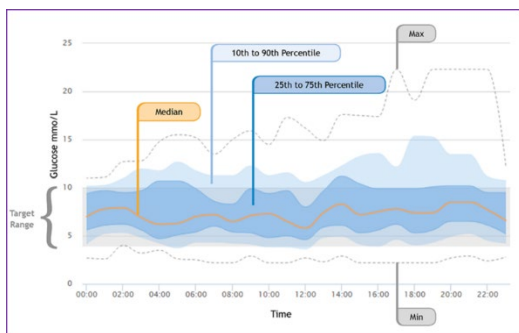
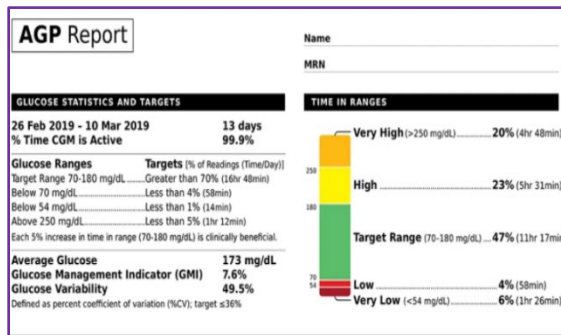
Each 1% = about 15min of time per day (4% of time = 1 hour/day)

Goal = 70% Time in Range (TIR)

Sample Reports



Ambulatory Glucose Profile (AGP)



Global standard for viewing CGM data

Designed to see all important information on one page

Shows the amount of time in range

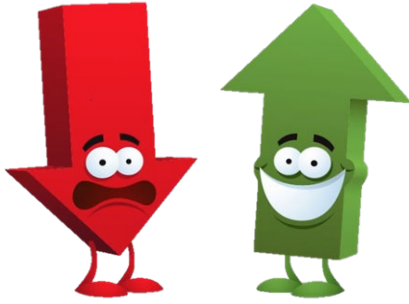
Shows predicted A1C

Multiple days of information overlaid

Easy to identify trends

Focuses on hourly glucose variability

Calibration Tips



Medtronic sensors require calibration

Wash hands thoroughly before calibrating to ensure best accuracy

Do not calibrate when there are rapidly changing blood sugars

Calibrate before bed

Use the same meter

Homework Prior To Starting

Please read *Continuous Glucose Monitoring* handouts #1, 2 and 3

BC Children's Hospital
ENDOCRINOLOGY & DIABETES UNIT
Diabetes Clinic: 604-875-2868
Toll-Free Phone: 1-888-300-2068, #2868
Fax: 604-875-3231
<http://endodab.bccchildrens.ca>

**CONTINUOUS GLUCOSE MONITORING (CGM) #1:
THE BASICS**

Continuous glucose monitoring (CGM) is a tool for diabetes management. It can be used alone or as part of an integrated insulin pump system. CGM provides real-time continuous glucose monitoring. It consists of a transmitter and a sensor, inserted separately from a pump site, as well as a receiver. The receiver can be a handheld device or a phone, or it can be an insulin pump. CGM measures glucose in the interstitial fluid under the skin, rather than in the blood. It displays and updates a glucose value every 5 minutes.

CGM can assist in identifying glucose trends and patterns. CGM can show what the glucose was in the past, what it is now, and it can predict what direction it is heading with the use of graphs and trend arrows. The Dexcom G6® and G6R and Medtronic Elin® systems need to be calibrated every 12 hours using a blood glucose meter.

Figure 1 (courtesy of Anasac)

Glucose monitoring with a meter provides the blood glucose reading at exactly the moment it is checked. For most people, this is 4-6 times a day. CGM provides more information. It can "fill in the blanks" of what is happening between meals and how the body reacts to food, insulin and activity.

CGM has two main types of benefits:

- Reactive: setting alerts to catch the highs and lows before they happen
- Preventive: looking back at the upload for patterns and trends to make changes to prevent the highs and lows

August 18, 2018 www.bccchildrens.ca/endocrinology-diabetes-site/documents/cgmonoverview.pdf Page 1 of 2

BC Children's Hospital
ENDOCRINOLOGY & DIABETES UNIT
Diabetes Clinic: 604-875-2868
Toll-Free Phone: 1-888-300-2068, #2868
Fax: 604-875-3231
<http://endodab.bccchildrens.ca>

**CONTINUOUS GLUCOSE MONITORING (CGM) #2:
GETTING STARTED**

Glucose monitoring with a meter provides the blood glucose reading at exactly the moment it is checked. For most people, this is 4-6 times a day. CGM provides much more information. It can "fill in the blanks" of what is happening between meals and how the body reacts to food, insulin and activity. Reviewing the CGM information regularly will help in making informed treatment decisions.

CGM has two main types of benefits:

- Reactive: setting alerts to catch the highs and lows before they happen
- Preventive: looking back at the upload for patterns and trends to make changes to prevent the highs and lows

Starting on a CGM system is very exciting, but it can also be overwhelming. Real-time glucose results will be displayed every 5 minutes. There will be a lot more information, and some of it will be surprising. The glucose may go up more after meals than you thought it did. Activity may lower the blood glucose for a lot longer than you thought it would. Do not overreact to the sensor data.

Suggestions for getting started with CGM:

- Read the user guide and watch the instructional video.
- Start with a wide range for the low- and high-glucose alert settings. Consider setting the low alert at 4.5 mmol/L and the high alert at 17 mmol/L to start. These can be tightened later, as you get used to the information the system provides.
- Do not set the rate-of-change alerts at first.
- Do not expect the CGM results to be exactly the same as blood glucose meter readings! Results can vary by up to 20% between devices and still be considered accurate.
- Give insulin at the usual times. Remember it takes 3-4 hours for a dose of rapid-acting insulin to finish working. Do not add extra corrections when you see a high glucose reading after meals. Giving corrections too closely together will cause insulin "stacking" which can lead to low blood glucose.
- Wait at least 2 hours before next correction dose of insulin.
- Expect to see at least 50% of the glucose readings to be outside of targets at first.
- Expect to see a spike after setting glucose levels should be back under 10 mmol/L within 2 hours of setting. Remember, this may initially be even higher.
- Download and review sensor information at home weekly to see if any adjustments to insulin doses or insulin pump settings are needed (this is preventive).

August 18, 2018 www.bccchildrens.ca/endocrinology-diabetes-site/documents/cgmonoverview.pdf Page 1 of 2

BC Children's Hospital
ENDOCRINOLOGY & DIABETES UNIT
Diabetes Clinic: 604-875-2868
Toll-Free Phone: 1-888-300-2068, #2868
Fax: 604-875-3231
<http://endodab.bccchildrens.ca>

**CONTINUOUS GLUCOSE MONITORING (CGM) #3:
REVIEWING YOUR RESULTS**

Review sensor information at home on a weekly basis. This helps guide you with making informed adjustments. This is also very useful for your healthcare team and should be uploaded prior to your appointments. Regular review of this information is required to help maximize the benefits of this technology, and it will help you build your confidence in making ongoing adjustments.

- Abbot FreeStyle Libre: <https://myfreestyle.ca/en/products/libre/softwre>
- Dexcom G6R: Set up a Dexcom Clarity® account: <https://clarity.dexcom.eu/>
To look up and interpret your reports: [Dexcom Clarity® User Guide](https://clarity.dexcom.eu/)

We found no patterns during this date range. The best day was July 11, 2018.

If you are not on a pump, you will need to log carbohydrates and insulin doses into the Dexcom app, or the Libre reader, to help with adjustments.

August 18, 2018 www.bccchildrens.ca/endocrinology-diabetes-site/documents/cgmonoverview.pdf Page 1 of 2

Sensor Tips for Success

- Enter all carbohydrates and insulin doses
- Set alerts and alarms so that an action is required when they go off
- Review manufacturer reports (Libreview, Clarity, Medtronic Assessment and Progress) weekly
- Adjust carb ICR, ISF and insulin doses based on reports
- Check BG after 1st treatment for low blood sugar (sensor glucose lags behind and can take up to 20 minutes to show up on graph). This prevents over treating lows.
- Place sensor to avoid compression sites
- "When in doubt, get the meter out"

Interested in Learning More?

Dexcom

- <https://www.dexcom.com/en-CA/training-resources>
- trial sample: <https://www.dexcom.com/en-CA/hello-dexcom-join-trial>

Libre

- <https://www.freestyle.abbott/ca/en/products/libre/faqs.html>
- trial sample: www.RegisterGettingStarted.com

Medtronic

- <https://www.medtronic.com/ca-en/diabetes/home/support/product-support/guardian-connect-support.html#compatibility>

BC Pharmacare Coverage

Currently only Dexcom G6 is covered by BC Pharmacare

Many insurance companies will cover

Pacific Blue Cross – will cover Libre generally, and will cover Dexcom with PhamraCare approval

Libre – limited strip coverage, age restrictions

Sensor cost varies by company

- Dexcom: approximately \$300/month
- Freestyle Libre 2: approximately \$170/month
- Medtronic: approximately \$ 320/month (\$399 for 5 sensors)

Process

Discuss CGM options with diabetes health care team

If you have extended benefits:

- Obtain claim form from benefit company
- Fill in ALL member information and sign
- Scan and email to dcnurse@cw.bc.ca

BCCH will send completed form to insurance company directly.

Benefit company will mail correspondence directly to you- can take up to 3 weeks- follow up with benefit company re: status of application

Contact CGM company and order sensor

You will need a prescription from your healthcare provider (for extended benefits)